

LADOT Qualified Products List - Traffic Signal Equipment

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93-005-03	Rectangular Rapid Flash Beacon (RRFB)	745-747
95-001-00	ATC Traffic Signal Cabinet Assembly Model 351 & 352	748-796
95-002-00	ATC Traffic Signal Cabinet Assembly Model 356	797-829
95-003-00	ATC Traffic Signal Cabinet Assembly Model 357	830-859

**City of Los Angeles
Department of Transportation
Qualified Products List
Traffic Signals**

Specification #	Title of Specification/ Device	Approved Mfr Model	Approved Mfr Model	Approved Mfr Model	Approved Mfr Model	Approved Mfr Model
54-053-08	Cabinet Assembly, Traffic Signal	McCain Traffic 332,336,337	Econolite 332,336,337			
	Model 222 Vehicle Detector	Reno A&E 222				
	Model 224 Vehicle Detector	Reno A&E 224				
	Model GT-200 Light Rail Detector	Reno A&E GT200 LRT				
	Model 283 Bus Detector	Reno A&E AVI-E	Diablo AVI 222			
	Model 200 Switchpack	EDI	PDC SSS-87	PDC SSS-88LA		
	Model 204 Flasher	EDI	PDC SSF-88LA	PDC SSF-87WP		
	Model 242 DC Isolator	EDI 242LAX				
	Model 252 AC Isolator	PDC-ACI-88 w/o dip switches				
	Model 2018 Conflict Monitor	EDI 2018ECL-LAX				
54-055-02	Controller Unit, Traffic Signal Model 2070E w/ Program Data Key	McCain Traffic w/GDI 2070-6LA	Safetran 2070ELA6G7565 w/GDI 2070-6LA			
56-002-04	Wire Nut, water tight	King Connector	IDEAL Connector			
82-049-04	Blank Out Sign, Fiber Optic	National Sign	Traffic Parts Inc.			
82-051-02	Radar Speed Feedback Sign	Fortel Traffic Vcalm VMS				
92-066-02	Battery Backup System	McCain Traffic 332-Alpha	Clary SP1250LX	Zinc Five 4 hr only	Marathon 1500 watt	
92-067-02	Cabinet Type 2 Communications	Caltrans approved				
92-044-04	Cabinet Type M Communications	Caltrans approved				

**City of Los Angeles
Department of Transportation
Qualified Products List
Traffic Signals**

Specification #	Title of Specification/ Device	Approved Mfr Model	Approved Mfr Model	Approved Mfr Model	Approved Mfr Model	Approved Mfr Model
92-053-04	Pedestrian Pushbutton Assembly	POLARA LAMPBPGY				
92-095-03	APS (Accessible Pedestrian System)	POLARA N45ONO-G-LA				
92-061-06	Traffic Signal Vehicle Head and Housing	McCain polycarbonate	TCT polycarbonate			
92-064-06	Traffic Signal Pedestrian Head and Housing	McCain polycarbonate				
92-088-07	LED Traffic Signal Modules	G.E. Illumination	Dialight			
	Red, Tinted 8 inch	DR4-RTFB-LA	433-1110-003XL			
	Amber, Tinted 8 inch	DR4-YTFB-VLA	433-3130-901XL			
	Green, Tinted 8 inch	DR4-GTFB-VLA	433-2120-001XL			
	Red, Tinted 12 inch	DR6-RTFB-VLA	433-1210-003XL			
	Amber, Tinted 12 inch	DR6-YTFB-VLA	433-3230-901XL			
	Green, Tinted 12 inch	DR6-GTFB-VLA	433-2220-001XL			
	Red Arrow, 12 inch	DR6-RTAAN-VLA	432-1314-001X0D			
	Yellow Arrow, 12 inch	DR6-YTAAN-VLA	431-3334-901X0D			
	Green Arrow, 12 inch	DR6-GTAAN-VLA	432-2374-001X0D			
	Pedestrian Module, Countdown	PS7-CFF1-VLA	** Not to Spec			
	Program Visibility (PV) Red, 5 inch	DR3-RCFB-01A				
	PV Yellow, 5 inch	DR3-YCFB-01A				
	PV Green, 5 inch	DR3-GCFB-01A				

**City of Los Angeles
Department of Transportation
Qualified Products List
Traffic Signals**

Specification #	Title of Specification/ Device	Approved Mfr Model	Approved Mfr Model	Approved Mfr Model	Approved Mfr Model	Approved Mfr Model
		G.E. Illumination	Dialight			
	Bicycle Mask Insert, 12 inch	MSQ-12GTX-B2	n/a			
	U-Turn Mask Insert, 12 inch	MSQ-12GTX-U1	n/a			
92-088-07	Lunar White Light Rail Module, 12 inch Vertical Bar		433-2W22-C121-NQ01			
92-088-07	Lunar White Light Rail Module, 12 inch Horizontal Bar		433-3W22-C121-NQ01			
93-004-01	Solar Powered Flashing Beacons	Carmanah	TAPCO	JSF Technologies L-AB3412Y&A LA		
93-005-03	Rectangular Rapid Flash Beacon RRFB	TAPCO	Carmanah	El Tec		
95-001-00	Cabinet Assembly, Traffic Signal ATC Model 351 & 352	McCain Traffic				
95-002-00	Cabinet Assembly, Traffic Signal ATC Model 356	McCain Traffic				
95-003-00	Cabinet Assembly, Traffic Signal ATC Model 357	McCain Traffic				
	Conflict monitor EDI Model 2212-HV CMUip	Eberle Design				
	SIU EDI Model 2218	Eberle Design				
	Switchpack EDI Model 2202-HV HDFU	Eberle Design				
	4-channel Detector ATC Reno Model LMD624H	Reno A&E				
	ATC EDI Model 2220 ADU	Eberle Design				

**CITY OF LOS ANGELES
DEPARTMENT OF TRANSPORTATION**

SPECIFICATION NO. 51-006-04 (REVISED 5/99)

MAY 1999

FOR: THE INSTALLATION OF PVC CONDUIT USING OPEN TRENCH EARTH SAW METHOD

I. Purpose of Specification

It is the intent of the specification to provide for the installation of PVC conduit using open trench earth saw method by private concerns or individuals under contract to the City of Los Angeles, with all labor, equipment, and material to be furnished by the Contractor. The City of Los Angeles Department of Transportation will designate a Coordinator for each contract or suborder.

II. Legal Requirements

- A. The Contractor shall comply with the "Standard Specifications for Public Works Construction", or latest revision, as adopted by the City of Los Angeles Board of Public Works. For this purpose, the work agency is construed to indicate the City of Los Angeles.
- B. The Contractor shall comply with the requirements and methods stated in the publication "Work Area Traffic Control Handbook" (Watch), latest revision, as adapted by the City of Los Angeles Board of Public Works and the Department of Transportation.
- C. The Contractor shall comply with the provisions of the California Occupational Safety and Health Act of 1973, and any succeeding acts, and the standards and regulations issued there under and shall certify that all items furnished under this contract shall conform to and comply with said standards and regulations. Supplier shall indemnify and hold harmless the City of Los Angeles for all damages assessed against the City as a result of the Contractor's failure to comply with the Act and the standards issued there under, and for failure of the items furnished under this contract to so comply.
- D. The contractor shall meet all requirements and tests that may be imposed the South Coast Air Quality Management District and the California Resources Board for control over dust or other emissions into the air in accordance with the schedules established by those authorities.

- E. The use of traffic warning and control devices as set forth in Section V of the Specifications shall be strictly adhered to by the Contractor.
- F. Bidders shall have experience in performing similar work and must have adequate personnel and equipment on hand to perform the required work.
- G. The Contractor is responsible for determining and obtaining all necessary permits.
- H. Contractor to provide two cellular telephones with a maximum usage of 300 hours per month.

III. **Work Required**

PVC conduit runs in paved roadways and in unpaved areas shall be installed in open trench using earth saw methods.

Trenches shall be cut by a machine that will produce a smooth edge cut in the pavement. The trenching machine shall be shielded to prevent the scattering of loose material. Concrete pavement serving as bus pads, spandrels, cross gutters, local depressions or wide gutters shall not be cut. At these locations, the PVC conduit shall be installed by the boring method.

The work shall include, but not be limited to, removing surface material; trenching; furnishing and placement of conduit, fittings, bends, bushings, pull boxes and other material that may be required; backfilling; surface restoration; providing entrances to new and existing pull boxes; cleaning entrances to areaways; and furnishing all labor, tools and equipment materials, storage, transportation and other incidentals necessary to complete the work.

Conduit runs containing traffic signal load wiring shall be three (3) inches Schedule 80 PVC electrical conduit; interconnect and detector conduit shall be either two (2) or three (3) inches Schedule 80 PVC. All conduit bends shall have a radius of three (3) feet unless otherwise noted. All proposed conduits shown in the streets shall be installed in a common trench. The solvent weld type of joint shall be used to connect PVC conduit, per paragraph 207-17.33 of the Standard Specifications.

A. **Installation in Parkways**

- 1. All conduit installations in parkways shall have a minimum cover of 16 inches below surface (LAMC Sec. 62.04).
- 2. All existing improvements in parkways, including landscaping and sprinklers, shall be protected from damage or injury or restored to preconstruction condition.

B. Installation in Roadways

1. Conduits containing traffic signal load wires (115 volts) shall be installed to provide a minimum cover of 30 inches. Conduits containing traffic signal low voltage interconnect wires and detector wires shall be installed to provide a minimum cover of 18 inches when parallel to the curb and 24 inches at all street crossings. Any deviation from these standards shall be approved by the Coordinator.
2. Conduit trenches approximately four (4) inches wide shall be excavated at locations shown on the plans, using earth saw methods.

Where it is not adjacent to a gutter, the trench shall be at a distance of 36 inches from the existing or future curb face (which will accommodate the construction of a 24 inch wide gutter some time in the future), or as shown on the plan. Removal and replacement of all pavements shall be done at the discretion of the City Engineer.

In major or secondary highways, the pavement placed over the trench shall have a minimum thickness of four (4) inches in asphaltic roadways, the thickness of pavement removed in Portland Cement Concrete (PCC) roadways or such thickness as may be specified by the City Engineer. In all other streets or alleys, the upper two (2) inches of trench in asphaltic roadways, or the thickness of pavement removed in PCC roadways, shall be completed with material matching the existing pavement; For excavations outside the trench area, PCC roadways, resurfacing shall be a minimum of six (6) inches thick and twenty-four inches wide.

Major secondary highways shall be those shown on the Highways and Freeways element of the City's General Plan.

3. Concrete pavement serving as bus pads, spandrels, cross gutters, or local depressions shall not be cut. In addition, concrete curbs and gutters (regardless of gutter width) shall not be cut. At these locations, including railroad tracks, the conduit shall be bored or jacked.
4. It is desirable to maintain a straight alignment. Routing of a conduit at a bus pad or at any other protrusions beyond the gutter edge must be approved by the Coordinator. It should be noted that some installations may require locations in back of the curb. Locations directly above and within one foot of, or otherwise in conflict with existing utilities will be permitted.

5. Backfill shall be a sand Portland cement, slurry mix of four sacks of cement per cubic yard of sand. Portland Cement Concrete backfill shall be a 560-D-2500 mix with a four-inch maximum slump. For PCC, calcium chloride must be added up to the maximum amount allowed by Section 201-1.2.4 of the Standard Specifications.

Backfill shall be installed to fill the trench to grade. Prior to installing the permanent paving over the trench, backfill shall be removed to accommodate the pavement depth specified in paragraph 2. All trenches left unfilled or not filled to grade by the end of the work day shall be covered with steel plates and the plates shall be secured to prevent their movement by traffic.

The sidewalk shall be saw cut before removal at all new or existing pull box locations. Conduits shall be extended under the curb and up to within four (4) inches of the surface at all pull box locations. A nylon pull cord and a green #8 AWG stranded wire shall be installed in all new conduits and the conduits shall be capped with a loose fitted PVC pipe cap.

All necessary pull boxes will be provided by the Contractor and shall be installed as per LADOT Specification S- 78.5.1. Pull box locations having only interconnect or loop detector conduits shall be PB-2 and all other pull box locations shall be PB-3 unless otherwise specified by the Coordinator. Where a new conduit is installed in an existing PB-2 location with traffic signal load wires present (115 volts), that pull box shall be replaced by the Contractor with a PB-3. The Contractor shall restore all pull locations where sidewalk has been removed by installing two (2) inches of temporary AC tamped to match existing grade.

IV. **Hours of Work and Traffic Interference**

Each proposed contract or suborder may stipulate the time of day and the day of the week during which work may be carried out. . Limitations are established to minimize traffic interference and nuisance to the adjacent development. No work shall be performed on Fridays unless approved by the Coordinator.

Under no circumstance shall any work be performed between 6 AM and 9 AM or between 3:30 PM and 7 PM, Monday through Friday. At least one unobstructed lane of traffic in each direction shall be maintained at all times.

V. Traffic Control

The Contractor shall furnish and install the following traffic control devices:

- A. Fluorescent orange traffic cones, a minimum of 28 inches in height, shall be used directly at the working location to guide traffic safely around the working area. For night work, the cones shall have 13-inch reflectorized sleeve.
- B. Rotating amber lights of a type specified by the State of California as approved lights and devices shall be prominently mounted on each piece of equipment and shall be in use at all times when the equipment is at the job site, as prescribed in Sections 25256 and 25268 of the California Vehicle Code and Title 13 of the California Administrative Code.
- C. A Type II flashing arrow sign (F AS) shall be mounted on the vehicle or on a separate trailer and shall be operated in the chevron mode whenever working in a traffic lane. The F AS shall never be located at a distance greater than 100 feet from the end of the taper.
- D. The Coordinator may initiate the posting of "Temporary No Parking" signs at the expense of the City of Los Angeles, Department of Transportation. All "Temporary No Parking" signs posted at the work site shall be removed daily by the Contractor at the completion of the affected segment of the job. Signs shall be turned in to the Coordinator when he visits the job site. The Contractor shall notify the Coordinator a minimum of 72 hours in advance of the actual work date for the posting of signs.

VI. Method of Ordering**Sub ordering**

Separate suborders will be issued to the Contractor specifying work to be done at an individual location or group of locations. Each suborder is to specify the date and time work will commence. The Coordinator shall notify the contractor two (2) working days prior to commencement of work. The following information shall be provided: suborder number, job site location, appropriate work orders, plans and sketches as may be applicable. Deviation from date or time of starting work must be approved by the Coordinator.

VII. Method of Payment

- A. Payment will be made upon completion of each suborder ~r individual contract for a specific job. Payment is contingent upon approval by the Coordinator of the quality and amount of work completed.
- B. Costs to the City estimated at not less than one hundred dollars (\$100) per day shall be deducted from payment due the Contractor on each suborder, under the following conditions:
 - 1. Failure to start a suborder at the specified time and place without prior approval of the Coordinator;
 - 2. Failure to return to a job on (a) succeeding work day (s) without approval of the Coordinator;
 - 3. Work at a day and/or time conflict with days/times specified on the departmental work orders with out approval of the Coordinator;
 - 4. Work at a day and/or time in conflict with instructions, written or verbal, of the Coordinator;
 - 5. Failure to finish the work described in the Work Order Acceptance Package on the agreed completion date without prior approval of the Coordinator; and,
 - 6. Failure to perform in accordance with instructions in section III. ~ Required without approval of the Coordinator.

**CITY OF LOS ANGELES
DEPARTMENT OF TRANSPORTATION
February 1995**

REMOVAL AND INSTALLATION OF TRAFFIC SIGNAL LAMPS (RELAMPING)

I. Purpose of Specification

It is the intent of the specification to provide for relamping of traffic signals by private concerns or individuals under contract to the City of Los Angeles with all labor and equipment to be furnished by the Contractor. The City of Los Angeles Department of Transportation (DOT) will supply incandescent lamps and replacement lenses. The Contractor will provide all other materials and supplies including cloth and cleaning agent, labels and fuel. All materials will conform to the most current DOT specifications. The Department of Transportation will designate a Relamping Coordinator. The Relamping Coordinator will hereinafter be referred to as the Coordinator.

II. Work to be Performed

A. Clean Lenses and Reflectors

1. Vehicle Signal Heads the Contractor shall clean lenses and reflectors using a cloth and cleaning agent.
The inside will be cleaned first, starting with the reflectors, then the inside of the lens, and finally the outside of the lens.
2. Pedestrian Signal Heads the Contractor shall clean the inside lens and reflector using a cloth and cleaning agent.
3. 3M Programmed Visibility Signal Heads the Contractor shall clean the outside of the lens using a cloth and cleaning agent.

B. Replacement of Vehicle Signal Lenses

The Contractor shall replace any lens that is burned, discolored, broken or otherwise damaged.

The Contractor shall make sure that the new lens is properly oriented in accordance with the manufacturer's specification.

C. Relamping

The Contractor shall replace all vehicle and pedestrian incandescent lamps with lamps of the proper type, size and life rating in accordance with DOT Specification Number 92-083-03, dated 09/93, or as provided by the City.

D. Signal Heads

The Contractor shall effect minor **alignment and tightening of signal and pedestrian heads as needed**, inspect them for missing or damaged parts, and report any irregularities to the Department of Transportation.

The Contractor shall attach to the exterior of each vehicle and pedestrian signal head a vinyl color coded label after all work has been accomplished to signify that the relamping is complete.

The label shall be affixed to the front of each vehicle and pedestrian head so that it is easily visible from the direction of vehicular travel.

The vinyl label color shall be **the same color as the DHV license plate YEAR tags for the year during which the relamping takes place.**

E. Quality of Work

All work shall be performed in a good and workman like manner.

III. Salvaged Materials

The Contractor shall deliver any salvage or salvageable materials to a location within the City's jurisdiction as designated by the City.

IV. Documentation

The Contractor shall **by 10: 00 AM each regular working day** generate, **and forward to the Signal Lab via modem**, a computer report which specifies **the work performed the previous working day, including** the exact date each intersection was relamped and any damaged **equipment** found at each intersection.

The report will be in the form of a database and shall be constructed using Paradox V3.5 or shall be easily converted to Paradox V3.5 without any special hardware or software.

Approval of the base program used by the contractor will rest with the LADOT Signal Repair Lab supervisor.

The necessary structure of the tables to be transmitted daily to the Signal Lab is:

Table Name: RELAMP

Field Name	Field Type	Characters	Description
ROUTE	A*	5	
RELAMP DATE	D*	8	
8" BULBS	N	2	COUNT
12" BULBS	N	2	COUNT
PED BULBS	N	2	COUNT
8" RED LENS	N	2	COUNT
			REPLACED
8" YELLOW LENS	N	2	COUNT
			REPLACED
8" GREEN LENS	N	2	COUNT
			REPLACED
12" RED LENS	N	2	COUNT
			REPLACED
12" YELLOW LENS	N	2	COUNT
			REPLACED
12" GREEN LENS	N	2	COUNT
			REPLACED
+ 8" 3M HEADS	N	2	COUNT
+ 12" 3M HEADS	N	2	COUNT
+XFMR PED HEADS	N	2	COUNT
COMMENTS	A	1	YES/NO
TSR CALLED	A	1	YES/NO

NOTE: + = A complete head assembly shall be reported as one unit in these fields.

Table Name: PROBLEMS

Field Name	Field Type	Characters	Description
ROUTE	A*	5	
RELAMP DATE	D*	8	
COMMENTS	A	60	PROBLEM

The Department will provide the Contractor with detailed instructions regarding counts and all other information to be reported.

V. Legal Requirements

- A. The Contractor shall comply with section 7 of the publications "Standard Specifications for Public Works Construction, 1985 Edition" or the latest revision, as adopted by the City of Los Angeles Board of Public Works.
For this purpose, the work agency is construed to indicate the City of Los Angeles.

- B. The Contractor shall comply with the requirements and methods stated in the publication "Work Area Traffic Control Handbook" 1990 Edition, or latest revision, as adopted by the City of Los Angeles Board of Public Works, and the Department of Transportation.
- C. The Contractor shall comply with the provisions of the California occupational Safety and Health Act of 1973, and any succeeding acts, and the standards and regulations issued there under and shall certify that all items furnished under this contract shall conform to and comply with said standard and regulations.

Supplier shall indemnify and hold harmless the City of Los Angeles for all damages assessed against the City as a result of the contractor's failure to comply with the Act and the standards issued there under and for the failure of the items furnished under this contract to so comply.

- D. The Contractor shall meet all requirements and tests that may be imposed by the South Coast Air Quality Management District and the California Air Resource Board for control over fumes or other emissions into the air, in accordance with schedules established by those authorities.
- E. The use of traffic warning and control devices as set forth in section VI of the specification shall be strictly adhered to by the Contractor.
- F. Bidders shall have had two years experience within the last five years in performing similar work and must have adequate personnel and equipment on hand to perform the required work.

VI. Hours of Work

Each proposed contract or subcontract may stipulate the time of day and the days of the week during which relamping may be carried out. Limitations are established to minimize traffic interference and nuisance to adjacent development and to the traveling public. Normally, no work shall be performed from 7-9 A.M. and 4-7 P.M. weekdays; however, work may be performed during this time if traffic lanes are not blocked and there is minimal interference.

The Contractor may work multiple shifts Sunday through Saturday to maximize equipment and personnel productivity.

VII. Traffic Control

The Contractor shall furnish and install the following traffic control devices:

- A. Rotating amber lights of a type specified by the State of California as approved lights and devices shall be prominently mounted on each piece of equipment and shall be in use at all times when the equipment is at the job site as prescribed in section" 25256 and 25268 of the California Vehicle Code and Title 13 of the California Administrative Code.
- B. The Coordinator may provide specific instructions in the use and placement of traffic control devices in any instance not covered in the pamphlet "Work Area Traffic Control Handbook" or under subsection A above.

VIII. Relamping Equipment

The prime contractor shall own or have under their direct control a minimum of three (3) pieces of the following equipment, unless otherwise approved by the coordinator:

- A. Truck, Aerial Lift with basket rated at 300 lbs. (136Kg.) maximum load, with a minimum working height of 28 feet.
- B. Cellular telephone for emergency communications between Contractor and Department of Transportation. The Coordinator shall provide Contractor with emergency telephone number(s).
- C. **DOT will provide the Contractor with a written protocol for reporting trouble calls to the City.**
- D. **Any traffic signal malfunction will be reported immediately to DOT.**

IX. Contractor Experience

The contractor shall submit with the bid a minimum of three references showing that they are capable of performing traffic signal or electrical lamp maintenance work. At least one of the references shall be from a City, County or State agency.

The contractor shall submit with the bid, photographs of their equipment, proof of ownership or exclusive lease.

X. Correction of Work

The Coordinator shall be the sole judge as to the acceptability of the work and shall inspect the completed work, informing the Contractor of any faulty methods or unsatisfactory results. It shall be the Contractor's responsibility at his own expense, to correct all unsatisfactory work upon his notification.

XI. Method of Ordering

A. Suborder

A suborder will be issued to the Contractor specifying work to be done at an individual location or group of locations. The suborder is to specify the date and time work will commence.

The Department of Transportation, Coordination Section, telephone (213) 485-4294, shall notify the Contractor two working days prior to the commencement of work. The following information shall be provided: suborder number, job site location(s), appropriate work order, name of Coordinator and number of intersections to be relamped.

Deviation from date or time of starting work must be approved by the Coordinator.

B. Definition of Job

A job shall be identified by a single line item on a general suborder. The job may be a single intersection, or a group of intersections, not necessarily, adjacent.

XII. Method of Payment

A. Payment will be made upon completion of each suborder or individual contract for a specific job. Payment is contingent upon approval by the Coordinator of the quality and amount of work completed.

B. Costs to the City estimated at not less than one hundred dollars (\$100) per day shall be deducted from payment due the Contractor, on each suborder, under the following conditions:

1. Failure to start a suborder within five (5) days of notification to proceed without approval of the Coordinator.
2. Failure to return to a job on (a) succeeding work day(s) without approval of the Coordinator.

3. Relamping on a day and/or time in conflict with instruction, written or verbal, of the Coordinator.
 4. Failure to finish all work described in a Suborder within 30 days of the date of the Contractor's receipt of notification to proceed without approval of the Coordinator.
 5. Failure to comply with Section X. Correction of Work, within seven (7) calendar days unless waived by the Coordinator.
- C. **The contractor will be held responsible for any work required by the Department as a result of negligence. Charges for work required by the Department as a result of negligence will be deducted from the amount due upon completion of the suborder at the current cost to the Department of Transportation for wages, equipment and materials.**

SPECIFICATION NO. 54-053-08

July 2008

TRAFFIC SIGNAL CABINET ASSEMBLY SPECIFICATION

TYPE 332/336/337 and RELATED EQUIPMENT

CITY of LOS ANGELES

DEPARTMENT of TRANSPORTATION

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CITY of LOS ANGELES
DEPARTMENT of TRANSPORTATION
TRAFFIC SIGNAL CABINET ASSEMBLY SPECIFICATION
54-053-07
December 2007
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GENERAL SPECIFICATIONS FOR TRAFFIC SIGNAL CABINET ASSEMBLY

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GENERAL SPECIFICATIONS FOR TRAFFIC SIGNAL CABINET ASSEMBLY

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SCOPE

This Chapter defines the general requirements applicable to all equipment specified in this document. The intent of this specification is to establish the minimum acceptable electrical, mechanical, design, and performance requirements within which all equipment must operate satisfactorily and reliably. All items supplied shall be new and unused.

The scope of this specification allows and encourages development of new designs and enhancements. New designs may be submitted for Acceptance Testing by the LADOT.

SPECIFICATION PRIORITIES

In case of conflict, the individual chapter shall govern over the PLANS and DRAWINGS, and the PLANS and DRAWINGS shall govern over CHAPTER 1, GENERAL REQUIREMENTS.

SPECIFICATION COMPLIANCE

All controller assemblies and associated hardware shall be inspected and evaluated for compliance with the following specifications:

- ? **UNDERWRITERS LABORATORIES INC.**
- ? **ELECTRONIC INDUSTRIES ASSOC. (EIA)**
- ? **NATIONAL ELECTRICAL CODE (NEC)**
- ? **AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)**
- ? **AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)**
- ? **NATIONAL ELECTRICAL MANUFACTURERS ASSOC. (NEMA)**

The LADOT remains the sole judge on the ability of each device to meet specifications.

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1 GENERAL SPECIFICATIONS FOR TRAFFIC SIGNAL CONTROL EQUIPMENT

1.1 GLOSSARY SECTION

Wherever the following terms or abbreviations are used, the intent and meaning shall be interpreted as follows:

AC	Alternating Current.
AC+	120 Volts AC, 60 Hertz ungrounded power source.
AC-	120 Volts AC, 60 Hertz grounded return to the power source.
ACIA	Asynchronous Communications Interface Adaptor device, Motorola MC6850 or equivalent.
ANSI	American National Standards Institute.
Assembly	A complete structure, unit or device that was manufactured by fitting together parts and/or modules.
ASTM	American Society for Testing and Materials.
ATSAC	Los Angeles DOT- Automated Traffic Surveillance and Control System
AWG	American Wire Gauge.
C	Celsius
Cabinet	An outdoor enclosure for housing the controller unit and associated equipment.
Certificate of Compliance	A certificate signed by the manufacturer of the material or the manufacturer of assembled materials stating that the materials involved comply in all respects with the requirements of the specifications.
Channel	An information path from a discrete input to a discrete output.
City	The City of Los Angeles
Component	A component shall be defined as any electrical or electronic device.
Contractor	The person or persons, manufacturer, firm, partnership, corporation, vendor, or combination thereof, who have entered into a contract with the City of Los Angeles Department of Transportation, as party or parties of the second part or his or their legal representative.

Controller Unit

The component device within the controller assembly devoted to the operational control of the traffic signals.

CPU Central Processing Unit

DB Decibel

DBa Decibels above reference noise, adjusted

DC Direct Current

EG Equipment Ground

EIA Electronic Industries Alliance

Engineer The General Manager of the Department of Transportation of the City of Los Angeles, acting either directly or through properly authorized agents, such agents acting within the scope of the particular duties delegated to them.

Equal Connectors

Complying to physical dimensions, contact/pin material, plating and method of connection.

Equal Devices

Conforming to function, pin out, electrical, and operating parameters of the specified device. Interpretation shall be in the judgement of the Engineer.

FLASH A powered IC Memory Device with nonvolatile, electrically erasable, programmable, 100K read/write minimum cycles and fast access time features

HEX Hexadecimal

Hz Hertz

I.D. Identification

Jumper A means of connecting/disconnecting two (2) or more conductive points by soldering/removing a conductive wire jumper

Laboratory The established laboratory of the City of Los Angeles or other laboratories authorized by the City to test materials involved in the contract

LADOT City of Los Angeles Department of Transportation

LED	Light Emitting Diode
Lsb	Least significant bit
mA	Milliampere
MIL	Military Specifications
Module	A functional unit that plugs into an assembly
Motherboard	A printed circuit connector interface board with no active or passive components
MOS	Metal Oxide Semiconductor
MPU	Microprocessor Unit
ms	Millisecond
Msb	Most significant bit
mW	Milliwatt
NA	Presently not assigned. Cannot be used by the contractor for other purposes
NEMA	National Electrical Manufacturer's Association
NETA	National Electrical Testing Association
N.C.	Normally closed contact
N.O.	Normally open contact
ns	Nanosecond
PAL/PLA	Programmable Array Logic device
PCB	Printed Circuit Board
ppm	Parts per million
RAM	Random Access Memory Device
RMS	root mean square
ROM	Read Only Memory device

SCI Serial Communications Interface

SS **Second Sourced**, produced by more than one (1) manufacturer

SRAM Static Random Access Memory device

STATE State of California

SW switch

Thumb Screw Device

A 8-32 retractable screw fastener with projecting stainless steel screw, spring and natural aluminum knob finish (SOUTHCO #47-62-301-XX or equal)

ua Microampere

UL Underwriters Laboratories

VAC Voltage Alternating Current

VDC Voltage Direct Current

Watchdog Timer (WDT)

A monitoring circuit, internal to the Conflict Monitor which senses the Controller Unit Watchdog output Line

XX Manufacturer's option

1.2 GENERAL SECTION

All equipment furnished under these specifications shall be of solid state design. Use of electro-mechanical devices within the equipment is not acceptable unless otherwise indicated.

LADOT reserves the right to bid any and all components when deemed in the best interests of the LADOT, and/or where State or Federal participation requires that such components be purchased on a competitive bid basis.

1.2.1 CODE REQUIREMENTS

Traffic controls, parts, and accessories **MUST** meet the following codes wherever applicable:

- ? Radio Manufacturer's Association
- ? National Electrical Code
- ? Manual of Uniform Traffic Control Devices
- ? ANSI Code
- ? NEMA
- ? ASTM
- ? ASA
- ? Federal
- ? State of California DTSC proposal 66260.202
- ? LADOT

In the event of conflict, the LADOT Specifications for Traffic Signal and Street Lighting shall prevail.

The LADOT remains the sole judge on the ability of each device to meet specifications.

1.2.2 DOCUMENTATION

Two (2) manuals shall be supplied with each item required under this specification, up to a maximum of ten manuals per item type per contract.

Manuals shall be printed in a standard publishers font, no less than 10 point on 8.50 by 11.00 inch paper. Schematics, layouts, parts lists and plan details may be on 11.00 by 17.00 inch sheets, but the sheets must be neatly folded to 8.50 by 11.00 inch size. The manual shall be bound in durable covers, and shall suffer no degradation when subjected to normal cabinet temperature testing as described in this specification.

Each manual shall include the following:

- ? **General Description**
- ? **General Characteristics**
- ? **Installation**
- ? **Adjustments**
- ? **Theory of Operation**
- ? **Systems Description (Include block diagram)**
- ? **Detailed Description of Circuit Operation**
- ? **Maintenance:**
 - Preventive Maintenance
 - Trouble Analysis
 - Trouble Shooting Sequence Chart.
 - Wave forms
 - Voltage Measurements
 - Alignment Procedures
- ? **Technical Information**

Technical information in the form of Manufacturer's published data sheets for all medium and large scale integrated circuits.
- ? **Parts List**

Parts List (to include circuit and board designation, part type and class, power rating and component manufacturer, and original manufacturer's part number).
- ? **Electrical Interconnection Drawing**
- ? **Schematic and Logic Diagram**
- ? **Drawings & Diagrams**

Assembly drawings and a pictorial diagram showing physical locations and identification of each component.
- ? **Serial & Revision Numbers**

The serial numbers and revision numbers of equipment covered by manuals shall be printed on the front cover of the manuals.
- ? A cabinet wiring diagram for the model 332 and 336 cabinets shown complete on a single plan sheet.

Manuals for the Models 332, 336 and 337 Cabinets shall be furnished with each unit.

Prior to final printing, three (3) copies of a preliminary draft of all manuals shall be submitted to the LADOT Signal Lab for approval.

Updated documentation shall be provided for ANY and ALL design changes or modifications to equipment, circuits, or components supplied to the LADOT.

Notification of impending changes shall be made by letter, with support documentation to follow in an expeditious manner. Sufficient copies of documentation shall be provided at a rate of 10 copies total, or one (1) copy for every 10 units supplied, whichever is greater.

1.2.3 SAMPLE UNITS and ACCEPTANCE TESTING

The sample unit shall reflect all requirements contained in these Specifications. Final authority over the acceptance of the sample unit with regard to the interpretation of these Specifications shall reside with the City of Los Angeles.

The participating bidders shall deliver one (1) sample unit to the City for inspection and testing within 30 days following the opening of the bid. Each shipment shall be delivered to:

**Piper Technical Center
Att: Signal Lab
555 Ramirez Street
Quad 1, Space 100
Los Angeles, California 90012**

All equipment supplied by the Vendor will be acceptance tested by the City for complete conformance to the specifications and Special Provisions referenced in this document. The Vendor shall be responsible for removing rejected equipment from the testing laboratory.

Sample units may be complete Controller and Cabinet assemblies, or component parts. When the bid is for Controller Assembly units, then the sample unit shall be one (1) complete controller assembly unit as defined by the bid package. For the winning bidder that unit shall be considered the first shipment of the contract and will remain in the possession of the LADOT as the reference sample.

The appropriate Cabinet Verification Test Program shall be provided with the sample. One (1) set of: wrap-around connectors and/or special test jigs shall be provided for use with the Diagnostic Test Program.

Five (5) copies of a user's manual shall be provided. The User's Manual shall describe operation of all components included in the Sample Unit.

Four (4) sets of cabinet wiring diagrams shall be provided with the Sample Unit. Detailed equipment layout scale drawings and wiring diagrams of all equipment installed in the cabinet shall be submitted for approval prior to production.

Satisfactory completion of acceptance testing will be a prerequisite to formal acceptance of the Vendor's bid.

Rejection of the Sample Unit

Rejection of the sample unit during acceptance testing will be grounds for rejection of the Vendor's bid, and the Vendor shall be responsible for removal of all rejected equipment from the LADOT testing facility.

The LADOT reserves the right, at any time during the term of the contract, to reject any piece of equipment that fails to meet testing requirements or specifications. It is the Vendor's responsibility to rectify all discrepancies, and re-submit sample units, as required, for acceptance testing.

The LADOT may, at its option, return all defective equipment, including Stock equipment, to the Vendor for full credit, or exchange for newly acceptance tested units.

Any and all expenses incurred, as a result of equipment being rejected during the term of the contract, shall be born by the Vendor, including any penalties resulting from project delays.

1.2.4 CONTROLLER ASSEMBLY UNIT

Standard controller assembly units per these specifications, shall consist of the following equipment listed below.

1.2.4.1 Model 332 Controller Cabinet Assembly Unit

- ? Cabinet Assembly Unit, Model 332, one (1) each
- ? Traffic Controller Unit (Optional), zero (0) each
- ? Conflict Monitor, Model 2018, one (1) each with red monitor cable
- ? Vehicle Detector, Model 222, two (2) each
- ? Vehicle Detector, Model 224, four (4) each
- ? Two Channel DC Isolator, Model 242, four (4) each
- ? Two Channel AC Isolator, Model 252, one (1) each
- ? Two Channel AC Railroad Isolator, Model 255, zero (0) each
- ? Solid State Switchpack, Model 200, ten (10) each
- ? Flasher, Model 204, three (3) each (2 installed and 1 spare)

1.2.4.2 Model 336 Controller Cabinet Assembly Unit

- ? Cabinet Assembly Unit Model 336, one (1) each
- ? Traffic Controller Unit (Optional) zero (0) each
- ? Conflict Monitor, Model 2018, one (1) each with red monitor cable
- ? Vehicle Detector Model 222, four (4) each
- ? Vehicle Detector Model 224, two (2) each.
- ? Two channel DC Isolator Model 242, three (3) each
- ? Two Channel AC Isolator Model 252, two (2) each
- ? Two Channel AC Railroad Isolator Model 255, one (1) each
- ? Solid State Switchpack Model 200, twelve (12) each
- ? Flasher, Model 204, two (2) each

1.2.4.3 Model 337 Controller Cabinet Assembly Unit

- ? Cabinet Assembly Unit Model 337, one (1) each.
- ? Traffic Controller Unit (Optional), zero (0) each.
- ? Conflict Monitor, Model 2018, one (1) each with red monitor cable
- ? Vehicle Detector Model 222, two (2) each.
- ? Vehicle Detector Model 224, two (2) each.
- ? Two Channel DC Isolator Model 242, two (2) each.
- ? Two Channel AC Isolator Model 252, one (1) each.
- ? Two Channel AC Railroad Isolator Model 255, zero (0) each.
- ? Solid State Switchpack Model 200, four (4) each.
- ? Flasher, Model 204, two (2) each.

1.2.4.4 Delivery

The first shipment of cabinet assemblies shall be delivered not more than 60 calendar days from the award of the bid. The rate of delivery shall not exceed or be less than 25 per month; unless the contract calls for less than 25 units or a variance is authorized by the City. A Unit shall consist of the controller unit (if called for in the contract), cabinet, and the number of peripherals that the bid designates for each complete controller assembly. Additional shipments will be predicated on the acceptance of the previous delivery.

In addition to the standard shipping invoices, shipment documentation shall be e-mailed to the LADOT Signal Lab in a database format compatible with Microsoft ACCESS 2000 or EXCEL 97-2003. The e-mail address(s) shall be provided at the award of the contract.

The list shall be organized by Cabinet assembly by manufacturer name and serial number and shall include the manufacturer name and serial number for each controller unit (when specified) and conflict monitor unit supplied in each assembly.

Each shipment shall be delivered to:

**Piper Technical Center
Att: Signal Lab
555 Ramirez Street
Quad 1, Space 100
Los Angeles, California 90012**

A minimum of 48 hours advance notice to the Prep Lab Supervisor shall be given by the Vendor prior to each delivery. All deliveries shall be made during the hours of 8:00 AM and 2:00 PM on any working day, Monday - Thurs.

1.2.4.5 Warranties and Guarantees

- ? It is the responsibility of the Vendor to ensure that all equipment provided has been thoroughly tested prior to shipment, and that each shipment conforms to these specifications.
- ? The minimum warranty for any equipment and materials shall be for a period of 2 years from the date of test acceptance by the Department of Transportation, City of Los Angeles. The warranty shall cover all manufacturer's defects, parts, labor, and shipping costs. The warranty for each unit of equipment that requires repair by the Vendor shall be extended by the length of time that the unit is out of service for repair.
- ? The supplier shall furnish the City with a contact name and telephone number for the person to notify of any alleged defects for which the supplier has repair or replacement responsibilities.

1.2.5 CASH CONTRACT

Cash Contract projects, or Testing and Inspections for other agencies:
Arrangements for inspection and testing by the LADOT must be made in advance.
Controller units, auxiliary equipment and cabinet, fully wired, including wiring diagrams and manuals, shall be delivered to the testing facility at:

Piper Technical Center
Att: Signal Lab
555 Ramirez Street
Quad 1, Space 100
Los Angeles, California 90012

- ? The contractor shall allow 30 working days for testing from the time the equipment is delivered to the testing facility until notification of the final results.
- ? The contractor shall remove all equipment submitted to the testing facility within 5 working days after notification of the test results. In the event the equipment is not removed within said period, it may be shipped to the contractor at his expense. It shall be the contractor's responsibility to pick up and deliver acceptable equipment to the work site.
- ? Should any of the equipment fail to comply with the specifications, the contractor shall correct the deficiency and resubmit the equipment for an additional 30 working-day test period. All testing subsequent to rejection of the equipment, for failure to comply with specification requirements, will be at the expense of the contractor.
- ? The Controller Unit Diagnostic Test Program and the appropriate Cabinet Verification Test Program shall be provided with sample cabinet assembly. One (1) complete set of wrap-around connectors and/or other special test jigs shall be provided for use with the Diagnostic Test Program.
- ? Three (3) copies of a User's manual shall be provided. The User's Manual shall describe operation of all components included in the Sample Unit.
- ? Four (4) sets of cabinet wiring diagrams shall be provided with the Sample Unit. Detailed equipment layout scale drawings and wiring diagrams of all equipment installed in the cabinet shall be submitted for approval prior to production.

1.2.6 INTERCHANGEABILITY

The following assemblies and their respective associated devices shall electrically and mechanically interface with each other:

ASSEMBLIES

Output File #1 & #2

Input File

Power Distribution Assembly

#1 & #2

ASSOCIATED DEVICES

Switchpack Model 200

Monitor Unit Model 2018

Relay:

Heavy Duty Model 430

Detectors Model 222

222LRT

224

Isolators Model 242

252

255

Flasher Unit Model 204

Relay:

Heavy Duty Model 430

Cabinet: Model 332

Model 336

1.2.7 INDICATORS and CHARACTER DISPLAYS

All indicators and character displays shall have a +45 degree cone of visibility with its axis perpendicular to the front panel. All indicators and character displays shall be readily visible at a radius of up to 4 feet within the cone of visibility when the indicator is subjected to 9,000 footcandles of white light with the light source at 45 (± 2) degrees to the front panel. If characters are not self-luminous, illumination shall be provided for viewing in low levels of ambient light. Indicators supplied on equipment requiring handles shall be mounted such that a horizontal clearance of 15 degrees minimum shall be provided for models 2018, 222, 224, 242, 252, and 255 as well as a clearance of 30 degrees minimum for Models 200 and 204.

- ? All indicators and character displays shall have a rated life of 100,000 hours minimum.
- ? Liquid Crystal Displays (LCD) shall operate at temperatures of -20 degrees to 70 degrees Celsius without loss of visibility or bleeding.

1.2.8 HEAVY DUTY- FLASH TRANSFER RELAYS

Model 430 Heavy duty relays shall be the electro-mechanical type designed for continuous duty from 90 to 135 VAC.

Each relay shall have a BEAU 5408 Plug Connector (or equivalent) and be enclosed in a removable, clear plastic cover. The manufacturer name, electrical rating and part number shall be placed on the cover. Markings shall be permanent, durable and readily visible from a distance of 3 feet.

Each relay shall be provided with double-pole, double-throw contacts. Contact points shall be of fine silver, silver alloy or superior alternative material. Contact points and arms shall be capable of switching a 20 Amp or 1kW tungsten load per contact at 120VAC once every 2 seconds with a 50% duty cycle for at least 250,000 operations without contact welding or excessive burning, pitting or cavitation. The points and arms shall be able to withstand 0.1 DA or 10Gs, 10-55 Hz without contact chatter. The relay coil shall have a power consumption of 2 volt-amperes or less.

Each relay shall withstand a potential of 1,500 VAC at 60 Hz between insulated parts and between current carrying or non-carrying parts. Each relay shall have a 1 cycle surge rating of 175 Amps RMS.

1.2.9 CONNECTORS

General

All connectors shall be keyed to prevent improper insertion of the wrong connector or PCB. The keyed slot shall utilize a molded key that cannot be extracted on removal or crushed upon insertion.

The TYPE 25 Connector shall be a 25 contact AMP HDP - 20 Connector or equal with gold on nickel plated contacts. The female mating connector with socket contacts is designated TYPE 25S and the male mating connector with pin contacts is designated TYPE 25P. The TYPE 25P Connector shall be provided with lock spring clips for latching to its mating connector.

The TYPE T Connector shall be a single row, 10 position, feed through terminal block. The terminal block shall be a barrier type with *6-32 -by-1/4-inch*, or longer, nickel plated brass binder head screws. Each terminal shall be permanently identified as to its function.

The mating connectors shall be designated as the connector number and male/female relationship such as C1P (plug or PCB edge connector) and C1S (socket).

Connectors C1, 2, 4, and C5

Pin and socket contacts for Connectors C1, C2, C4 and C5 shall be beryllium copper construction subplated with 0.00005 inch nickel and plated with 0.00003 inch gold. Pin diameter shall be 0.062 inch. Connectors shall have the following number of contacts:

- C1 - 104 contacts
- C2 - 14 contacts
- C4 - 37 contacts
- C5 - 24 contacts

All pin and socket connectors of C1, C2, C4, and C5 shall use the AMP #601105-1 or #91002-1 contact insertion tool, and the AMP #305183 contact extraction tool.

Connector C1 and C2 blocks shall be constructed of phenolic or equal and shall have an Insulation resistance of 5000 megohms. The contacts shall be secured in the blocks with stainless steel springs.

Connector C1 and C2 corner guides shall be stainless steel. The guide pins shall be 1.097 inches in length and the guide sockets 0.625 inch in length.

Connector C4 and C5 shall be circular plastic type with quick connect/disconnect capability and thread assist, positive detent coupling. The connectors shall be UL listed Glass Filled Nylon, 94 V-1 Rated, heat stabilized, fire resistant.

1.2.10 PCB CONNECTORS

PCB edge connectors shall have bifurcated gold plated contacts. All edge connector contacts shall be plated with a minimum thickness of 0.00003 inches gold over a minimum thickness of 0.000075 inches of nickel.

The PCB connector shall meet or exceed the following:

Operating Voltage:		600 VAC (RMS) at sea level
Current Rating:		5 amperes
Insulation Resistance:		5,000 megohms
Contact Material:		Copper alloy
		(plated with 0.00005 inch of nickel and 0.000015 inch of gold)
Contact Resistance:		0.006 ohm maximum

The PCB 22/44 Connector shall have 22 independent contacts per side, dual-sided with 0.156 inch contact centers.

The PCB 28/56 Connector shall have 28 independent contacts per side, dual-sided with 0.156 inch contact centers.

The PCB 36/72 Connector shall have 36 independent contacts per side, dual-sided with 0.10 inch contact centers.

Connectors that are of the "INSULATION DISPLACEMENT" type will not be permitted.

All edge connectors shall use the "bifurcated bellow" type contact or equivalent.

1.2.11 PACKAGING

Each item delivered shall be individually packed in its own shipping container. When loose Styrofoam is used for packing the item, the item shall be sealed in a plastic bag to prevent direct contact with the Styrofoam. A 24" x 28" wooden pallet shall be used when shipping a 336 controller assembly, secured with (4) 1/4-20 bolts. A 29" x 40" wooden pallet shall be used when shipping a 332 controller assembly, secured with (4) 1/4-20 bolts.

1.2.12 DELIVERY

Each item delivered for testing shall be complete, including manuals, and ready for testing.

1.2.13 METALS

Aluminum

Sheet shall be Type 5052-H32 ASTM designation B209.
Rod, Bar and Extruded shall be Type 6061-T6, or equal.

Stainless Steel Sheet

Stainless Steel sheet shall be annealed or one-quarter-hard complying with the ASTM Designation: A666 for Type 304, Grades A or B, stainless steel sheet.

Cold Rolled Steel

Sheet, Rod, Bar and Extruded shall be Type 1018/1020.
Plating - All cold roll steel shall be plated. All plating shall be either cadmium plating meeting the requirements of Federal Specification QQ-P-416C, Type 2 Class 1 or zinc plating meeting the requirements of Federal Specification QQ-Z-325B, Type 2 Class 1.

All sharp edges and corners shall be rounded.

1.3 COMPONENTS SECTION

1.3.1 GENERAL

Electronic components or devices integral to the traffic signal controller cabinet shall comply with the State of California guidelines for RoHS compliance as listed in California DTSC proposal 66260.202 regarding the use of heavy metals in Covered Electronic Devices as of January 1, 2007.

All components shall have a second source and shall be of such design, fabrication, nomenclature, or other identification as to be purchased from a wholesale electronics distributor, or from the component manufacturer, except as follows:

Circuit design shall be such that all components of the same generic type, regardless of manufacturer, shall function equally in accordance with the specifications.

Memory, MPU, MIC, and ACIA devices shall be the ONLY socket mounted devices on the PCBs.

No component shall be operated above 80% of its maximum rated voltage, current or power ratings. Digital components shall not be operated more than 3% above their nominal voltage, current, or power ratings.

No component shall be provided where the manufactured date is 2 years older than the contract award date. The design life of all components, operating for 24 hours a day in their circuit application, shall be 10 years or longer.

Encapsulation of two (2) or more discrete components into circuit modules is prohibited, except for transient suppression circuits, resistor networks, diode arrays, solid state switches, optical isolators and transistor arrays.

Except as specified in 1.3.5, all discrete components, such as resistors, capacitors, diodes, transistors, and integrated circuits shall be individually replaceable. Components shall be arranged so they are easily accessible for testing and maintenance.

The Contractor shall submit detailed engineering technical data on all components at the request of the Engineer. A letter from the component manufacturer shall be submitted with the detailed engineering data when the proposed application of the component alters the technical data. The letter shall certify that the component application meets specification requirements.

1.3.2 CAPACITORS

The DC and AC voltage ratings as well as the dissipation factor of a capacitor shall exceed the worst case design parameters of the circuitry by 150%.

A capacitor which may be damaged by shock or vibration shall be supported mechanically by a clamp or fastener.

Capacitor encasement shall be resistant to cracking, peeling, and discoloration.

All capacitors shall be insulated and shall be marked with their capacitance value and working voltage.

Electrolytic capacitors shall not be used for capacitance values of less than 1.0 microfarad and shall be marked with polarity.

All non-electrolytic capacitors of less than 1uf value SHALL NOT be of the Ceramic Disk type.

1.3.3 POTENTIOMETERS

Potentiometers with ratings from 1 to 2 watts shall be equivalent to Military Type RV4.

No potentiometers less than 1 watt rating shall be used (except for trimmer type function).

The power rating of any potentiometer shall be at least 100% greater than the maximum power requirements of the circuit.

All trimmer potentiometers shall have 10 turns minimum.

1.3.4 RESISTORS

Fixed carbon film, deposited carbon, or composition insulated resistors shall conform to the performance requirements of Military Specifications: MIL-R-11F or MIL-R-22684.

All resistors shall be insulated and shall be marked with their resistance value. Resistors with color codes shall adhere to the EIA color codes. Resistor tolerance shall not exceed 10%.

The value of the resistors shall not vary by more than 5% when operating between 37 degrees and 74 degrees Celsius.

Resistors that have a rating exceeding 2 watts shall not be used unless special ventilation or heat sinking is provided. They shall be thermally insulated from the PCB.

1.3.5 SEMICONDUCTOR DEVICES

All solid state devices, except LEDs, shall be of the silicon type.

All transistors, integrated circuits, and diodes shall be a standard type listed by EIA and clearly identifiable.

All metal oxide semiconductor components shall contain circuitry to protect their inputs and outputs against damage due to high static voltages or electrical fields.

Semiconductor devices that dissipate more than 150 mW or cause a temperature rise of 50 degrees F or more shall be mounted with spacers, transipads or heat sinks.

1.3.6 TRANSFORMERS and INDUCTORS

All power transformers and inductors shall have the manufacturer's name or logo and part number clearly and indelibly printed on the case or lamination.

All transformers and inductors shall have their windings insulated and shall be protected to exclude moisture.

All transformer and inductor leads shall be color coded per EIA color code standard or identified in a manner to facilitate proper installation.

1.3.7 CIRCUIT BREAKERS (10 amperes or greater)

Circuit breakers shall be listed by UL or ETL. The trip and frame sizes shall be plainly marked (marked on the breaker by the manufacturer), and the ampere rating shall be visible from the front of the breaker. All circuit breakers (30 amperes or greater) shall be quick-break on either automatic or manual operation. Contacts shall be silver alloy and enclosed in an arc quenching chamber. Overload tripping shall not be influenced by an ambient air temperature range of from -18 degrees to 50 degrees Celsius. Minimum interrupting capacity shall be 5,000 amperes, RMS.

Circuit breakers shall be the trip-free type.

Multi-pole breakers shall not be the "mechanically ganged" type.

1.3.8 SWITCHES

DIP

Dual-inline-package, quick snap switch(es) shall be rated for a minimum of 30,000 operations per position at 50 mA, 30 VDC. The switch contact resistance shall be 100 milliohms maximum at 2 mA, 30 VDC. The contacts shall be gold over brass (or silver). The switch shall be rated for a minimum of 40,000 operations.

Logic

The switch contacts shall be rated for a minimum of one ampere resistive load at 120 VAC or 28 VDC and shall be silver plated over brass (or equal). The switch shall be rated for a minimum of 40,000 operations.

Control

The switch contacts shall be rated for a minimum of 5 ampere resistive load at 120 VAC or 28 VDC and shall be gold over brass (or equal). The switch shall be rated for a minimum of 40,000 operations.

Power

Ratings shall be the same as **Control** except the contact rating shall be a minimum of 10 amperes at 125 VAC.

1.4 MECHANICAL SECTION

1.4.1 ASSEMBLIES

Assemblies (including Controller Unit) -- All assemblies shall be easily replaceable and incorporate plug-in capability for their associated devices except for PCBs in the following exceptions:

- ? The cabinet power supply.
- ? Mother board assemblies.

Assemblies shall be provided with two (2) **NYLON** guides for each plug-in PCB or associated device (except relays). The guides shall extend to within 3/4 inch from the face of either the socket or connector and front edge of the assembly. The **NYLON** guides shall be securely attached to the file or assembly chassis.

1.4.2 PRINTED CIRCUIT BOARDS

Component Mounting: No components, traces, brackets, obstructions shall be within 1/8 inch of the board edge (guide edges).

Contacts: All contacts on PCBs shall be plated with a minimum thickness of 0.00003 inches gold over a minimum thickness of 0.000075 inches nickel.

Copper tracks: NEMA FR-4 glass cloth base epoxy resin copper clad laminates 0.0625 inches minimum thickness shall be used. Inter-component wiring shall be by laminated copper clad track having a minimum weight of 2.0 ounces per square foot with adequate cross section for current to be carried. All copper tracks shall be plated or soldered to provide complete coverage of all exposed copper tracks. Jumper wires to external PCB components shall be from plated-through padded holes and as short as possible.

Military Specification: All PCBs shall conform to Section 3.3 of Military Specification MIL-P-13949G. Grade of pits and dents shall be of Grade B quality (3.5.1.3) or better. Class of permissible bow or twist shall be Class C (Table V) or better. Class of permissible warp or twist shall be Class A (Table II) or better.

Semiconductor devices that dissipate more than 150 mW or cause a temperature rise of 50 degrees F or more shall be mounted with spacers, transipads or heat sinks to prevent contact with the PCB.

Coating: All PCB assemblies shall be coated with a moisture resistant coating. The manufacturer's name or logo, model number, serial number, and circuit issue or revision number shall appear and be readily visible on all items. Placement of this information for modules such as the Model 2018 Monitor Unit, Model 222, 242, & 252 Modules shall be on the PCB.

1.4.3 WORKMANSHIP

Workmanship shall be in accordance with the highest industry standards.

1.4.4 MODEL NUMBERS

The manufacturer's model number, serial number and circuit issue or revision number shall appear on the rear panel of all equipment and modules supplied.

In addition to any assignment of model numbers by the manufacturer, a model number assigned in the table below shall be displayed on the front panel in bold type, at least ¼ inch high.

<u>MODEL #</u>	<u>TITLE</u>
200	SWITCHPACK
204	FLASHER UNIT
2018	MONITOR UNIT
222	LOOP SENSOR UNIT
224	LOOP SENSOR 4 CHANNEL
222LRT	LIGHT RAIL SENSOR UNIT
242	DC ISOLATOR
252	AC ISOLATOR
255	AC ISOLATOR Railroad ONLY

1.4.5 CONNECTORS

All PCB connectors mounted on a motherboard shall be mechanically secured to the chassis or frame of the unit.

All screw type fasteners shall utilize locking devices or locking compounds except for finger screws which shall be captive.

1.4.6 TOLERANCES

The following tolerances shall apply, except as specifically shown on the plans or in these specifications:

Sheet Metal	± 0.0525 inch
PCB	+0, -0.010 inch
Edge Guides	± 0.015 inch

1.5 ENGINEERING SECTION

1.5.1 HUMAN ENGINEERING

To the highest practicable degree, the unit shall be engineered for simplicity and ease of operation and maintenance. This shall include the following:

All fuses shall be easily accessible and shall be replaceable without the use of any tools.

PCB assemblies shall slide smoothly in their guides while being inserted into or removed from the frame and shall fit snugly into the plug-in PCB connectors.

PCB assemblies shall require a force no less than 5 pounds or greater than 50 pounds for insertion or removal.

1.5.2 DESIGN ENGINEERING

The following practices shall be employed in the design of solid state equipment circuitry:

The design shall be inherently temperature compensated to prevent abnormal operation. The circuit design shall include such compensation as is necessary to overcome adverse effects due to temperature in the specified environmental range.

For reasons of personal safety, personnel shall be protected from all dangerous voltages.

Generated Noise: No item, component or subassembly shall emit a noise level exceeding the peak level of 55 DBa when measured at a distance of 1 meter away from its surface.

1.6 PRINTED CIRCUIT BOARDS SECTION

1.6.1 DEFINITIONS

Definitions for the purpose of this section on PCB assemblies shall be taken from MIL-STD-429 and any current addendum.

1.6.2 DESIGN

All single-board modules shall be vertically mounted, including any combination of CPU, I/O, voltage regulation, display, or Modem.

All contacts on PCBs shall be plated with a minimum thickness of 0.000030 inch gold over a minimum thickness of 0.000075 inch nickel.

PCB design shall be such that components may be removed and replaced without damage to boards, traces, or tracks.

1.6.3 FABRICATION

Fabrication of PCBs shall be in compliance with Military Specification: MIL-P-13949, except as follows:

Only NEMA FR-4 glass cloth base epoxy resin copper clad laminates 0.0626 inch minimum thickness shall be used. Intercomponent wiring shall be by laminated copper clad track having a minimum weight of 2 ounces per square foot with adequate cross section for current to be carried. All copper track shall be plated or soldered to provide complete coverage of all exposed copper track. Jumper wires will not be permitted, except from plated-through padded holes to an external component or for designed function selection with the jumper insulated and as short as possible.

Section 3.3.3 of Military Specification: MIL-P-13949E shall read "Pits and Dents. Grade of Pits and Dents shall be of Grade B quality (3.3.3.2) or better."

Section 3.3 of Military Specification: MIL-P-13949 shall be omitted.

Section 3.4 of Military Specification: MIL-P-13949 shall read "Warp or Twist. Class of permissible warp or twist shall be Class A (Table II) or better."

Sections 4.2 through 6.6 of Military Specification: MIL-P-13949 (inclusive) shall be omitted except as referenced in previous sections of this specification.

The fabrication of PCBs and the mounting of parts and assemblies thereon shall conform to Military Specification: MIL-STD-275E, except as follows:

All semiconductor devices required to dissipate more than 250 mw or any case temperature that is 10 degrees Celsius above ambient shall be mounted with spacers or transipads to prevent direct contact with the PCB.

When completed, all residual flux shall be removed from the PCB.

The resistance between any two (2) isolated, independent conductor paths shall be at least 100 megohms when a 500 VDC potential is applied.

All PCB assemblies shall be coated with a moisture resistant Coating with Ultra-violet tracer.

Where less than ¼ inch lateral separation is provided between the PCB (or the components of a PCB) and any metal surface, a 0.03125 (-0 to +0.0156) inch thick Mylar (polyester) plastic cover shall be provided on the metal to protect the PCB.

1.6.4 MOUNTING

Each PCB connector edge shall be chamfered at 30 degrees from board side planes. The key slots shall also be chamfered so that the connector keys are not extracted upon removal of board or jammed upon insertion. The key slots shall be 0.045 ($\pm$ 0.005) inch for 0.10 inch spacing and 0.055 ($\pm$ 0.005) inch for 0.156 inch spacing.

1.6.5 SOLDERING

Hand soldering shall comply with Military Specification: MIL-P-55110.

Automatic flow soldering shall conform to the ANSI/IPC A-610 specification and the following conditions:

- ? Constant speed conveyor system.
- ? Conveyor speed shall be the optimum to minimize solder peaks or points which form at component terminals.
- ? Temperature shall be controlled to within ± 8 degrees Celsius of the optimum temperature.
- ? The soldering process shall result in the complete coverage of all copper runs, joints, and terminals with solder except that which is covered by an electroplating process.
- ? Wherever clinching is not used, a method of holding the components in the proper position for the flow process shall be provided.
- ? If exposure to the temperature bath is of such a time-temperature duration, as to come within 80% of any component's maximum specified time-temperature exposure, that component shall be hand soldered to the PCB after the flow process has been completed.

1.7 QUALITY CONTROL SECTION

The following measures shall be taken by the Contractor during the production process to insure a high standard of quality.

1.7.1 COMPONENTS

All components shall be lot sampled to assure a consistent high conformance standard to the design specification of the unit.

1.7.2 SUBASSEMBLY or MODULE

Visual inspections shall be performed on all modules, printed circuits, and subassemblies to determine any physical defects such as cracking, scaling, poor fastening, incorrect component values, etc.

1.7.3 ELECTRICAL TESTING

Complete electrical testing shall be performed on each module, printed circuit or subassembly to determine its compliance with the manufacturer's design function.

1.7.4 INSPECTION

Housing, chassis, and connection terminals shall be inspected for mechanical sturdiness, and harnessing to sockets shall be electrically tested for proper wiring sequence.

1.7.5 ASSEMBLED UNITS

The completely assembled unit shall be subjected to a full environmental cycling and timing test.

The unit shall be visually and physically inspected to assure proper placement, mounting, and compatibility of subassemblies.

1.7.6 SAMPLE UNIT DEFECTS

Any defects or deficiencies found by the inspection system involving mechanical structure or wiring in the bid sample unit shall be corrected through the manufacturing process or special repair process before any contract shipment can be scheduled.

Defects in PCB assemblies or electronic circuit components shall be specially treated as follows:

- ? A PCB may be flow soldered a second time if copper runs and joints are not satisfactorily coated on the first run.
- ? Under no circumstances shall a PCB be flow soldered more than twice.
- ? Hand soldering may be used for printed circuit repair.

1.8 ELECTRICAL, ENVIRONMENTAL, and TESTING REQUIREMENTS SECTION

1.8.1 GENERAL

The General procedures and equipment used in the evaluation of the controller unit, cabinet, and auxiliary equipment are a minimum guide and should not limit the testing and inspection to insure compliance of the equipment with these specifications.

These test procedures shall be followed by the Contractor who shall certify that he has conducted inspection and testing in accordance with these specifications.

Inspection

A visual and physical inspection shall include mechanical, dimensional, and assembly conformance of all parts of these specifications which can be checked visually or manually with simple measuring devices.

1.8.2 ELECTRICAL

All components shall operate properly within the following limits:

Applied Line Voltage- 90 to 135 VAC

Frequency: 60 (± 3.0) Hz

All circuits unless otherwise noted, shall commence operation at or below 90 VAC as the applied voltage is raised from 50 VAC to 90 VAC at a rate of 2 (± 0.5) volts per second.

All equipment, when housed within its associated cabinet, shall be unaffected by transient voltages normally experienced on commercial power lines. Equipment purchased separately from cabinet will be tested for compliance with the equipment housed within an LADOT accepted Model 332 cabinet and the cabinet connected to the commercial power lines.

The power line surge protection (including the cabinet protection and that internal to the equipment) shall enable the equipment being tested to withstand (nondestructive) and operate normally following the discharge of a 25 microfarad capacitor, charged to plus and minus 2,000 volts, applied directly across the AC line (applied at the Cabinet Service Terminal Block) at a rate of once every 10 seconds for a maximum of 50 occurrences per test. The unit under test will be operated at 20 degrees (± 5 degrees) Celsius and at 120 (± 12) VAC.

All equipment shall be unaffected by transient voltages normally experienced on commercial power lines. Equipment purchased separately from the cabinet will be tested for compliance as follows:

Power from commercial power lines applied at Cabinet Service Terminal Block.

Equipment properly housed and connected within an LADOT Accepted Cabinet Assembly.

The Cabinet Power Surge Protectors deactivated or removed.

The equipment shall withstand (nondestructive) and operate normally when one discharge pulse of plus or minus 300 volts is synchronously added to the AC power at the Cabinet Service Terminal Block and moved uniformly over the full wave across 360 degrees or stay at any point of Line Cycle once every second. Peak noise power shall be 5 kilowatts with a pulse rise time of 500 ns. The unit under test will be operated at 20 degrees (± 5 degrees) Celsius and at 120 (± 12) VAC.

Within the circuit of any device, module or PCB, electrical isolation shall be provided between DC common, equipment ground and the AC grounded conductor. The DC common and equipment ground shall be electrically isolated from the AC grounded conductor and from each other by 500 megohms, minimum, when tested at the input terminals with 500 VDC.

All equipment shall be capable of normal operation following opening and closing of contacts in series with the applied voltage to the cabinet at a rate of 30 openings and closings per minute for a period of 2 minutes in duration.

All equipment shall resume normal operation following a period of at least 5 hours at -37 degrees Celsius, when 90 VAC is applied to the input terminals of the cabinet.

1.8.3 ENVIRONMENTAL

All components shall properly operate within the following limits:

Ambient Temperature

-37 degrees to +74 degrees Celsius.

Humidity

5 to 95 percent, 1.1 degrees C to 46.0 degrees C.

The relative humidity and ambient temperature values in the following table shall not be exceeded.

AMBIENT TEMPERATURE
VERSUS
RELATIVE HUMIDITY
AT BAROMETRIC PRESSURES
(29.92 In. Hg.)

Ambient Temperature Dry Bulb (in degree C)	Relative Humidity (in percent)	Ambient Temperature Wet Bulb (in degree C)
1.1 to 46.0	95	42.7
48.8	70	42.7
54.4	50	42.7
60.0	38	42.7
65.4	28	42.7
71.2	21	42.7
74	18	42.7

Shock Test

Per Military Specification: MIL-STD-810D Method 516.1

Vibration

Per Military Specification: MIL-STD-810D Method 514.1, equipment class G (Common Carrier)

Cabinets shall comply with the requirements of UL Bulletin of Research No. 23, "Rain Tests of Electrical Equipment".

All equipment shall continue normal operation when subjected to the following:

Low Temperature Test

With the item functioning at a line voltage of 90 VAC in its intended operation, the ambient temperature shall be lowered from 20 degrees Celsius to 0 degrees Celsius at a rate of not more than 18 degrees Celsius per hour. The item shall be cycled at 0 degrees Celsius for a minimum of 5 hours and then returned to 20 degrees Celsius at the same rate. The test shall be repeated with the line voltage at 135 VAC.

High Temperature Test

With the item functioning at a line voltage of 90 VAC in its intended operation, the ambient temperature shall be raised from 20 degrees Celsius to 55 degrees Celsius at a rate of not more than 18 degrees Celsius per hour. The item shall be cycled at 55 degrees Celsius for a minimum of 5 hours and then returned to 20 degrees Celsius at the same rate. The test shall be repeated with the line voltage at 135 VAC.

1.8.4 CABINET VERIFICATION TEST PROGRAM

The Vendor shall furnish Cabinet Verification Test Program software and associated hardware with each contract. The program shall execute from the front panel in a ITS Siemens 2070 controller unit designed per LADOT Specification 54-055-02. The program in conjunction with any necessary test jigs shall verify the integrity of cabinet wiring related to the output file, input file, the police panel, and flash switches. It shall be possible by front panel selection to test each cabinet input in a given sequence. The controller will acknowledge each correct input test with an audible tone and display the C-1 pin assignment before advancing to the next test interval in the sequence.

It shall be possible by front panel selection to generate and observe controller unit outputs in sequence by phase-color, port-bit allocation, C-1 pin assignment or conflict monitor channel for either a 332 or 336 style cabinet assembly. The output feature shall be selectable for manual control of an individual output or for automatic advance, activating one output at a time in sequence.

10 copies of Cabinet Verification Program operational manuals shall be supplied per contract. The manual shall give a full and complete description of the specific tests and procedures.

Contractor's Testing Certification

- ? The Contractor shall supply, with each shipment, a full test report of the quality control and final test conducted on each item. The test report shall indicate the name of the tester and shall be signed by a responsible manager.
- ? The Contractor shall submit his quality control procedure and format of test reports to the Engineer for approval within 15 days following the approval of the contract.
- ? The quality control procedure shall include the following:
 - Acceptance testing of all supplied components.
 - Physical and functional testing of all modules.
 - A minimum 100-hour burn-in of all modules.
 - Physical and functional testing of all items.
 - A minimum 24 hour operation of all controller units and cabinets.

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SPECIFICATIONS FOR TRAFFIC SIGNAL CONTROLLER UNIT

(Optional)

Refer to LADOT Model 2070 Controller Specification #54-055-02 or latest revision when required by the contract.

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SPECIFICATIONS FOR MODEL 200 SWITCHPACK & MODEL 204 FLASHER UNIT

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3.0 SWITCHPACK and FLASHER

3.1 GENERAL REQUIREMENTS MODEL 200 SWITCHPACK

- ? The Switchpack Unit shall be a plug-in device of solid state design. Each switchpack shall be a modular assembly containing three independent solid state switches to be used for opening and closing connections between the applied AC power and traffic signal indications.
- ? The module chassis shall provide rigid unit support for connector mounting, PCB support, module alignment and insertion/removal. It shall provide Triac heat sinking, and shall be made of metal suitable to meet support and environmental requirements. Where electrical isolation protection is the only requirement, plastic insulation material may be used in lieu of metal.
- ? All indicator lights shall be water clear, Ultra Bright, T-1 3/4 package LEDs, General Instruments MK9160 (Red), or equivalent.
- ? Each switch shall be designed for a minimum of 300 million operations while switching a tungsten filament load of 1,000 W at 70 degrees C.
- ? The front panel of the module shall be labeled with the manufacturer's name and model 200.

3.2 ELECTRICAL REQUIREMENTS MODEL 200 SWITCHPACK

- ? A LOW input state of 0 to +6 VDC (from the controller unit) shall cause the switch to be ON. A HIGH input state of +16 to +30 VDC shall cause the switch to be OFF. The outputs must respond to input change within 8.33 ms.
- ? The LOW input load shall be less than -15 mA. The HIGH input load shall be less than +1.0 mA.
- ? The input of each switch shall have reverse polarity protection up to 30 VDC.
- ? Each switch shall have the capability of switching any current from 0.05 to 10 A (AC) into a tungsten lamp load or 10 A at a power factor of 0.85, over a voltage range of 85 to 135 volts at 60 Hz and at 70 degrees C.
- ? Each switch shall have a one (1) cycle surge rating of 175 A rms and a 1 second surge rating of 40 A rms.
- ? Each switch shall turn ON within ± 5 degrees of the zero voltage crossing of the AC sinusoidal line, and shall turn OFF within ± 5 degrees of the zero current crossing of the AC sinusoidal line. After power restoration, the zero voltage turn ON must be within ± 10 degrees of the zero voltage crossing only during the first half cycle of line voltage in response to a LOW input.

- ? Each switch shall have an OFF state dv/dt rating of 100 volts per microsecond or greater.
- ? Each switch shall have an isolation greater than 2,000 VDC and DC resistance of 10 megohms between its input and output.
- ? Each switch shall have an open resistance greater than 15 kohms between AC+ and its output. The leakage current of each switch shall be less than 10 mA with 135 VAC AC line and 1800 W load.
- ? Each switch shall have an isolation greater than a DC resistance of 50 megohms between its output and chassis ground.
- ? Each switch shall be capable of withstanding a peak inverse voltage of 500 volts at 70 degrees C with less than 20 mA leakage.
- ? Each switch shall be isolated so that line transients or switch failure will not adversely affect the controller unit.
- ? The maximum 24 VDC supply current shall be 60 mA at +30 VDC.

3.3 MECHANICAL REQUIREMENTS MODEL 200 SWITCHPACK

- ? The front panel of the switchpack shall be provided with three LED indicators to indicate the state of the INPUT to the Switchpack. Indicators shall be mounted and labeled as follows: "Red" at top, "Yellow" in middle, and "Green" at bottom when switch is installed. Indicators shall be vertically centered on the switchpack front panel.
- ? Switchpack control circuitry and switches shall be readily accessible by the use of a screwdriver or common wrench. Only one type of screw head, slotted or phillips, shall be used throughout. It shall not be possible to bow any surface of the switchpack during assembly with a screwdriver or common wrench by more than 0.050 inch.
- ? Live voltage shall not be exposed while inserting or removing the switch. A metal handle or gripping device shall be attached to the front of each switchpack to eliminate the need to insert hands or fingers into the Cabinet Output File.

- ? A metal enclosure shall be used to provide electrical parts suitable protection from dust and corrosion.
- ? The length dimension of the switchpack from the plug connector surface to the front panel of the switchpack (location of indicators) shall be 7.375 ± 0.125 inches. The switchpack shall be no wider than 1.75 inches and no higher than 4.20 inches.
- ? The lower surface of the switchpack shall be no more than 2.10 inches below the centerline of the connector configuration and no part will extend more than 0.90 inch to the left and 1.10 inches to the right of the centerline of the connector pin configuration.
- ? Edges shall be provided on the unit to mate with edge guides.
- ? All electrical connections into and out of the Switchpack shall be through a multi-terminal connector plug. The connector contact tails shall be solder hook or eye styles only, Beau P-5412-LAB or equivalent. Connectors soldered directly to the printed circuit board and quick connector connection styles are not allowed. The connector shall be rigidly fixed to the rear of the unit.
- ? Wires soldered to the printed circuit board shall be stranded type.
- ? Solid state switches may utilize encapsulated components.
- ? Components on printed circuit board must be securely mounted to withstand damage by shock or vibration.
- ? Machine screws shall be used to mount components to the heat sink.

3.4 GENERAL REQUIREMENTS MODEL 204

This specification establishes minimum standards for Flasher Units designed for use in Model 332 and 336 Traffic Signal Controller Cabinets supplied to the LADOT. General specifications for documentation, connectors, components, mechanical, engineering, printed circuit boards, quality control, electrical, environmental and testing shall be referenced to Chapter 1 of the specification.

3.5 FUNCTIONAL REQUIREMENTS MODEL 204

- ? The Flasher Unit shall be a modular plug-in device containing one flasher control circuit and two solid state switches. Its function shall be to alternately open and close connections between the applied power and external traffic signal load.
- ? The two alternating flash circuits shall be synchronized so as to never be on or off at the same time.
- ? The module shall generate its own internal DC power from the AC line for logic and control.
- ? The Flasher Unit shall commence flashing operation when AC power is applied to the AC+ terminal.
- ? The Flasher Unit shall provide 50 to 60 flashes per minute with a 50 percent duty cycle. The flash rate shall be derived from the 60 Hz line.

3.6 ELECTRICAL REQUIREMENTS MODEL 204

- ? Each output switch shall be capable of switching any current from 0.03 to 10 A of tungsten lamp load at 120 VAC and 60 Hz, or 10 A at a power factor of 0.85, at 70 degrees C.
- ? The output switches shall have a one cycle surge rating of 175 A RMS, of 247.5 A peak and a 1 second surge rating of 40 A RMS. Each output switch shall be capable of withstanding a peak inverse voltage of 500 volts.
- ? Each output switch shall turn on within ± 5 degrees of the zero voltage crossing of the AC sinusoidal line, and shall turn off within ± 5 degrees of the zero current crossing of the alternating current sinusoidal line. Upon application of power, the zero voltage turn-on must be within ± 10 degrees of the zero voltage crossing only during the first half cycle of the incoming line.
- ? Each switch shall have an OFF state dv/dt rating of 200 V per microsecond or greater.
- ? The output switches shall have a mean time between failure of 300 million operations or greater when switching a tungsten filament load of 1,000 W per switch.

- ? A surge arrester shall be provided between AC+ and Flasher Outputs. The surge arrester shall be capable of reducing the effects of a transient voltage applied to the field signal circuits, and shall have the following ratings:
 - ? Recurrent peak voltage: 212 V
 - ? Energy rating, maximum: 50 joules
 - ? Power dissipation, average: 0.85 W
 - ? Peak current for pulses less than 6 microseconds: 2,000 A
 - ? Standby current: less than 1 mA
- ? Each circuit shall be designed to operate in an open circuit (without load) condition for a minimum of 10 years.

3.7 MECHANICAL REQUIREMENTS MODEL 204

- ? Indicators shall be mounted on the Flasher Unit to indicate when the output from each solid state switch is on or off, with or without a load.
- ? All indicator lights shall be water clear, Ultra Bright, T-1 3/4 package LEDs, General Instruments MK9160 (Red), or equivalent.
- ? The dimensions of the Flasher Unit shall be the same as shown on the attached drawings for the L.A. Model 200 Switchpack. The Flash Unit connector shall be centered in place of the Model 200 Switchpack connector with same orientation of pin 12.
- ? The Flasher Unit shall be constructed so that its lower surface will be $2.10 \pm 0.050/-0.0$ inches below the centerline and so that no part will extend more than 0.850 inch to the left or more than 1.05 inches to the right of the centerline of the connector configuration.
- ? Flasher unit control circuitry and switches shall be readily accessible by the use of a screwdriver or common wrench. Only one type of screw head, slotted or phillips, shall be used throughout. It shall not be possible to bow any surface of the flasher unit during assembly with a screwdriver or common wrench by more than 0.050 inch.
- ? Live voltage shall not be exposed while inserting or removing the flasher. A metal handle or gripping device shall be attached to the front of each flasher unit to eliminate the need to insert hands or fingers into the Power Distribution Assembly or flasher slot.

- ? A metal enclosure shall be used to provide electrical parts suitable protection from dust and corrosion.
- ? Edges shall be provided on the Flasher Unit to mate with edge guides.
- ? All electrical connections into and out of the flasher unit shall be through a multi-terminal connector plug. The connector contact tails shall be solder hook or eye styles only, Beau P-5406-LAB or equivalent. Connectors soldered directly to the printed circuit board and quick connector connection styles are not allowed. The connector shall be rigidly fixed to the rear of the unit.
- ? The Flasher Unit shall mate with a Beau S-5406 or equivalent connector as shown on the Plans.
- ? Wires soldered to the printed circuit board shall be stranded type.

Connector pinouts

Pins	Signal Name
7	Output #1
8	Output #2
9	Chassis Gnd
10	Neutral
11	AC +
12	Spare

- ? Solid state switches may utilize encapsulated components.
- ? Components on printed circuit board must be securely mounted to withstand damage by shock or vibration.
- ? Machine screws shall be used to mount components to the heat sink.

SPECIFICATION FOR MODEL 2018 CONFLICT MONITOR

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4 CONFLICT MONITOR

4.1 GENERAL REQUIREMENTS

4.1.1 FINAL APPROVAL

A Conflict Monitor must be submitted by the winning bidder and approved by the City prior to acceptance.

4.1.2 MINIMUM STANDARDS

This specification establishes minimum standards for eighteen channel Conflict Monitors designed for use in Model 332, 336 and 337 Traffic Signal Controller Cabinets supplied to the LADOT. The specifications for connectors, components, mechanical workmanship, engineering and environmental testing shall be referenced to the latest LADOT SPECIFICATION. The dimensions are defined in the Plans.

All electrical/electronic components shall be mounted on the main PCB, conflict program card, front panel or display board on the front panel without the use of daughter boards or component stacking. No components shall be mounted on the diode card connector header. All plated through holes shall be filled with solder.

Manufacturer name, model number, main PCB revision, and unit serial number shall be labeled on the main PCB.

The front panel shall be easily removable for repair or replacement.

4.1.3 DESCRIPTION

The Model 2018 Conflict Monitor is integral to the cabinet assembly designed to monitor traffic signals at an intersection for conflicting indications due to malfunction of the controller unit, load switches, field wiring and loads or miswiring of the cabinet. The 2018 also monitors and provides error sensing of the cabinet 24VDC supply, the controller unit Watchdog signal, Red Enable and two Special Function circuits. If a fault condition is determined to have occurred, a relay output (Relay Failed State) places the cabinet and intersection into Flash operation.

The 2018 once entering into a Failed State will remain in the Failed State until a Reset command is issued. Reset can be issued only by the front panel Reset switch or by the External Test Reset line. The loss of AC line power subsequent to a Failed State will not reset the Fault and will retain the status of all fault and channel indicators for review upon restoration of AC line power.

All monitored field output voltages shall be measured using a true Root Mean Squared (RMS) technique. AC signals at 60 Hz shall be monitored at least 32 times per cycle and be insensitive to changes in frequency, phase, wave shape, and distortion. Dimming algorithms such as alternating cycle omission shall not compromise the monitor's ability to detect Fault conditions.

4.2 FUNCTIONAL REQUIREMENTS

4.2.1 MONITORING

FAILED STATE Condition

When the model 2018 unit is triggered by the detection of a Fault condition the relay becomes de-energized, the Stop Time output to the controller is enabled, and the front panel indicators describe the applicable Fault condition. This action places the cabinet into Flash operation and remains in this mode until a Reset command is applied.

? 24VDC FAIL

When the cabinet +24 volts DC input **is not** within the specified thresholds:

LOW THRESHOLD $< 20 \pm 2 \text{ VDC}$ for longer than $350 \text{ ms} \pm 150 \text{ ms}$
 HIGH THRESHOLD $> 29 \pm 1 \text{ VDC}$ for longer than $350 \text{ ms} \pm 150 \text{ ms}$

? WDT ERROR

When the watchdog signal has ceased or failed to meet the prescribed criteria. The input voltage must transition between:

$< 4.0 \text{ VDC}$ and $> 12 \text{ VDC}$, with at least 2 VDC hysteresis, at least every $1000 \pm 100 \text{ ms}$

? CONFLICT

When the green or yellow inputs to two or more channels are ON simultaneously using the low threshold criteria and not programmed as permissive on the Conflict Program Card.

ON $> 20 \pm 5 \text{ V rms}$ for $> 350 \pm 150 \text{ ms}$

? **MULTIPLE OUTPUTS**

When more than one input to a channel (including red if Red Enable is active) are ON simultaneously using the low threshold criteria:

ON $> 20 \pm 5$ V rms for $> 350 \pm 150$ ms

and the channel is not programmed to inhibit Multiple Outputs fault, see 4.2.3.3.

? **YELLOW ERROR**

When the Yellow interval, subsequent to the end of Green for the same channel, is less than 2.7 ± 0.1 seconds as measured at the Yellow channel input to the monitor. This fault shall not occur when the channel is programmed for Yellow Inhibit, or when Red Enable is inactive. The same minimum yellow time will apply to all active channels. During power outages shorter than Line Drop Out and when Yellow is ON before or after the power outage, Yellow shall be sensed as ON for purposes of timing.

? **RED FAIL**

When the green, yellow and red inputs on a channel are simultaneously OFF using the high threshold criteria, the Red Enable input is active, and the channel is programmed for Red Fail monitoring via the DIP switch:

OFF $< 60 \pm 10$ V rms for $> 1350 \pm 150$ ms

A RED FAIL will also occur if the red monitor ribbon cable is removed and the wire jumper to defeat this function has not been removed. See 4.2.3.1.

? **CONFLICT PROGRAM CARD AJAR/ CONFIGURATION FAULT**

The Conflict Program Card has been removed or is not properly seated in the connector.

A change in the configuration of the monitor from the stored monitor configuration, see section 4.3.

A sixteen channel card mistakenly installed in place of a eighteen channel card.

? **MONITOR FAILURE**

A fault or operational error is detected internal to the monitor itself.

4.2.2 BASIC OPERATION

4.2.2.1 MONITOR POWER

The Monitor shall be fully operational from **85 to 135 VAC at 60 ± 6 Hz**. If the line drops ***below 85 ± 2 VAC for $> 400 \pm 100$ ms*** the Monitor shall suspend Fault monitoring, de-energize the Failed State Relay and extinguish the AC POWER indicator light.

The monitor shall not use current from the 24VDC input being sensed to power any of its internal circuitry.

4.2.2.2 POWER UP

The model 2018 Conflict Monitor shall be compatible with the model 170 controller and the model 2070 controller which requires several seconds to power-up. When line voltage is established or when there is a line voltage recovery ***$> 103 \pm 2$ VAC for $> 400 \pm 50$ ms*** the 2018 will power up in the FAULT RELAY RECOVERY mode:

When line voltage is established, FAULT RELAY RECOVERY shall be initiated. If the AC line voltage drops ***$< 103 \pm 2$ VAC for $> 400 \pm 50$ ms*** at any time, the monitor returns to a FAULT RELAY mode (see Line Drop Out Section 4.2.2.3) Otherwise, for an interval of ***4.0 ± 0.5 seconds***, the following action will take place:

- ? The Failed State Relay remains de-energized.
- ? All fault monitoring functions remain suspended.
- ? The AC POWER indicator light flashes at a ***4 Hz $\pm 20\%$ rate with 50% duty cycle***.
At the end of this time interval the Monitor begins counting watchdog signal transitions from the controller.

The resumption of normal fault monitoring shall follow Fault Relay Recovery when:

The monitor has counted 5 transitions between the True and False state from the watchdog signal

OR

10 ± 0.5 seconds has elapsed from the time that power is established. If the watchdog signal does not become active within this time, the monitor shall enter a WDT Error Fault Condition (Stop Time output to the controller shall become active).

4.2.2.3 LINE DROP OUT

The monitor will determine that a LINE DROP OUT has occurred and enters the FAULT RELAY mode when:

The AC Line Voltage is $< 98 \pm 2$ VAC for $> 400 \pm 50$ ms

In this event the Monitor shall suspend all fault monitoring functions and de-energize the Failed State Relay. The AC POWER indicator on the front panel will flash at a rate of $2 \text{ Hz} \pm 20\%$ *with 50% duty cycle* to indicate LINE DROP OUT status. The Monitor remains in the FAULT RELAY mode until a LINE RECOVERY has occurred.

4.2.2.4 LINE RECOVERY

The monitor will determine that a LINE RECOVERY has occurred when the AC Line Voltage is restored to:

$> 103 \pm 2$ VAC for $> 400 \pm 50$ ms.

Normal monitoring will then resume following Fault Relay Recovery as described previously.

4.2.3 FEATURES

4.2.3.1 RED MONITORING

The monitor Red Fail and Yellow Error features are activated when the Red Enable input on Pin 20 of the Red Interface ribbon cable connector is active:

ACTIVE $> 60 \pm 10$ V rms for $> 400 \pm 150$ ms

The monitoring of Multiple Outputs faults shall not be affected by the Red Enable signal. A DIP switch shall be provided for each channel. In the ON position the Red Fail is enabled. Red Fail shall not occur when the Red Enable signal is inactive, the Special Function 1 input is active, or the channel DIP switch is in the OFF position. Multiple Outputs fault for G/R or Y/R shall not occur when the channel DIP switch is in the OFF position.

A connector, 3M - 3428-5302 or equivalent, with two 3518 polarizing keys, shall be mounted on the monitor front panel for the red signal inputs. The pin assignments for the Red Interface connector and terminal assembly are defined in section 4.10.

Unplugging the Red Interface Connector shall place the cabinet into Flash operation. The monitor shall determine that the Red Interface Connector is not in place by internal logic using the signals available on the cable: if the Red Enable input and all channel 1-16 red inputs are not active simultaneously, a Red Fail Fault shall occur.

A soldered jumper wire, when removed, will defeat this feature. Monitors shall have this soldered jumper in place.

4.2.3.2 YELLOW INHIBIT

Monitoring of selected yellow channel inputs shall be inhibited by installation of Yellow Inhibit jumpers on the conflict program card. Yellow Inhibit shall disable the monitoring of YELLOW ERROR and MULTIPLE OUTPUTS faults involving yellow, only on the channel(s) selected. Yellow Inhibit shall not disable Multiple Outputs fault (G/R) or Red Fail monitoring on the selected channel(s). See Section 4.8.

4.2.3.3 MULTIPLE OUTPUTS CONFIGURATION

Multiple Outputs fault involving yellow (G/Y and Y/R) shall be inhibited on selected channel(s) by installation of Yellow Inhibit jumper. Multiple Outputs fault involving red (G/R and Y/R) shall be inhibited on selected channel(s) by placing the Red Monitoring DIP switch in the OFF position.

4.2.3.4 SPECIAL FUNCTION INPUTS 1 AND 2

Special Function 1 (pin 8)

This AC input shall disable only the RED FAIL monitoring functions while it is active (e.g. during Railroad Preempt).

Special Function 2 (pin 6) is reserved for future use and shall be non-functional.

The time and voltage thresholds shall adhere to the high threshold criteria for an active input:

ACTIVE > 60 ± 10 V rms for > 400 ± 150 ms

4.2.3.5 MC COIL INPUT (PIN EE)

Section deleted.

4.2.3.6 MONITOR RESET

A Reset (front panel momentary pushbutton switch labeled "RESET") and an independent circuit External Test Reset line (logic low) shall be provided to reset the monitor to normal operation. A power failure shall not result in resetting the monitor if it is in the Latched Fault state.

Reset *< 4.0 ± 0.5 VDC for > 10 ms ± 10%*

The front panel Reset switch shall be positioned so that it can be depressed while gripping the front panel handle. The External Test Reset line shall be optically isolated from the internal circuitry.

The monitor, once entering a Latched Fault state, shall remain in that state until a Reset Command is issued. Reset is issued only by the Reset button or by the External Test Reset line. A reset issuance by either source (Unit Reset) shall be triggered by the leading edge (to prevent a constant reset from a switch failure or a constant external input).

4.3 MONITOR CONFIGURATION

All monitor program settings and permitted channels shall be accomplished by use of a Conflict Program Card, DIP switches, and solder jumpers. Programmable devices requiring the exclusive use of PDAs or computers for configuration are not allowed. DIP switches and solder jumpers must be clearly visible and indicate configuration settings on the monitor. They cannot be located beneath the Conflict Program Card.

The following settings shall always be enabled as part of the firmware and shall not be switch selectable. DIP switches used for these settings may populate the circuit board for the benefit of other agencies but cannot be functional for LADOT:

Yellow Time	< 2.7 ± 0.1 seconds	global
Watchdog	> 1.0 ± 0.1 second	always enabled
Red Fail	> 1350 ± 150 ms	

The Conflict Program Card permissive settings, yellow inhibit jumpers, red fail DIP switches and all other programmed switch parameters shall be stored in non-volatile memory only by depressing and holding the front panel Reset button for five seconds. ***The external reset line shall not have this capability.*** During normal operation, the monitor program will test the circuit board configuration and compare it to the stored configuration at power up, reset, and periodically, at least once every 2 seconds. A change in configuration due to manual reconfiguration or hardware failure, shall cause a PC AJAR Fault and flash the PC AJAR indicator.

4.4 FAULT DIAGNOSTICS

The monitor shall have means of displaying, storing and reviewing at least two previous Faults in addition to an existing Fault. The discreet LEDs as outlined in section 4.6 shall provide as much comprehensive data as possible to describe a Fault condition. A DB9 connector located on the front faceplate shall be provided to access more detailed Fault information and shall include but not be limited to: the type of Fault, active channel indications at the time of the Fault, Line voltage, individual channel voltage, line frequency and cabinet temperature associated with each Fault shall be available through the front panel connector. A loss of Power shall not affect the retention of this data.

4.5 MONITOR INTEGRITY DIAGNOSTICS

The monitor design shall incorporate internal diagnostics that will provide integrity checks within the operation of the program. Hardware external to the microprocessor circuits shall be employed to constantly sense proper microprocessor operation. An integrity test shall be performed on power up, on Reset, and periodically at least once every 2 seconds. The routine should include testing memory and as much hardware as practical. A checksum of the firmware shall be stored in a section of memory for comparison in the integrity tests.

The unit shall execute a Monitor Fail Fault condition (MON FAIL) if an error is detected as a result of the integrity tests. The Monitor Fail condition shall only be reset by AC Power Up.

4.6 INDICATORS

The 2018 front panel shall incorporate LEDs to indicate the dynamic status of the monitor under normal conditions and to provide a comprehensive review of field inputs and monitor status under Fault conditions. All indicators and displays shall be clearly visible in direct sunlight and at night.

4.6.1 All LED indicators shall be water clear (not colored), not diffused lenses, Ultra-Bright, T-1 package LEDs, Ledtech LT0373-41 (Red), LT0323-41HE (Green), LT0333-41-UR (Yellow) or equivalent with a minimum luminous intensity of 100 mcd at 20 mA. Indicator lights shall be clearly visible in direct sunlight.

Discreet LEDs shall be provided on the front panel in the vertical order shown below.

AC Power

A green LED shall illuminate when the AC Line Voltage exceeds 103 ± 1 VAC, shall FLASH at a $2 \text{ Hz} \pm 20\%$ rate with 50% duty cycle during FAULT RELAY MODE, and shall FLASH at a $4 \text{ Hz} \pm 20\%$ rate with 50% duty cycle during FAULT RELAY RECOVERY.

VDC

Shall illuminate when the monitor has detected a 24 VDC failure.

WDT ERROR

Shall illuminate when the watchdog signal has ceased or failed to meet the prescribed timing criteria.

CONFLICT

Shall illuminate when a conflicting signal condition has been detected.

RED FAIL

Shall illuminate when the Monitor detects no active field outputs on a monitored channel. The failed channel(s) shall be displayed on all corresponding channel indicators.

Shall illuminate when the Monitor detects the Red Interface Connector is removed and the jumper to defeat this feature is intact. All channel indicators shall be dark in this case.

When Red Monitoring is disabled via the Red Enable line, the Red Fail indicator shall flash at $2 \text{ Hz} \pm 20\%$ rate with 15% duty cycle.

MULT IND

Shall illuminate when the Monitor detects simultaneous outputs on more than one of the field outputs that comprise a monitored channel (green, yellow, red). The failed channel(s) shall be displayed on the corresponding channel indicators(s).

YELLOW

Shall illuminate when the yellow clearance interval is not within tolerance.

PC AJAR

Shall illuminate continuously when the Conflict Program Card has been removed, or is not properly seated in its connector. This indicator shall remain illuminated until the monitor is manually Reset.

If the configuration settings inadvertently get changed, the indicator shall flash at $4 \text{ Hz} \pm 20\%$ rate with 15% duty cycle to indicate Configuration Change Fault.

If a sixteen channel Conflict Program Card is installed by mistake (pin 16 and pin "T" are electrically connected) the PC AJAR indicator shall illuminate continuously and all channel indicators 1 thru 16 shall flash on and off at $2 \text{ Hz} \pm 20\%$ rate with 25% duty cycle.

MON FAIL

Shall illuminate to indicate an internal Monitor Failure.

4.6.2 CHANNEL INDICATORS

There shall be one each red, yellow and green LED mounted horizontally from left to right for each of the eighteen channels.

In normal operation the LEDs shall illuminate to display all active channels and colors. In a Fault condition, the indicators shall display the colors that were active at the time of the Fault. In the case of Conflict, Red Fail, Multiple Outputs or Yellow Error, the indicators shall alternately toggle between displaying the active colors at the time of the Fault and displaying the failed channel(s) with other channels dark. The colors that were active at the time of the fault shall be displayed for 6 seconds. The failed channels will be displayed for 2 seconds with red, yellow and green LEDs pulsing simultaneously at a 4 Hz rate.

4.7 ELECTRICAL

4.7.1 FAILED STATE OUTPUT CIRCUITS

An electro-mechanical relay shall be used to provide the Failed State output circuit. The relay shall switch from energized to non-energized when in the Failed State. The output relay common (side #2, pin EE) shall be switched from output relay normally open (side #3, pin 27) to output relay normally closed (side #1, pin 28) in the Failed State. The function of this output circuit is to initiate flash operation within the cabinet and transfer field circuits from the switchpack outputs to the flash bus during a Failed State.

The Failed State Relay contacts shall be rated for a minimum of 3 A at 120 V ac and 100,000 operations. Contact opening/closing time shall be 30 ms or less.

A second output circuit (Stop Time output to the controller input) shall be provided separate from the Failed State Relay circuit. It shall be an optically coupled NPN Open Collector Transistor circuit rated for 30 VDC open collector and shall sink a minimum 150 mA load to less than 1.5 VDC in the active state. A blocking diode shall be provided on the transistor output to prevent it from sourcing current into the controller.

The Stop Time output shall only be active during a Failed State condition. The Stop Time output shall not be active during Fault Relay operation. When the monitor is reset, the Stop Time shall deactivate 250 ± 50 ms before the Failed State Relay de-energizes.

4.7.2 LINE ISOLATION

AC- (pin 21), Chassis Ground (pin 20) and controller Logic Common (pin Y) shall be isolated from one another. (See Cabinet Specification section 6.1.23.9)

4.7.3 INPUT IMPEDANCE/ISOLATION

Input impedance for all AC inputs (except power) shall be 150k ohms $\pm 20\%$. These resistors shall be capable of dissipating 1/4 watt each simultaneously.

The Watchdog signal, Stop Time, External Reset and the 24 VDC monitor input circuits shall be optically isolated from the monitor internal power supply. See Cabinet Specification section 5.5.3

4.7.4 PROGRAM CARD EDGE CONNECTOR

The Conflict Program Card Connector shall be PCB 28/56P Type. The connectors shall use the "bifurcated bellow" type contact or equivalent.

4.7.5 DOOR AJAR CIRCUIT

Pin 24 shall be connected to pin 25 on the monitor PCB at the edge connector and be capable of carrying 1.0 A.

4.7.6 FUSE HOLDER

Fuse holders on the front panel must be the low profile type 3AG. Fuses shall be 1 1/4" x 1/4" size.

4.7.7 SOCKETS

All revisable firmware shall be upgradable through the front panel serial port or reside in a socketed IC.

Firmware in DIP packaging shall be in sockets with concentric funnel entry for lead insertion, Augat 500 Series or equivalent.

4.7.8 BATTERIES

If a battery is used, battery failure shall not cause the monitor to fail to perform any required functions other than date and time data.

4.7.9 FIRMWARE LABELS

UV erasable memory, if used, shall be protected from UV light. All microprocessors/micro controllers and memory with manufacturer's firmware shall be labeled with their name and firmware revision.

4.7.10 BLANK PCB

One blank set of printed circuit boards shall be supplied for each revision as a troubleshooting aid with every Contract.

4.8 CONFLICT PROGRAM CARD

A plug-in PCB Conflict Program Card shall be provided in the monitor and inserted through the monitor front panel. The card shall contain 153 diodes (1N4148 or equivalent). Each diode shall match 1 through 18 channels of possible conflict. The Conflict Program Card shall be logically labeled and laid out in a horizontal/vertical pattern for easy identification of the diodes by channel (see section 4.8.7).

All the diodes in place shall cause all output channels to be monitored for conflict. When a diode is removed, its corresponding channel combination shall be defined as non-conflicting or permissive.

The Conflict Program Card shall be 6.0 +0.1 -0.0 inches in depth (edge connector to monitor faceplate) by 5.250 +0.0 -0.1 inches in height, and inter-mate with a 28/56 pin double sided connector having bifurcated contacts on 0.156 inch centers. The printed circuit board shall bisect its edge connector fingers at their centers to within ± 0.016 inches. The center of the edge connector shall be 2.638 inches from either edge of the board. The Conflict Program Card shall be provided with card ejectors for removal from the front panel. The bottom card ejector shall be labeled "18 CH" by etching, scribing or some other medium that cannot easily be removed.

Solder pads for 18 yellow inhibit jumpers shall be provided. Placement of a jumper between the channel yellow pin and the yellow inhibit common shall disable sensing yellow input and Yellow Error for that particular channel. Jumpers shall be installed for channels 13-16.

The monitor shall provide a mechanically sound support for the conflict program card and connector, with the use of continuous nylon card guides. When the conflict program card is resident in the monitor, the front edge shall be flush with the monitor front panel.

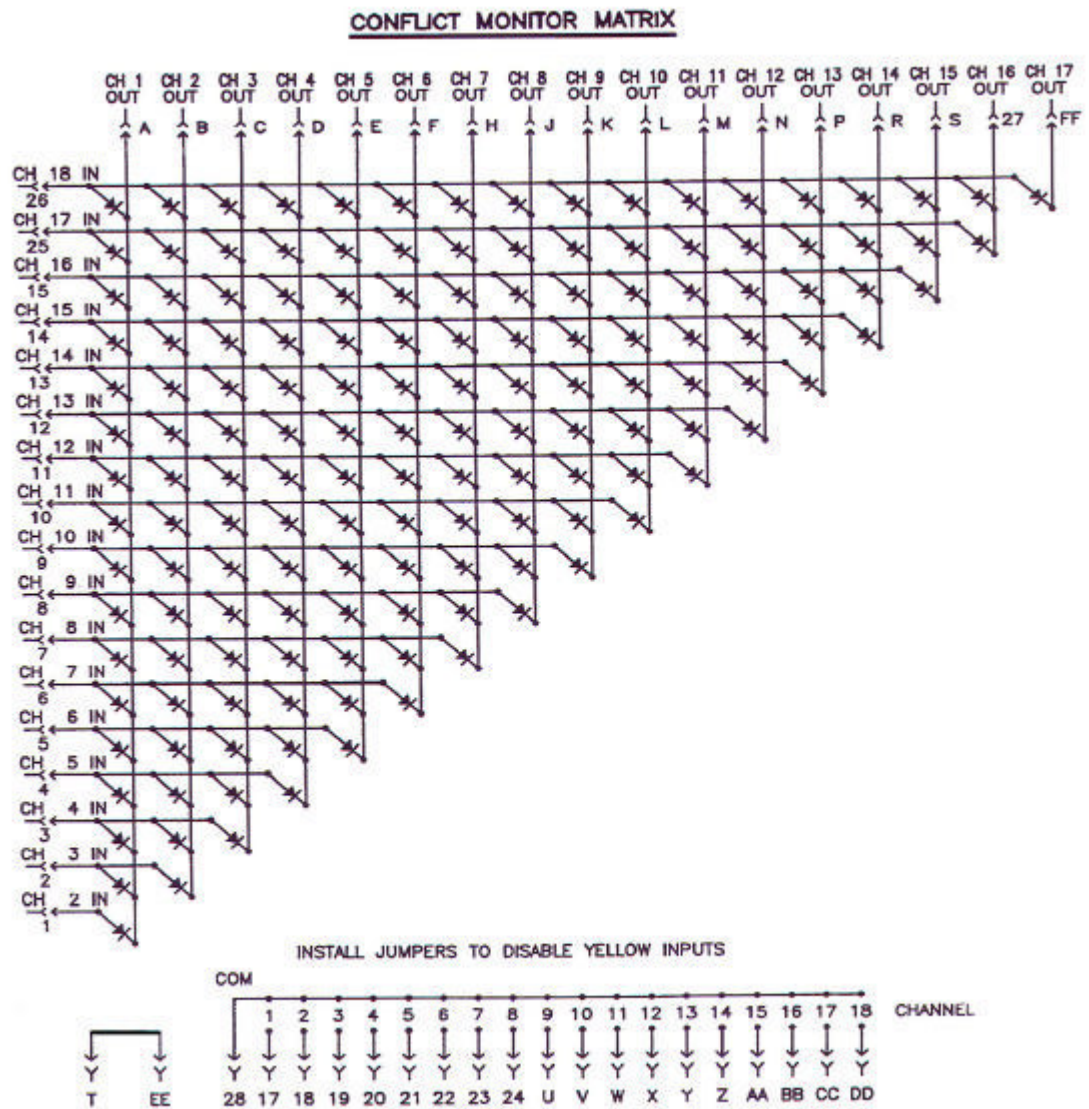
Pin 16 shall be floating, pins T and EE shall be connected together on the Conflict Program Card to distinguish 18-channel cards from 16-channel cards.

4.8.1 CONFLICT PROGRAM CARD PIN ASSIGNMENTS

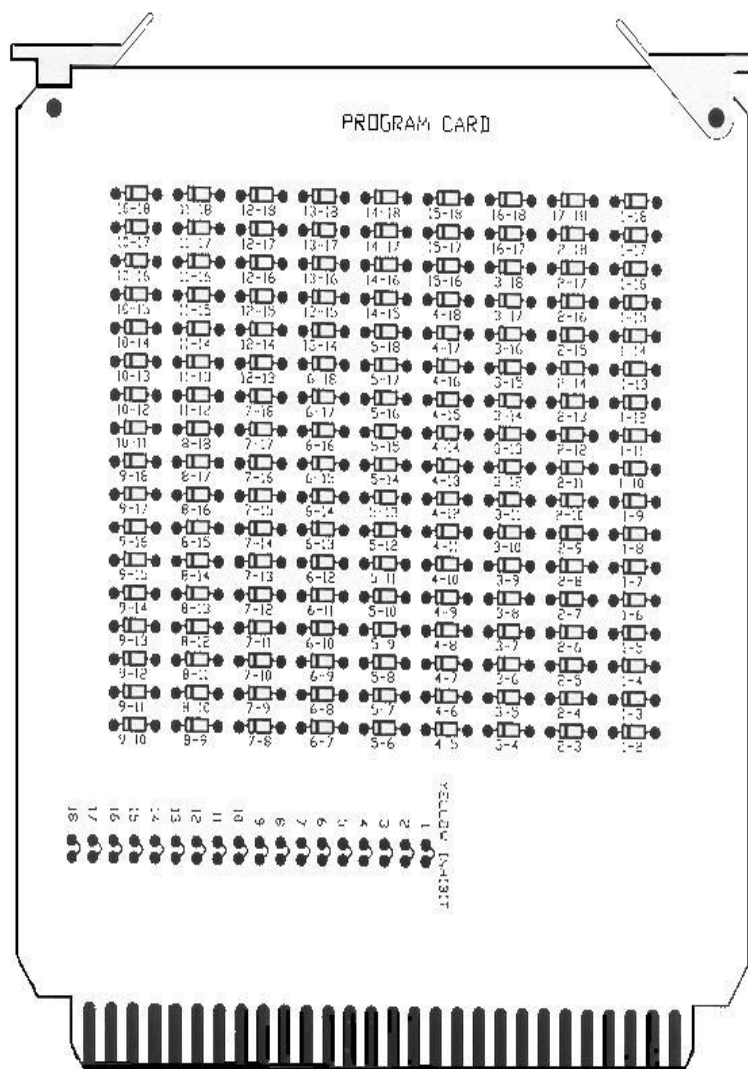
Pin	FUNCTION (Back Side)	Pin	FUNCTION (Component Side)
1	Channel 2 Green	A	Channel 1 Green
2	Channel 3 Green	B	Channel 2 Green
3	Channel 4 Green	C	Channel 3 Green
4	Channel 5 Green	D	Channel 4 Green
5	Channel 6 Green	E	Channel 5 Green
6	Channel 7 Green	F	Channel 6 Green
7	Channel 8 Green	H	Channel 7 Green
8	Channel 9 Green	J	Channel 8 Green
9	Channel 10 Green	K	Channel 9 Green
10	Channel 11 Green	L	Channel 10 Green
11	Channel 12 Green	M	Channel 11 Green
12	Channel 13 Green	N	Channel 12 Green
13	Channel 14 Green	P	Channel 13 Green
14	Channel 15 Green	R	Channel 14 Green
15	Channel 16 Green	S	Channel 15 Green
16	N/C	T	PC AJAR
17	Channel 1 Yellow	U	Channel 9 Yellow
18	Channel 2 Yellow	V	Channel 10 Yellow
19	Channel 3 Yellow	W	Channel 11 Yellow
20	Channel 4 Yellow	X	Channel 12 Yellow
21	Channel 5 Yellow	Y	Channel 13 Yellow
22	Channel 6 Yellow	Z	Channel 14 Yellow
23	Channel 7 Yellow	AA	Channel 15 Yellow
24	Channel 8 Yellow	BB	Channel 16 Yellow
--		--	
25	Channel 17 Green	CC	Channel 17 Yellow
26	Channel 18 Green	DD	Channel 18 Yellow
27	Channel 16 Green	EE	PC AJAR
28	Yellow Inhibit Common	FF	Channel 17 Green

-- The card shall be slotted for keying with the mating connector which shall have a molded key between pins 24/BB and 25/CC.

4.8.2 CONFLICT PROGRAM CARD DIODE MATRIX



4.8.3 CONFLICT PROGRAM CARD BOARD LAYOUT



4.9 MONITOR BOARD EDGE CONNECTOR

PIN	FUNCTION (Back Side)	PIN	FUNCTION (Component Side)
1	Channel 2 Green	A	Channel 2 Yellow
2	Channel 13 Green	B	Channel 6 Green
3	Channel 6 Yellow	C	Channel 15 Green
4	Channel 4 Green	D	Channel 4 Yellow
5	Channel 14 Green	E	Channel 8 Green
6	Channel 8 Yellow	F	Channel 16 Green
7	Channel 5 Green	H	Channel 5 Yellow
8	Channel 13 Yellow	J	Channel 1 Green
9	Channel 1 Yellow	K	Channel 15 Yellow
10	Channel 7 Green	L	Channel 7 Yellow
11	Channel 14 Yellow	M	Channel 3 Green
12	Channel 3 Yellow	N	Channel 16 Yellow
13	Channel 9 Green	P	Channel 17 Yellow
14	Channel 17 Green	R	Channel 10 Green
15	Channel 11 Yellow	S	Channel 11 Green
16	Channel 9 Yellow	T	Channel 18 Yellow
17	Channel 18 Green	U	Channel 10 Yellow
--		--	
18	Channel 12 Yellow	V	Channel 12 Green
19	Channel 17 Red	W	Channel 18 Red
20	Chassis Ground	X	Not Assigned
21	AC-	Y	DC Common
22	Watchdog Signal	Z	External Test Reset
23	24VDC	AA	24VDC
24	Tied to Pin 25	BB	Stop Time (Output)
25	Tied to Pin 24	CC	Not Assigned
26	Not Assigned	DD	Not Assigned
27	Relay Output, Sd #3, N.O.	EE	Relay Output, Sd #2, Common
28	Relay Output, Sd #1, N.C.	FF	AC+

-- Slotted for keying between Pins 17/U and 18/V

4.10 RED INTERFACE CONNECTOR

PIN ASSIGNMENTS

PIN	FUNCTION	PIN	FUNCTION
1	CHANNEL 15 RED	2	CHANNEL 16 RED
3	CHANNEL 14 RED	4	CHASSIS GND
5	CHANNEL 13 RED	6	SPECIAL FUNCTION 2
7	CHANNEL 12 RED	8	SPECIAL FUNCTION 1
9	CHANNEL 10 RED	10	CHANNEL 11 RED
11	CHANNEL 9 RED	12	CHANNEL 8 RED
13	CHANNEL 7 RED	14	CHANNEL 6 RED
15	CHANNEL 5 RED	16	CHANNEL 4 RED
17	CHANNEL 3 RED	18	CHANNEL 2 RED
19	CHANNEL 1 RED	20	RED ENABLE

Keying shall be between pins 3 and 5, and between 17 and 19. The odd numbered pins are on one side, and the even pins are on the other. The P20 connector and the Red Interface connector shall be keyed the same (to prevent the Red Interface cable from being inserted into the P20 180 degrees out of alignment).

**SPECIFICATIONS FOR
MODELS 222, 222LRT, & 224 LOOP SENSOR
242 DC, 252 AC, & 255 RxR ISOLATORS**

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5 PERIPHERALS

5.1 GENERAL REQUIREMENTS LOOP SENSORS

- ? The sensor shall respond to changes in the inductance of the loop/lead-in combination. When there is sufficient change in induction, in response to vehicles passing over or remaining within vehicle loops, the sensor shall produce an output signal. The method of detection shall be based upon a design which shall provide reliable operation. The sensor shall be of solid state design.
- ? The 222 sensor unit shall contain two channels and the 224 sensor unit shall contain four channels. The 224 front panel shall extend to cover the slot to the left. Each sensor channel shall operate independently from each other. The sensor shall provide isolation between "field" input circuits and the controller unit input circuits.
- ? A red DETECT indicator on the front panel, to indicate the active low output, shall be provided for each channel. All channels shall be visible simultaneously.
- ? A red or amber FAULT indicator on the front panel shall be provided for each channel. The indicator shall flash in a pattern to indicate present or historical: open loop, shorted loop, or >25% inductance change.
- ? All indicator lights shall be water clear, Ultra Bright, T-1 package LEDs, Ledtech LT0373-41 (red), Ledtech LT0333-41UR (yellow) or equivalent. Indicator lights shall be clearly visible in direct sunlight.
- ? A control (menu selection) or switch position shall be provided to disable the field and output of each channel on an individual basis.
- ? All user controls and switches shall be accessible from the front panel.
- ? The sensor shall be mounted on a PCB with an edge-connector. The lettered and numbered sides of the PCB connector shall be commonly assigned. It should be conformal coated for environmental protection.
- ? UV erasable memory, if used, shall be protected from UV light. All microprocessors/micro controllers and memory with manufacturer's firmware shall be labeled with their name and firmware revision.
- ? A handle shall be provided to facilitate insertion and removal from the input file.
- ? The sensors shall be capable of detecting all types of California licensed motor vehicles when connected to a loop/lead-in configuration as described below.

5.2 FUNCTIONAL REQUIREMENTS LOOP SENSORS

- ? Loop sensors shall comply with all performance requirements of this specification when connected to an inductance (loop plus lead-in) of 40 to 700 micro henries with a Q-parameter as low as 5 at the operating frequency. Three-turn loops in the following configurations shall be supported:
 - ? Single 6 by 6 foot loop with a 250 foot lead-in cable.
 - ? Single 6 by 6 foot loop with a 1000 foot lead-in cable.
 - ? Four 6 by 6 foot loops connected in series / parallel with a 250 foot lead-in cable.
 - ? Four 6 by 6 foot loops connected in series with a 1000 foot lead-in cable.
- ? The sensor shall be the scanning type. Only one channel shall be functioning at any time, while all others nonactive. This is to prevent crosstalk between channels on the same detector. Adequate dead time shall be inserted between sequential channel scans to prevent interference.
- ? Selection of frequency, sensitivity and mode shall be completely independent for each sensor channel.
- ? Tuning for environmental changes shall be done automatically. Environment changes and applied power drift shall not cause an actuation.
- ? A valid channel input shall cause an active low output of a minimum 100 ms duration.
- ? An open, shorted or otherwise malfunctioning loop shall cause the sensor channel to output a constant active low output to the controller for any modes.
- ? The sensor channel shall not detect vehicles, moving or stopped, at distances of 3 feet or more from the perimeter of any of the loop configurations listed above.
- ? Each channel shall have a minimum of 4 operating frequencies selectable by switches. The frequencies shall be spaced so that there shall be no interference/crosstalk between different frequencies within one sensor and multiple sensors.

5.2.1 MODE SELECTION

Each sensor channel shall have Pulse and Presence modes of operation, selectable by a switch.

? Pulse Mode

Each new vehicle in the zone of detection shall initiate one channel output pulse of 125 ± 25 milliseconds. If a vehicle remains in a portion of the zone of detection for a period greater than 2 seconds, the channel shall automatically "tune out" the presence of this vehicle. The channel shall then be capable of detecting another vehicle entering the same zone of detection within 3 seconds of the first output pulse.

? Presence Mode

For each new vehicle in the zone of detection the sensor shall initiate a constant active low output until the vehicle exits the loop. If the vehicle stays in the zone of detection over 3 minutes, see below. The sensor channel shall recover to normal sensitivity within 1 second after vehicle exits the zone of detection, regardless of the duration of the presence.

? With the sensitivity setting at HIGH level, a vehicle that is within the zone of detection shall be detected for a minimum of 3 minutes when the inductance change is 0.02 percent, and a minimum of 10 minutes when the inductance change is 0.06 percent.

? With the sensitivity setting at LOW level, a vehicle that is within the zone of detection shall be detected for a minimum of 4 minutes when the inductance change is greater than 1.00 percent.

5.2.2 SENSITIVITY SELECTION

? Each sensor channel shall be equipped with at least seven selectable sensitivity settings to accomplish function when connected to the three-turn loop configurations in 5.2

? When LOW sensitivity is selected, the sensor shall respond to a nominal loop inductance change between 0.15 percent and 0.4 percent This setting shall NOT respond to an inductance change of less than 0.1 percent.

? When HIGH sensitivity is selected, the sensor shall respond to a nominal loop inductance change of .02 percent.

? All sensitivity settings shall not differ more than ± 40 percent from the nominal value chosen.

5.2.3 RESPONSE TIMING

- ? Response time of the sensor channel, when LOW sensitivity is selected, shall be less than 20 milliseconds.
- ? Response time of the sensor channel, when HIGH sensitivity is selected, shall be less than 250 milliseconds.
- ? In the Presence Mode, when the inductance change is removed, the output shall open within 20 milliseconds

5.3 ELECTRICAL REQUIREMENTS LOOP SENSORS

- ? The loop sensor shall be fully operational within 30 seconds after the application of power.
- ? The sensor shall be capable of compensating or tracking for an environmental change up to 0.001 percent change in inductance per second.
- ? The sensor shall be capable of normal operation as the input inductance is changed $\pm 5.0\%$ from the quiescent tuning point regardless of internal circuit drift.
- ? The operation of the sensor shall not be affected by changes in the inductance or capacitance of the environment when the rate of change in temperature is less than 1 degree C per 3 minutes. The opening or closing of the controller cabinet door, with a temperature differential of up to 18 degrees C between the inside and outside air, shall not affect the proper operation of the sensor.
- ? Loop inputs to each channel shall be transformer isolated.
- ? The output of each channel shall be an optically coupled NPN Open Collector Transistor circuit rated for 30 VDC open collector and shall sink a minimum 50 mA load to less than 1.5 VDC in the active state. This output shall be compatible with the Model 170 and 2070 Controller inputs.
- ? The sensor shall respond to a logic common reset signal of 15 microseconds or longer and begin normal operation within 2 seconds.
- ? Each sensor channel shall be less than a 50 mA load to the +24 VDC supply and withstand a 700 mV RMS ripple on the +24 VDC supply.

5.3.1 TRANSIENT SUPPRESSION

Transient suppression shall be installed within the sensor unit.

- ? Each sensor shall be able to withstand the discharge of a 10 microfarad capacitor charged to +1,000 VDC and -1,000 VDC directly across the loop input terminals without loop present.
- ? Each sensor shall be able to withstand the discharge of a 10 microfarad capacitor charged to +2,000 VDC and -2,000 VDC directly across the loop input terminals and between either loop input terminal and earth ground. For purposes of this test, the sensor chassis shall be grounded and the loop input terminals shall have a 5.0 ohm resistive load attached.

5.3.2 EDGE CONNECTOR PIN ASSIGNMENT

The numbered and lettered sides of the PCB connector shall be commonly assigned. NEMA TS2 sensors shall have the channel Status Outputs disabled.

<u>Pin</u>	<u>Function</u>
A	DC Common
B	+24 VDC
---	Slotted for Keying
C	Reset
D/4	Loop #1 Input A
E/5	Loop #1 Input B
F	Output #1 (Collector)
H	Output #1 (Emitter)
J/8	Loop #2 Input A
K/9	Loop #2 Input B
L	Chassis Ground
M	AC neutral
---	Slotted for Keying
N	AC+
P/13*	Loop #3 Input A
R/14*	Loop #3 Input B
S*	Output #3 (Collector)
T*	Output #3 (Emitter)
U/17*	Loop #4 Input A
V/18*	Loop #4 Input B
W	Output #2 (Collector)
X	Output #2 (Emitter)
Y*	Output #4 (Collector)
Z*	Output #4 (Emitter)

* Denotes terminals for the FOUR channel unit, not used on TWO channel unit.

5.4 GENERAL REQUIREMENTS ISOLATORS - FUNCTIONAL

- ? The isolators are units containing two channels which plug into the standard input file. Each channel shall provide isolation between field circuits and the controller unit.
- ? Each isolator channel shall be operationally independent.
- ? Each channel shall have a test switch to simulate a valid input. The test switch signal shall be inserted after the input isolation and prior to any of the timing circuits. The test switch shall be a three (3) position toggle type with "on" (up), "off" (center) and "momentary on" (down) positions. The contacts shall be gold plated and capable of reliably carrying the switching current.
- ? Each isolator channel shall have a LED indicator to provide visual indication of the status of the output. The indicator shall be "ON" when the output is LOW, and the indicator shall be "OFF" when the output is HIGH.
- ? All indicator lights shall be water clear, Ultra Bright, T-1 3/4 package LEDs, General Instruments MK9160 (Red), or equivalent.
- ? The isolator shall be mounted on an edge connected printed circuit board. The numbered and lettered sides of the PCB connector shall be commonly assigned.
- ? All controls and switches shall be accessible from the front panel.
- ? The isolator shall be provided with a handle to facilitate insertion and removal from the standard input file.
- ? The method of detection shall be based upon a design which shall provide reliable operation. The isolator shall be of solid state design.
- ? The isolator shall operate and interface successfully with an associated LADOT sensing unit or element. A valid channel input shall output a logic ground true of a minimum 100 ms duration.
- ? Power Failure or Restoration shall not cause an output to the Controller Unit.

5.5 GENERAL REQUIREMENTS ISOLATORS - ELECTRICAL

- ? The output shall switch from the OFF state to the ON state in less than 20 microseconds. The output shall switch from the ON state to the OFF state in less than 20 microseconds.
- ? Each channel output shall be an optically coupled NPN Open Collector Transistor circuit rated for 30 VDC open collector and shall sink a minimum 50 mA load to less than 1.5 VDC in the active state. This output shall be compatible with the Model 170 and 2070 Controller inputs.
- ? The minimum isolation for DC Isolators shall be 1,000 megohms and 2,500 VDC from input to output. The minimum isolation for AC Isolators shall be 1,000 megohms at 500 VAC from input to output.
- ? The edge connector contacts shall be either silver or coin silver with gold over nickel plate rated for 5 A at 120 VAC.

5.5.1 LIGHTNING PROTECTION

Lightning protection shall be installed inside the Isolator.

- ? The isolator shall withstand the discharge of a 10 microfarad capacitor charged to +1,000 VDC and -1,000 VDC directly across the input terminals without load present.
- ? The isolator shall withstand the discharge of a 10 microfarad capacitor charged to +2,000 VDC and -2,000 VDC directly across the input terminals and between either input terminal and equipment ground. For purposes of this test, the isolator chassis shall be grounded and the input terminals shall have a 5.0 ohm resistive load.

5.5.2 ISOLATOR EDGE CONNECTOR PIN ASSIGNMENT

<u>PIN</u>	<u>FUNCTION</u>
A	DC Common
B	+24VDC
---	Slotted for Keying
C	N/A
D	Input #1
E	Input #1 Common
F	Output #1 Collector
H	Output #1 Emitter
J	Input #2
K	Input #2 Common
L	Chassis Ground
M	AC neutral
---	Slotted for Keying
N	AC+
P	N/A
R	N/A
S	N/A
T	N/A
U	N/A
V	N/A
W	Output #2 Collector
X	Output #2 Emitter
Z	N/A

5.6 SPECIAL REQUIREMENTS - 242 DC ISOLATOR

- ? Front panel of the isolator shall be labeled as to model number "242" and title "DC ISOLATOR". Channels shall be labeled as "CH 1" for the upper channel and "CH 2" for the lower channel.
- ? Each input channel shall be turned on when a contact closure causes an input voltage of less than +8 VDC, and shall be turned off when the contact opening causes the input voltage to exceed +12 VDC. Each input shall deliver greater than 15 mA and less than 40 mA to an electrical contact closure.
- ? A channel contact closure input of 5 ms or less shall not cause an output. An input duration of 25 ms or greater shall cause an output of 100 milliseconds minimum duration. An input duration between 5 ms and 25 ms may or may not cause an active output. The channel input shall reset within 25 ms after opening of either field input or input test switch.
- ? The isolator shall have an internal power supply which shall supply $+20 \pm 4$ VDC to the field input side of the isolation channels. The Isolator shall not draw more than 2.5 W from 120 VAC. No current shall be drawn from the +24 VDC.

5.7 SPECIAL REQUIREMENTS - 252 AC ISOLATOR

- ? Front panel of the isolator shall be labeled as to model number "252" and title "AC ISOLATOR". Channels shall be labeled as "CH 1" for the upper channel and "CH 2" for the lower channel.
- ? Each isolation channel shall be turned ON when the input voltage exceeds 83 ± 3 VAC for a period of 150 ± 50 ms.
- ? Each isolation channel shall be turned OFF when the input voltage falls below 67 ± 3 VAC for a period of 150 ± 50 ms.
- ? INPUT - OUTPUT CONDITIONS

Refer to the following truth table for the relationship between the "AC input voltage", "front panel test switch", "front panel indicator" and the "output transistor".

AC Input Voltage	Test Switch	Indicator	Output Transistor
$> 83 \pm 3$	OFF	ON	ON
$> 83 \pm 3$	ON	ON	ON
$< 67 \pm 3$	ON	ON	ON
$< 67 \pm 3$	OFF	OFF	OFF

- ? The input circuit shall be provided with hysteresis such that switching for the rising voltage occurs when the input exceeds 83 ± 3 VAC and switching for the falling voltage occurs when the voltage drops below 67 ± 3 VAC. No change shall occur when the voltage remains in the hysteresis band i.e. between 70 and 80 VAC.
- ? The input impedance of each input shall be greater than 8K ohms and less than 12K ohms at 60 Hz.
- ? Each 252 AC isolator channel shall draw no more than 50 mA from the +24 VDC and shall withstand 700 millivolts RMS ripple on the +24 VDC line.

5.8 SPECIAL REQUIREMENTS - 255 RxR ISOLATOR UNIT

- ? Front panel of the isolator shall be labeled as to model number "255" and title "RxR ISOLATOR". Channels shall be labeled as "CH 1" for the upper channel and "CH 2" for the lower channel.
- ? Each isolation channel output shall be turned OFF when the input voltage exceeds 83 ± 3 VAC for a period of 150 ± 50 ms.
- ? Each isolation channel output shall be turned ON when the input voltage falls below 67 ± 3 VAC for a period of 150 ± 50 ms.
- ? INPUT - OUTPUT CONDITIONS

Refer to the following truth table for the relationship between the "AC input voltage", "front panel test switch", "front panel indicator" and the "output transistor".

AC Input Voltage	Test Switch	Indicator	Output Transistor
$> 83 \pm 3$	OFF	OFF	OFF
$> 83 \pm 3$	ON	ON	ON
$< 67 \pm 3$	OFF	ON	ON
$< 67 \pm 3$	ON	ON	ON

- ? The input circuit shall be provided with hysteresis such that switching for the rising voltage occurs when the input exceeds 83 ± 3 VAC and switching for the falling voltage occurs when the voltage drops below 67 ± 3 VAC. No change shall occur when the voltage remains in the hysteresis band i.e. between 70 and 80 VAC.
- ? The input impedance of each input shall be greater than 8K ohms and less than 12K ohms at 60 Hz.
- ? Each 255 RxR isolator channel shall draw no more than 100 mA from the +24 VDC and shall withstand 700 millivolts RMS ripple on the +24 VDC line.

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6 CABINET

6.1 332 CABINET

6.1.1 GENERAL

The cabinet shall be rainproof, with dimensions and design style as shown on the plans. The cabinet top shall be "crowned" a minimum of 0.500 inch to prevent standing water. Crown measurement is from cabinet top center to edge.

Each cabinet shall include City of Los Angeles identification. The name "City of Los Angeles" shall be molded, cast, or scribed in 0.250 inch letters on the outside, top center area of the front cabinet door.

Cabinet Assemblies and Files

All assemblies and files shall be mounted on the cage mounting rails per cabinet model detail. Cabinet model interface wiring shall be per specified C1 harness, detailed wiring lists and One Line Diagram.

The controller cabinet assembly shall be designed to operate an eight vehicle phase intersection and **Fourteen** when the auxiliary output file is used, plus four pedestrian phases. The cabinet shall be provided with a full complement of standard equipment and populated as outlined in Section 1.2.4.

- ? Input Files I and J
- ? Power Distribution Assembly
- ? Output File
- ? Auxiliary Output File (when requested)
- ? Communications Terminal Panel
- ? All related wiring and terminal facilities as described in the Specifications.

The following equipment shall be completely removable from the cabinet without removing any other equipment and using only a screwdriver:

- ? 24 VDC Power Supply Assembly
- ? Power Distribution Assembly
- ? Input File
- ? Output File
- ? Cabinet Light Assembly

All fuses, circuit breakers, switches and indicators shall be readily visible and accessible when the front door is open. The exception is police panel switches and fan fuse.

? **Shipping Pallet**

The cabinet shall be delivered mounted on a plywood board shipping pallet whose construction and dimensions are shown on the Plans. The pallet shall be bolted to the cabinet base. The cabinet shall be enclosed in a slipover cardboard packing shell.

All equipment in the cabinet shall be clearly and permanently labeled. Marker strips shall be located immediately below the item they are to identify and must be clearly visible with the items installed. Marker strips shall be made of a material that can be easily and legibly written on using a pencil or ball point pen.

6.1.2 MATERIAL AND STRUCTURE

The cabinet and doors shall be fabricated from 0.125 inch minimum thickness sheet aluminum. All exterior seams for cabinet and doors shall be continuously welded. All exterior welds shall be smooth. All edges shall be filed to a radius of 0.03125 inch minimum.

- ? The welding of the corners, sides and top of the cabinet shall be watertight and of equal or greater thickness than the base metal after the grinding and smoothing is completed. All construction shall be free of dents, scratches, weld burn-through and abrasions harmful to the strength and general appearance.
- ? Cabinets fabricated from aluminum sheet shall conform to the requirements of ASTM Designation: B 209 for 5052-H32 aluminum sheet.
- ? Welding on aluminum cabinets shall be done by the gas metal arc (Mig) or gas tungsten arc (Tig) process using bare aluminum welding electrodes. Electrodes shall conform to the requirements of the American Welding Society (AWS) A5.10 for ER5356 aluminum alloy bare welding electrodes.
- ? Procedures, welders and welding operators for welding on aluminum shall be qualified in accordance with the requirements of AWS B3.0, "Welding Procedure and Performance Qualification", and to the practices recommended in AWS C5.6.

6.1.3 CABINET FINISH

The surface of each aluminum cabinet shall be finished using an anti-graffiti clear coat procedure as described below.

- ? All exterior surfaces shall be cleaned with laquer thinner.
- ? Wash all surfaces using a high pressure washer with liquid heated to 165 degrees F.
- ? Rinse all surfaces with clean water. Do not re-use rinse water.
- ? Suspend all components to dry in such a manner as to prevent contamination on visible surfaces.
- ? Place cabinet into oven for drying and initial heating for 15 minutes at 400 degrees F.
- ? Coat the entire cabinet exterior and doors with a base coat using TCI Wheel Silver #9811-0110. The film build shall not exceed 2 mils total thickness.
- ? Place coated items into oven and cycle for 10 minutes at 380 degrees F to gel the silver base coat. Do not cure completely as this will result in poor inter-coat adhesion of the clear coat to the base coat.
- ? Remove items from oven and once cool, apply a protective coat with a film build of 2.5 to 3.0 mils using TCI Anti-Graffiti Clear #9810-0231. Do not apply coat while surfaces are still hot.

- ? Return items to oven and fully cure at 380 degrees F for 40 minutes.
- ? The City, at its option, may require the winning bidder or Contractor to submit written certification of compliance to the requirements listed in this section of the specification.

6.1.4 DOORS

The cabinet shall have a front and a rear door, each equipped with a lock protected by a gravity or spring cover. When each door is closed and latched, the door shall be locked. Each door shall be accessed by a removable 5/8 inch hex wrench, six inches in length made of solid aluminum. The hex latching mechanism shall be constructed of stainless steel and protected by a gravity or spring cover.

The cabinet door frames shall be double flanged out on all four (4) sides and shall be provided with strikers to hold tension on and form a firm seal between door gaskets and cabinet door frames. The flange width shall be a minimum of 1 inch, measured from the flange front edge to the housing inside surface. The cabinet door openings shall be a minimum 22.00 inches wide by 56.50 inches high as shown on the plans.

The cabinet doors shall be reinforced with "L" channels 0.0625 inch minimum thickness by 0.500 inch height and width. This channel shall be installed on all door perimeters as close to the gaskets as practical and shall not interfere with closing of the door or any equipment in the EIA mounting Rack. Door reinforcement other than that specified above, must be approved by the City prior to being delivered in the sample unit.

Means shall be provided on the inside of the front door to hang two (2) separate plastic envelopes, which are to be supplied and installed by the vendor. The envelopes shall be the side opening "zip" type, fabricated of heavy-duty clear plastic, measuring 11 x 15 (± 1) inches. Two (2), 0.375 inch (hole size) brass grommets shall be mounted on each envelope, spaced 12.625 inches center-to-center. The hanging apparatus and plastic envelopes shall be located so as not to interfere with the latching mechanism or air filter on the cabinet front door.

The front door shall be provided with louvered vents. The louvered vent depth shall be a maximum of 0.25 inches. A removable air filter shall be housed behind the door vents. The filter filtration area shall cover the vent opening area. The filter resident in its shell shall be held firmly in place with a bottom bracket and a spring loaded upper clamp. No incoming air shall bypass the filter. The bottom filter bracket shall be formed into a waterproof sump with drain holes to the outside housing.

6.1.5 DOOR LOCKS

Cabinet locks shall be solid brass rim type comparable to Best Lock 5L series with interchangeable cores. For reference purposes, Best Lock numbers are:

Right Hand -- 5L6RL3XA7559-606

Left Hand -- 5L6RL4X47559-606

Each cabinet will be supplied with two (2) locks, each with a "LA-1" core, keyed alike. LA-1 Keys and Core Keys shall be supplied separately, the quantity will be specified at the time of each purchase order. Contractor cores must be available upon request through the parts contract.

The locks shall have rectangular, spring-loaded bolts. The bolts shall have a 0.281 inch throw and shall be 0.750 inch wide by 0.375 inch thick (dimension tolerance is ± 0.035 inch). Locks shall be rigidly mounted with two (2) stain-less steel machine screws. In the locked position, the throw shall extend a minimum of 0.250 ($\pm .03125$) inch.

The front portion of the lock shall not be recessed or allowed to extend more than 0.1875 inch from the face of the door. Means shall be provided to prevent water from leaking into the cabinet between the Best Lock key shaft and the shaft hole of the cabinet. The locks shall be mounted on the door in such a position that the tumblers are in the upper quadrant. A gravity or spring cover shall be provided for each lock to protect from dust and moisture intrusion.

6.1.6 DOOR LATCHES

The latching mechanism shall be a three-point draw roller type. The center catch shall be plated steel, the pushrods shall be plated steel or aluminum. The pushrods shall be turned edgewise at the outward supports and have a cross section of 0.250 inch by 0.750 inch minimum. Supports shall be 0.105 inch minimum, and of the same material as specified for the housing. Rollers shall have a minimum diameter of 0.875 inch and shall be equipped with ball bearings and nylon wheels. The mounting hardware shall be 1/4 inch. The center catch shall be fabricated of 0.1875 inch plated steel, minimum.

6.1.7 DOOR HINGES

Stainless Steel hinges (two bolts per leaf) shall be provided to bolt the housing to the doors. The housing shall have four hinges per door. Each hinge shall be 3.5 inch minimum length and have a fixed pin. Hinge pins and bolts shall be made of stainless steel. Hinge pins shall be welded at each end to form a cap and the welds filed or ground smooth. The pins and bolts shall be covered by the door edge and not accessible when the door is closed.

Front and rear doors shall be provided with catches to hold the door open at both 90 and 180(+10) degrees. The catches shall be 0.375 inch diameter minimum, plated steel rods.

6.1.8 LIFTING EYES

The cabinet shall be provided with two (2) removable lifting eyes. The lifting eyes shall be located to provide reasonable balance when the cabinet is lifted. Each eye opening shall have a minimum diameter of 1 inch and shall be capable of lifting 1,000 pounds. All dimensions shall be as shown on the Plans. The lifting eye mounts shall be mechanically designed to eliminate any possibility of water entry into the cabinet. The lifting screws shall be Carriage Bolt Steel Screws or compression sleeve with Allen head capable of lifting 1,000 pounds.

6.1.9 AIR INTAKE

The front door shall be provided with a louvered air intake. A disposable cotton/synthetic fiber filter shall be housed behind the intake (refer to appendix A for filter specification). The filter's working area shall cover the intake opening area and be held firmly in place with bottom and side brackets and a spring loaded upper clamp. The filter supports shall be so structured that no incoming air shall bypass the filter.

6.1.10 POLICE PANEL

The police panel door shall be equipped with a lock keyed for a master police key and shall be mounted on the side of the cabinet as shown on the plans. The police door shall provide access to the "Auto-Flash" and "Signals Off" switches. The police panel assembly including switches shall not extend into the cabinet more than 1.50 inches. Each police key shall have a shaft at least 1.75 inches in length. Keys shall be furnished for the police lock as specified in each purchase order.

- ? The police panel shall contain two (2) DPDT toggle switches. The switches shall be positioned so that the ON position is up. One (1) switch shall be labeled "ON-OFF" and the other "FLASH/AUTO". The switches shall have contacts rated for 15 Amps at 120 VAC.
- ? Police panel components connected to the line voltage shall be enclosed with a rigid metal covering to prevent electrical shock. The police panel doors that are flush mounted must be true to the surface of the cabinet and not misaligned in the closed position. There shall not be more than a 0.125 inch gap between the police door and the cabinet.

6.1.11 RAILS

A standard EIA 19.00 inch rack cage shall be installed inside the housing for mounting of the controller unit and cabinet assemblies. The EIA rack portion of the cage shall consist of 2 pairs of continuous, adjustable equipment mounting angles; angles are to be a minimum of 53.00 inches in height, 0.1345 inch nominal thickness plated steel tapped with 10-32 threads with EIA universal spacing. The angle shall comply with standard EIA RE-310-B and shall be supported top and bottom by welded support angles to form a cage. The cage shall be attached to each side of the cabinet at four (4) points, two (2) at the top and two (2) at the bottom of the rails. Cage support mounting angles shall be provided on either side level with the bottom edge of the door opening to provide both horizontal support and bolt attachment.

- ? Clearance between rails for mounting assemblies must be 17.75 inches. The distance between the front surface of the front mounting rail pair to the front surface of the rear mounting rail pair shall be 20.00 ± 0.10 inches.
- ? Two (2) plated supporting angles extending from the front to the back rails shall be supplied to support the controller unit. The angles shall be designed to support a minimum of 50 pounds each. The horizontal side of each angle shall be a minimum of 3 inches. The angles shall be mounted 17.50 inches from the top of the rail cage and shall be adjustable vertically.
- ? The clear area for the Controller Unit shall extend a minimum of 1.50 inches in front of the front EIA angles and 16 inches behind the front EIA angles.

6.1.12 GASKETS

Gaskets shall be provided on all door openings and shall be dust-tight. Gaskets shall be 0.250 inch minimum thickness closed cell neoprene and shall be permanently bonded to the metal. The mating surface of the gaskets shall be covered with a silicone lubricant to prevent sticking to the mating surface. Should a substance other than a silicone lubricant be employed, the Supplier shall submit a sample to the City for testing and evaluation. No cabinets employing the new substance shall be shipped without the prior written approval of the City.

6.1.13 FAN AND EXHAUST VENT

Each cabinet shall be equipped with an electric fan with ball or roller bearings and a minimum capacity of 100 CFM.

- ? The fan shall be mounted within the cabinet and vented out of the cabinet above the top of the door openings. The exhaust vent shall be so designed as to prevent water from entering the cabinet interior.
- ? The fan shall be thermostatically controlled and shall be manually adjustable to turn on between 33 degrees C and 65 degrees C with a differential of not more than 6 degrees C between automatic turn-on and turn-off. The cabinet fan circuit shall be fused at 125% of the ampacity of the fan motor.
- ? The intake and exhaust areas (including filter) shall pass a minimum of 60 cubic feet of air per minute. The exhaust vent shall be so designed as to prevent water from entering the cabinet interior.

6.1.14 INPUT FILE

The input file shall be wired and connected as shown on the plans. The wiring harnesses from the Field Input Terminal Blocks to the rear of the Input File from the detector inputs shall have lugs on both ends crimped and soldered. The file shall utilize no more than 5.25 inches of EIA rack height. The file shall mate with and support 14 two-channel loop detector units. The file shall allow air circulation through the top and bottom of the assembly.

- ? The file shall provide a 22 pin, single readout PC edge connector centered vertically for each two-channel detector. The edge connectors shall be double-sided having contacts on 0.156 inch centers with the number and letter sides of each pin shorted internally. Pins D, E, F, J, K, L and W shall be brought out to an 8 position terminal block on the back of the file. Pins H, T, X, and Z shall be commonly connected terminating at TB15, position 4.
- ? The input file shall have PC card guides both top and bottom. The Card guides shall begin 1.00 1.0 ± 0.50 inches from the front face of the file. The input file shall be provided with marker strips above and below input cards in the file in order to identify them.

6.1.15 OUTPUT FILE

Card guides (top and bottom) shall be provided to support the switchpacks and Conflict Monitor unit.

- ? The Output File shall be provided with marker strips to identify switchpacks in the file. The marker strips shall be made of a material that can be easily and legibly written on using a pencil or ball point pen. Marker strips shall be located immediately below the switchpack they are to identify.
- ? Switchpack sockets, monitor unit sockets, flash transfer relay sockets and flash programming sockets shall be accessible, via a hinged swing down rear panel, from the back of the output file without the use of tools.
- ? Field wire terminal blocks shall be mounted vertically on the back of the assembly. The 3 terminal blocks shall be the 12 terminal type. (A description of the block is found in Section 6.1.25 of these specifications.)
- ? Output files and 120 VAC circuits shall be hand-wired. Printed circuit boards will not be acceptable for high current circuits.

- ? The Conflict Monitor unit compartment including the housed monitor unit exclusive of handle shall extend no farther than 1.25 inches in front of the 19.00 inch rack front surface. The front surface of the switchpack socket shall be no more than 8.50 inches in depth from the front surface of the output file.
- ? The output file shall utilize 10.50 inches of rack height and shall accommodate (12) Model 200 switchpacks, four (4) flash transfer relays, and the Conflict Monitor unit. Four (4) flash transfer relays and one (1) Conflict Monitor unit shall be furnished with each output file. The depth of the assembly shall not exceed 14.50 inches from the front cabinet rails including terminal blocks and relays.
- ? The controller unit outputs to the output file shall be connected through connector C4.
- ? The red and yellow signal circuits of all vehicle switchpacks shall be available at a Molex Type 1375 plug to allow flash programming. Plug connectors, with programming jumpers shall be furnished for each circuit.. Connectors shall be readily accessible without the removal of any other equipment. Wires to plug pins shall be crimped and soldered.
- ? The Conflict Monitor connector shall be a rigidly supported printed circuit board edge connector, having two (2) rows of 28/56 independent double readout bifurcated contacts on 0.156 inch centers. The connector shall mate with the Model 2018 Monitor Unit. Anti-static sheeting shall line the sides of the Monitor housing.
- ? It **shall not** be possible to remove the Conflict Monitor without causing the intersection to go into flash operation. The cabinet shall be wired so that with the monitor unit removed, the intersection shall go into flash operation. The cabinet shall contain a conspicuous warning against operation with the monitor unit removed.
- ? The Conflict Monitor connector shall be wired in accordance with the pin assignment shown on the Plans.

- ? A connector and terminal assembly designated as P20 (Magnum P/N 722120 or equivalent) for monitoring the absence of red shall be an integral part of the output file. The connector shall mate and be compatible with the cable and connector of a Type 2018 CMU capable of monitoring the absence of red. The pin assignments of the P20 connector and terminal assembly shall be as shown on the Plans.
- ? Connection shall be available to extend the monitoring of channels 9, 10, 11 and 12 to an auxiliary output file. Some means of connection shall be made available for the pedestrian Don't Walk circuits. These channels shall be pre-wired in two foot lengths, terminated with ring type lugs, insulated and bundled for optional use. Any P20 incorporating variations or additions to this Specification shall be submitted to the City for approval prior to delivery of the sample unit.
- ? The P20 connector and the CMU ribbon connector shall be keyed physically alike to prevent the absence-of-red cable connector from being inserted into P20 180 degrees out of alignment.

6.1.16 AUXILIARY OUTPUT FILE

The Auxiliary Output File should comply with electrical and mechanical plans in Appendix C and consist of the following:

- ? Six (6) model 200 Switchpacks
- ? Three (3) model 430 Flash Transfer Relays
- ? The red and yellow output circuits of Switchpacks No. 1 thru 6 shall be made available at a Molex receptacle/plug connection for flash programming.
- ? One (1) C-5 connector Amp part No. 206838-1
- ? Three (3), six (6) position terminal strips for field wire connection.
- ? One (1), seven (7) position terminal strip for cabinet connection.

6.1.17 POWER DISTRIBUTION ASSEMBLY

The power distribution assembly shall be furnished and mounted on the EIA 19.00 inch rack utilizing no more than 7 inches of rack height. All equipment shall be readily accessible for ease of replacement. The depth of the assembly including terminal blocks shall not exceed 10.5 inches. Wiring exiting the rear of the PDA shall be of sufficient length and flexibility to allow access to the internal components.

? The following equipment shall be provided as part of the power distribution assembly:

- 1- Main Circuit Breaker
- 5- Signal Bus Circuit Breakers
- 2- Single Pole Flash Bus Circuit Breakers
- 1- Equipment Circuit Breaker
- 1- Auto/Flash Switch
- 1- 24 VDC Power Bypass Pushbutton Switch
- 1- K-1 Relay
- 1- K-2 Relay
- 1- 24 Vdc Power Supply
- 1- Solid State Signal Bus Switch
- 1- EDCO Transient Voltage Surge Suppressor
- 1- Controller Unit Duplex Receptacle
- 2- Equipment Duplex Receptacles
- 2- Model 204 Flasher Units
- 1- Flash Status Indicator Light
- 1- Solid State Switch Failure Indicator

? The main circuit breaker shall be rated for 30 Amps at 120VAC. Five Signal Bus Circuit Breakers shall be rated for 10 Amps at 120VAC. The rating for each circuit breaker shall be shown on the face of the breaker or handle. The breaker function shall be labeled below each breaker on the front panel.

? The five (5) signal bus circuit breakers shall not be mechanically ganged however the opening of any one or more of the five (5) signal breakers shall initiate a "flash transfer" and only those breakers that opened shall indicate so. The circuit breakers shall be of the same type as Potter and Brumfield single pole, 10 Amps, 120 VAC, 50/60 Hz, curve 3 type breakers that have the auxiliary switch feature.

? The circuit breakers for the two flash circuits shall be single pole and not ganged. The Flash Bus Breakers shall be rated for 10 Amps at 120VAC. The circuit breakers shall be of the same type as Potter and Brumfield single pole, 10 Amps at 120VAC, 50/60 Hz, curve 3 type breakers that have the auxiliary switch feature.

- ? Equipment receptacles shall be NEMA 5-15R duplex type and the first receptacle in the circuit shall have ground-fault circuit interruption as defined in the National Electrical Code. Circuit interruption shall occur on 6 mA of ground-fault current and shall not occur on less than 4 mA of ground-fault current.
- ? A "Auto/Flash" switch shall be provided which, when placed in the "Flash" position (down), shall interrupt control power to the Solid State Signal Bus Switch to initiate flash transfer. The switch must be placed in the "Auto" position (up) for normal signal operation. The shall be a single-pole, double-throw toggle switch rated for 15 Amps at 120VAC.
- ? The Switch Fail indicator shall be a 120 VAC neon lamp, Dialight 507 Series Type 507-4537-0937-640 or equivalent. The lamp labeled "Switch Fail" shall be provided on the front panel of the PDA assembly to indicate failure of the solid state signal bus switch.
- ? The Flash Status indicator shall be a 24 VDC lamp that is energized when the cabinet is in "Flash" operation.
- ? The Controller Unit receptacle shall be a hospital grade NEMA 5-15R mounted on the back panel of the PDA assembly.
- ? Terminal blocks shall be provided and mounted on the back panel of the assembly. All conductors from the power distribution assembly routed to the cabinet wiring shall be connected to the terminal block on the common side, except for the AC power conductor between the service terminal block and main circuit breaker. All internal wiring terminating at the blocks shall be connected to the opposite side of the blocks. Terminal position assignments shall be as shown on the plans.
- ? K-1 is a 24VDC Relay normally de-energized and driven from the Stop Time output at less than 36 milliamperes from the CMU to provide redundant Fault/Flash operation. K-1 shall not be physically interchangeable with K-2.
- ? K-2 is a 120 VAC DPDT Relay that provides a logic input to the controller unit "Flash Sense" isolator when the cabinet is in flash operation. The secondary contacts of the relay interrupt 24 VDC control power to the switchpacks when the Signal Bus is de-energized.
- ? The 24 VDC power bypass switch is a 1 amp N.O. S.P.S.T. snap action momentary pushbutton switch.
- ? The operation of the Flasher circuit breaker FL-1 or FL-2 shall provide an "input" to the Input File J11-D position.

6.1.17.1 Solid State Switch

A **Crydom** model CWA4850 solid state switch shall control power to the Signal Bus. The switch will operate normally energized in the fail safe mode. Any interruption to the solid state switch control line by a power failure, conflict monitor fault, police panel or maintenance flash switch operation will cause the circuit to switch off and remove power to the signal bus.

The switch shall be mounted within the PDA using the heat transfer pad option per the switch manufacturer's recommendations regarding heat dissipation and electrical isolation requirements. The switch shall be wired as shown in the drawings and adhere to the specifications of a **Crydom** model CWA4850 solid state switch.

Output Specifications

Operating Voltage-	48-660 VAC at 47-63 Hz
Load Current-	0.15-50 Amps
Transient Over voltage-	1200 Vpk
Max Surge Current-	850 Apk
Max Off State Leakage-	1.0 mA

Input Specifications

Control Voltage Range-	90-280 VAC
Max Turn-On Voltage-	90 VAC
Min Turn-Off Voltage-	10 VAC
Typical Input Current-	6 mA @ 120 VAC

6.1.17.2 Transient Voltage Surge Suppressor

A **EDCO** model SHA-1220 or equivalent, transient voltage surge suppressor shall be installed as part of the PDA to filter and absorb power line noise and switching transients. It shall be connected on the back of the PDA chassis using a 12-pin Beau Connector and mounted in such a way so as to be easily removable. The unit shall be designed to the following specifications:

Operating Voltage-	120 VAC nominal
Continuous Current-	15 Amps max @ 120 VAC
Peak Current-	20,000 Amps
Clamp Voltage-	250 Volt typical @ 20 K Amps
Operating Temperature-	-40 to +85 degrees C.

6.1.17.3 CABINET POWER SUPPLY ASSEMBLY

A power supply shall be provided in a model 206 housing installed in the PDA to supply 24 VDC to the Input and Output Files for use by their associated devices. The design shall be a switching power supply with fuse protection on the AC line side. The supply shall have a rated MTBF greater than 211.3k hours per MIL-HDBK-217F (25 degrees C) and comply with the following specifications:

Electrical & Environmental

Output

Output Voltage: +24 Vdc
 Rated Current: 0-4.2 Amps
 Rated Power: 100 Watts
 Voltage Tolerance: +/- 1.0%
 Line Regulation: +/- 0.5%
 Load Regulation: +/- 0.5%
 Ripple & Noise: ? 150 mVp-p

Input

Voltage Range: 90-132 VAC
 Frequency Range: 57-63 Hz
 Power Factor: ? 0.98 at full load

Protection

Over Load: 105-150% rated output power; Constant current limiting, automatic recovery; a internal line fuse rated according to manufacturer's overload parameters.

Over Voltage: shut down o/p voltage, re-power on to recover

Environment

Working Temp: -37 to +74 degrees C
 Cooling: Convection only, no fan

Safety & EMC

The design must meet the requirements for safety, noise and transient immunity per UL60950-1; TUV EN60950-1; EN61000-3-2,-3; EN61000-4-2,3,4,5,6,8,11

6.1.17.3.1 Mechanical

The power supply unit shall be located within the model 206 chassis. It shall be mounted on a vertical plane or in such a manner as to maximize convection cooling of the device per the manufacturer's recommendation without use of a fan. Electrical connection to the cabinet shall be accomplished by plug connector **BEAU P-5406-LAB** or equivalent at the rear of the chassis per the drawings.

The front panel shall include the AC line fuse, AC and DC power indicator lights and 24 VDC test points with 1Kohm resistor in series for monitoring the output voltage. The power supply assembly including terminals shall be protected to prevent accidental contact with energized parts.

- ? The Power Indicator labeled "AC Power" shall be a 120 VAC lamp, Dialight 507 Series Neon Cartridge type 507-4537-0937-640 or equivalent with Dialight Datalamp holder type 508-8745-504 or equivalent. The lamp circuit shall be connected to the load side of the fuse.
- ? The DC power indicator labeled "24 VDC PWR" shall be a 24 VDC lamp, Dialight 507 Series LED cartridge type 507-4761-3331-500 or equivalent with Dialight Datalamp Cartridge Holder type 508-8738-504 or equivalent. The lamp circuit shall be connected to the output of the power supply.
- ? 24 VDC test points shall be provided on the front panel of the 206 chassis using banana jacks connected in parallel with the indicator light through a 1 Kohm resistor. The jacks shall be labeled as to polarity and the positive jack shall be red in color, the negative jack shall be black in color.

6.1.18 SIDE PANELS

Two (2) panels shall be provided and mounted on the EIA rack parallel to the cabinet sides as shown on the Plans.

- ? In viewing from the back door, the left side panel shall be designated as the "Input Panel" and the right side panel shall be designated as the "Service Panel".
- ? All input field terminal blocks for detector field cables and other input conductors, except service conductors, shall be mounted on the "Input Panel".

6.1.19 CONNECTORS

Connector C1P shall contain 104 pin contacts and shall mate with Connector C1S mounted on the controller unit chassis. Corner guide pins for Connector C1P shall be stainless steel and shall be 1.097 inches in length. Corner guide socket assemblies shall be stainless steel and shall be 0.625 inch in length.

- ? Connector C4 shall contain 37 contacts and shall be the circular plastic type with quick connect/disconnect capability and thread assist, positive detent coupling. The Plug connector C4P shall be mounted on the output file.
- ? Connector C5 shall contain 24 contacts and shall be the circular plastic type with quick connect/disconnect capability and thread assist, positive detent coupling. The Plug Connector C5 shall be mounted on the input file. Contact assignments are shown on the plans.
- ? Connector blocks for Connector C1 pin and socket connectors shall be constructed of diallyl phthalate or better. Contacts shall be secured in the blocks with springs of stainless steel.
- ? All wires terminating in connectors, unless otherwise noted, shall be crimped and soldered. Any other type of connectors shall be approved by the City of Los Angeles prior to submitting the sample unit.
- ? Data or signal carrying connectors shall have redundant areas of contact that will insure a contact resistance of 123 milliohms maximum at a rating of 3.0 Amps of current.
- ? Power carrying connectors shall have redundant areas of contact that will insure a contact resistance of 12 milliohms maximum at 15 Amps.
- ? All connectors shall have an operating temperature range of -55 to +105 degrees C.
- ? Some method of internal or external keying shall be present in every connector. If any two (2) or more connectors in an assembly are of the same type, all such connectors shall be keyed differently and shall be permanently labeled in a way that will identify their correct connection.

6.1.20 CABINET WIRING DIAGRAM

Two (2) sets of non-fading (comparable to Xerox 2080) cabinet wiring diagrams shall be supplied with each cabinet. The diagrams shall be nonproprietary. They shall identify all circuits in such a manner as to be readily interpreted.

The cabinet drawing shall show complete, on a single plan sheet, the C-1 listing, the Input File assignment and the component layout in an elevation view (as viewed from the rear of the cabinet with the left and right cabinet walls shown in their relative positions).

- ? The diagrams shall be placed in the plastic envelopes on the front door (see Section 6.1.4 of this Specification).
- ? Detailed equipment layout scale drawings and wiring diagrams of all equipment installed in the cabinet shall be submitted for approval prior to production. Review and/or approval does not lessen the Vendor's responsibility to meet the specifications.

6.1.21 CONDUCTORS

Conductors used in cabinet wiring shall terminate with properly sized spring-spade type terminals or shall be soldered to a through-panel solder lug on the rear side of the terminal block. All crimp-style connectors shall be applied with a power tool which prevents opening of the handles until the crimp is completed. Crimp type connectors shall not be used on solid wires within any assembly unless they are soldered.

- ? Conductors in the controller cabinet between the service terminals and the signal bus breakers, including the chassis ground conductor to the Power Distribution Assembly, shall be No. 10 AWG 19 stranded wire.
- ? The loop detector lead-in, from the field terminals in the cabinet to the sensor unit rack connector shall be a cable containing two (2) No. 22 gauge conductors or larger with a minimum of seven (7) strands. The connections at each end of the cable shall be soldered as well as crimped. Each conductor shall be insulated with either:
 - ? A minimum of 10 mils of polyvinylchloride and 2 mils of nylon, or
 - ? A minimum of 14 mils of polyethylene or polypropylene.

The conductors shall be twisted and the twisted pair shall be protected with a shield. The shield or a stranded tinned copper drain wire shall be connected to a terminal on the input file terminal block. This input terminal shall be connected to the equipment grounding bus through a single conductor. The cable shall be provided with a polyethylene or polyvinyl chloride outer jacket with a minimum thickness of 20 mils, or with a chrome vinyl outer jacket with a minimum thickness of 25 mils.

- ? All conductors, except those which can be readily traced, shall be labeled. Labels attached to each end of the conductor shall identify the destination of the other end of the conductor.

6.1.21.1 Conductor Color Codes

- ? The grounded conductors of AC circuits shall be identified by a continuous white color.
- ? The ungrounded AC+ conductors shall be identified by a solid black or black with colored stripes.
- ? The conductors for the filtered AC+ power from the EDCO line transient suppressor shall be identified by a solid light blue color.
- ? The equipment grounding conductors shall be identified by a solid green color or by a continuous green color with one (1) or more yellow stripes.
- ? The DC common conductors shall be identified by a solid white color with a red stripe.

All cabinet wiring harnesses shall be neat, firm and routed to minimize crosstalk and electrical interference. Printed circuit motherboards are to be used where possible to eliminate or reduce cabinet wiring.

- ? Wiring containing AC shall be routed and bundled separately or shielded separately from all logic voltage control circuits.
- ? Cabling shall be routed to prevent conductors from being in contact with metal edges whenever possible. If cabling must be in contact with metal edges, those edges shall be covered with a nylon (or equivalent) non-abrasive, smooth shield. Cabling shall be arranged so that any removable assembly may be removed without disturbing conductors not associated with that assembly.
- ? All conductors, terminals or energized parts which could be hazardous to maintenance personnel, shall be protected with suitable insulating material.
- ? Within the cabinet wiring, the DC common and equipment ground shall be electrically isolated from the AC grounded conductor and each other by 500 megohms when tested at 250 VDC with the power line surge protection disconnected.
- ? Conductors from connector C1 to the input files shall be of sufficient length to allow any conductor to be connected to any detector output terminal (positions S, F, W).
- ? The AC- copper terminal bus shall not be grounded to the cabinet or connected to the logic common and shall provide a minimum of 10 terminals for connection to field conductors. Nylon screws with a minimum diameter of 0.250 inches shall be used for securing the bus to the service panel.
- ? An equipment ground (earth ground) bus shall be provided in each cabinet. The bus shall be copper and grounded to the cabinet.
- ? A No. 8, or larger, copper conductor shall be connected between equipment ground bus and rack rails.

6.1.22 CABINET LIGHT

Each 332 cabinet shall be equipped with one (1) fluorescent lighting fixture NICOR model 10333EB or equivalent mounted inside the top front portion of the cabinet. Any fixture other than the specified unit shall be submitted to the City for approval, prior to the delivery of the sample unit. The fixture shall use a 16 watt T-4 lamp; operated from a normal power factor and UL listed ballast. A weather resistant, snap-action door actuated switch shall be installed to turn the cabinet light on when the front door is opened.

6.1.23 CABINET VERIFICATION TEST PROGRAM

The Vendor shall furnish Cabinet Verification Test Program software and associated hardware with each contract. The program shall execute from the front panel in a ITS Siemens 2070 controller unit designed per LADOT Specification 54-055-02. The program in conjunction with any necessary test jigs shall verify the integrity of cabinet wiring related to the output file, input file, the police panel, and flash switches. It shall be possible by front panel selection to test each cabinet input in a given sequence. The controller will acknowledge each correct input test with an audible tone and display the C-1 pin assignment before advancing to the next test interval in the sequence.

It shall be possible by front panel selection to generate and observe controller unit outputs in sequence by phase-color, port-bit allocation, C-1 pin assignment or conflict monitor channel for either a 332 or 336 style cabinet assembly. The output feature shall be selectable for manual control of an individual output or automatic advance which activates one output at a time in sequence.

- ? 10 copies of Cabinet Verification Program operational manuals shall be supplied per contract. The manual shall give a full and complete description of the specific tests and procedures.

6.1.24 TERMINAL BLOCKS

Terminal blocks shall be provided for terminating field conductors. They shall be readily accessible through the cabinet rear door and shall be rated for 20 Amps at 600 VAC RMS, minimum.

- ? The terminal blocks for detector field conductors, auxiliary field wires and control wires shall be the heavy duty barrier type and shall be provided with 8-32 by 0.3125 inch nickel plated brass, combination slotted/phillips binder head screws and nickel plated brass inserts.
- ? The terminal blocks for field wires to the signal indications and power distribution assembly shall be the barrier type and shall be provided with 10-32 by 0.3125 inch nickel plated brass, combination slotted/phillips, binder head screw and nickel plated brass inserts.

- ? The terminal blocks for the input file and power supply shall be the barrier type and shall be provided with 8-32 by 0.3125 inch nickel plated brass, combination slotted/phillips, binder head screws and nickel plated brass inserts.
- ? The terminals of the power line service terminal block shall be labeled "L1" and "AC-", and shall be covered with a clear insulating material to prevent inadvertent contact. Terminating lugs large enough to accommodate No.2 conductors shall be furnished for the service terminal block. The terminal block shall be rated for 50 amps at 600 volts peak minimum.
- ? A 12 position barrier type terminal block provided with 10-32 by 0.3125 inch nickel plated brass, combination slotted/phillips, binder head screws and nickel plated brass inserts labeled "TB0" shall be provided. The block shall be located a minimum 22" (± 1 "), from the bottom, and 1.375 ($\pm .125$) inches, from the right edge of the 332 cabinet "service panel".
- ? A 12 position barrier type terminal block provided with 10-32 by 0.3125 inch nickel plated brass, combination slotted/phillips, binder head screws and nickel plated brass inserts labeled "TBB" shall be provided and wired according to the drawing.

6.1.25 TRANSIENT VOLTAGE SURGE SUPPRESSOR

A **EDCO** model SHA-1250 or equivalent, transient voltage surge suppressor shall be installed in the PDA to filter power line noise and switching transients. It shall plug in externally on the back of the PDA chassis and mounted in such a way so as to be mechanically and electrically accessible. The unit shall be designed to the specifications outlined in **6.1.17.2**.

6.1.26 TRANSIENT SUPPRESSION

Transient suppression circuits shall be provided at the relay bases (across relay coils), fan and cabinet light door switch.

6.1.27 COMMUNICATIONS TERMINATION PANEL

Each model 332 Cabinet shall be provided with a Communication Termination Panel as shown in the drawings that provides cable termination blocks, over voltage protection devices, termination points for the C2P and C20P harnesses and connectors.

? Panel Construction

The panel shall be fabricated from 0.125 inch sheet aluminum, and shall have the dimensions shown in the Plans. The panel shall be drilled and tapped as necessary to mount the terminal blocks and other attachments described below, as well as to mount the panel to the EIA rack within the cabinet. Sharp edges or burrs caused by the cutting or drilling process shall be removed. Corners shall be rounded with a 0.750 inch radius.

? Communications Cable Terminal Block (CTB-1)

Communications Cable Terminal Blocks shall be quick-connected blocks consisting of 50 horizontal rows of six (6) clips per row, mounted in a molded self-extinguishing plastic case. The horizontal rows of six (6) clips shall be divided into two (2) sets of three (3) electrically common clips. The two (2) sets of three (3) clips shall be connected by a bridge clip. These blocks, commonly referred to "66B Type" blocks, shall terminate 25 pairs of 20 through 24 AWG solid unstripped conductors. The blocks shall be equipped with integral fanning strips and an enclosed back to prevent grounding of clips to the panel. The block shall be mounted on the panel, as shown in the Plans.

? C-2 Termination Block (CTB-2)

A four (4) position, double row, closed back design terminal block, **Kulka** part No. 671-GP-04 or equivalent, labeled CTB-2 shall be mounted on the Communications Termination Panel, as shown in the Plans. The strip shall be rated at 15 Amps and shall be provided with 6-32 by 0.250 inch nickel plated brass binder head screws.

? C-20 Termination Block (CTB-3)

A four (4) position, double row, closed back design terminal block, **Kulka** part No. 671-GP-04 or equivalent, labeled CTB-3 shall be mounted on the Communications Termination Panel, as shown in the Plans. The strip shall be rated at 15 Amps and shall be provided with 6-32 by 0.250 inch nickel plated brass binder head screws.

? **Over voltage Protection**

An over voltage surge protector shall be provided for each active communications cable pair (Audio-In pair, and Audio-Out pair) terminating at CTB-2 and CTB-3. Protectors shall be of the Three-Electrode Gas Tube type, and shall have the following ratings:

- ? Impulse Life (1,000 Amp, 10/1000 waveshape at one minute intervals each direction, with 500 Amps on each side to ground simultaneously): 1,000 surges minimum, 2,500 surges typical.
- ? AC Discharge Current, 11 cycles, 60 Hz: 400 Amps RMS, 200 Amps on each side to ground simultaneously
- ? Maximum Single Impulse Discharge Current, 8/20 waveshape: 40 kA maximum, 20 kA/side simultaneously
- ? Capacitance: Line-ground = 4 pf, Line-line = 2 pf
- ? DC Holdover: 180 VDC typical at 200 mA, 150 VDC minimum
- ? DC Arc Voltage: 30 volts typical
- ? Glow to Arc Transition Current: 1.0 Amp typical
- ? Transition Time: 0.5 microseconds maximum
- ? Line-Ground Impulse Breakdown Voltage at 10 kV/sec: 1000 volts maximum average

? **Insulation Resistance**

1,000 megohms minimum at 100 VDC (line-ground)

The protectors shall be encapsulated, and shall be equipped with minimum 2 inches long, spade lug tipped leads. Maximum size of each protector shall be 0.5 x 0.5 x 2.0 -inches. The grounding lead shall be attached to the panel's grounding stud.

? **Grounding Stud**

A grounding stud shall be provided. The stud shall extend through the panel. The over voltage protection devices' ground leads shall be attached to the stud on the front side of the panel. A No. 8 AWG copper conductor shall connect to the stud on the back side of the panel, and shall connect to the cabinet's Equipment Grounding Bus.

? **C2P Harness and Connector**

4-conductor jacketed cables shall each be attached to terminal blocks CTB-2 and CTB-3 with soldered ring lugs, as shown in the Plans. The cables shall terminate with a standard C2P and C20P connectors, and shall be routed through the cabinet, 2 feet in length to reach the back of the 2070 Controller Unit, when the unit is installed in the equipment rack.

? **Feed-Through Opening**

As shown in the Plans, feed-through openings, complete with protective grommets, shall be provided on the panel to protect the C2P and C20P harnesses. A strain relief device shall also be provided for each.

? **Cable-Tie Openings**

Six (6) 0.250 inch diameter holes shall be provided, as shown in the Plans, for installation of cable ties.

? **A Allen Tel Distribution Ring model #GB 13 or equivalent shall be installed at the bottom of the panel CTB-1 as shown in the drawing.**

? **Attachment to Equipment Rack**

The panel shall be securely attached to the equipment rack using mounting keyholes sized to facilitate removal of the panel without removing the mounting screws.

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6.2 336 CABINET

6.2.1 GENERAL

The cabinet shall be rainproof, with dimensions and design style as shown on the plans. The cabinet top shall be "crowned" a minimum of 0.500 inch to prevent standing water. Crown measurement is from cabinet top center to edge.

Each cabinet shall include City of Los Angeles identification. The name "City of Los Angeles" shall be molded, cast, or scribed in 0.250 inch letters on the outside, top center area of the front cabinet door.

Cabinet Assemblies and Files

All assemblies and files shall be mounted on the cage mounting rails per cabinet model detail. Cabinet model interface wiring shall be per specified C1 harness, detailed wiring lists and One Line Diagram.

The controller cabinet assembly shall be designed to operate an eight vehicle phase intersection plus four pedestrian phases. The cabinet shall be provided with a full complement of standard equipment and populated as outlined in Section 1.2.4.

- ? Input File I
- ? Power Distribution Assembly
- ? Output File
- ? Communications Terminal Panel
- ? All related wiring and terminal facilities as described in the Specifications.

The following equipment shall be completely removable from the cabinet without removing any other equipment and using only a screwdriver:

- ? 24 VDC Power Supply Assembly
- ? Power Distribution Assembly
- ? Input File
- ? Output File
- ? Cabinet Light Assembly

All fuses, circuit breakers, switches and indicators shall be readily visible and accessible when the front door is open. The exception is police panel switches and fan fuse.

? **Shipping Pallet**

The cabinet shall be delivered mounted on a plywood board shipping pallet whose construction and dimensions are shown on the Plans. The pallet shall be bolted to the cabinet base. The cabinet shall be enclosed in a slipover cardboard packing shell.

All equipment in the cabinet shall be clearly and permanently labeled. Marker strips shall be located immediately below the item they are to identify and must be clearly visible with the items installed. Marker strips shall be made of a material that can be easily and legibly written on using a pencil or ball point pen.

6.2.2 MATERIAL AND STRUCTURE

The cabinet and doors shall be fabricated from 0.125 inch minimum thickness sheet aluminum. All exterior seams for cabinet and doors shall be continuously welded. All exterior welds shall be smooth. All edges shall be filed to a radius of 0.030 inch minimum.

- ? The welding of the corners, sides and top of the cabinet shall be watertight and of equal or greater thickness than the base metal after the grinding and smoothing is completed. All construction shall be free of dents, scratches, weld burn-through and abrasions harmful to the strength and general appearance.
- ? The bottom of the cabinet shall be reinforced in such a manner as to provide solid support for the entire weight of the cabinet assembly, fully equipped, on a 4 inch pedestal mount slipfitter.
- ? Cabinets fabricated from aluminum sheet shall conform to the requirements of ASTM Designation: B 209 for 5052-H32 aluminum sheet.
- ? Welding on aluminum cabinets shall be done by the gas metal arc (Mig) or gas tungsten arc (Tig) process using bare aluminum welding electrodes. Electrodes shall conform to the requirements of the American Welding Society (AWS) A5.10 for ER5356 aluminum alloy bare welding electrodes.
- ? Procedures, welders and welding operators for welding on aluminum shall be qualified in accordance with the requirements of AWS B3.0, "Welding Procedure and Performance Qualification," and to the practices recommended in AWS C5.6.

6.2.3 CABINET FINISH

- ? The surface of each aluminum cabinet shall be finished using an anti-graffiti clear coat procedure as described below.
- ? All exterior surfaces shall be cleaned with laquer thinner.
- ? Wash all surfaces using a high pressure washer with liquid heated to 165 degrees F.
- ? Rinse all surfaces with clean water. Do not re-use rinse water.
- ? Suspend all components to dry in such a manner as to prevent contamination on visible surfaces.

- ? Place cabinet into oven for drying and initial heating for 15 minutes at 400 degrees F.
- ? Coat the entire cabinet exterior and doors with a base coat using TCI Wheel Silver #9811-0110. The film build shall not exceed 2 mils total thickness.
- ? Place coated items into oven and cycle for 10 minutes at 380 degrees F to gel the silver base coat. Do not cure completely as this will result in poor inter-coat adhesion of the clear coat to the base coat.
- ? Remove items from oven and once cool, apply a protective coat with a film build of 2.5 to 3.0 mils using TCI Anti-Graffiti Clear #9810-0231 or equivalent. Do not apply coat while surfaces are still hot.
- ? Return items to oven and fully cure at 380 degrees F for 40 minutes.
- ? The City, at its option, may require the winning bidder or Contractor to submit written certification of compliance to the requirements listed in this section of the specification.

6.2.4 DOORS

The cabinet shall have a front and a rear door, each equipped with a lock protected by a gravity or spring cover. When each door is closed and latched, the door shall be locked. Each door shall be accessed by a removable 5/8 inch hex wrench, six inches in length made of solid aluminum. The hex latching mechanism shall be constructed of stainless steel and protected by a gravity or spring cover.

The cabinet door frame shall provide strikers to hold tension and form a firm seal between door gaskets and cabinet door frame. Doors shall be fitted to ensure a maximum gap between door flange and cabinet side of 0.125 inch. The cabinet door opening shall be a minimum 19.60 inches wide x 34.60 inches high.

The cabinet doors shall be reinforced with "L" channels 0.0625 inch minimum thickness by 0.500 inch height and width. This channel shall be installed on all door perimeters as close to the gaskets as practical and shall not interfere with closing of the door or any equipment in the EIA mounting Rack. Door reinforcement other than that specified above, must be approved by the City prior to being delivered in the sample unit.

Means shall be provided on the inside of the front door to hang a plastic envelope, supplied and installed by the vendor. The envelopes shall be the side opening "zip" type, fabricated of heavy-duty clear plastic, measuring 11 x 15 ± 1 inches. Two (2), 0.375 inch (hole size), brass grommets shall be mounted on each envelope, spaced 12.625 inches center-to-center. The envelope installed on the front door and shall open towards the locking mechanism.

The front door shall be provided with louvered vents. The louvered vent depth shall be a maximum of 0.25 inches. A removable air filter shall be housed behind the door vents. The filter filtration area shall cover the vent opening area. The filter resident in its shell shall be held firmly in place with a bottom bracket and a spring loaded upper clamp. No incoming air shall bypass the filter. The bottom filter bracket shall be formed into a waterproof sump with drain holes to the outside housing.

6.2.5 DOOR LOCKS

Cabinet locks shall be solid brass rim type comparable to Best Lock 5L series with inter-changeable cores. For reference purposes, Best Lock numbers are:

Right Hand -- 5L6RL3XA7559-606

Left Hand -- 5L6RL4X47559-606

Each cabinet will be supplied with two (2) locks, each with a "LA-1" core, keyed alike. LA-1 Keys and Core Keys shall be supplied separately, the quantity will be specified at the time of each purchase order. Contractor cores must be available upon request through the parts contract.

The locks shall have rectangular, spring-loaded bolts. The bolts shall have a 0.281 inch throw and shall be 0.750 inch wide by 0.375 inch thick (dimension tolerance is ± 0.035 inch). Locks shall be rigidly mounted with two (2) stain-less steel machine screws. In the locked position, the throw shall extend a minimum of 0.250 ($\pm .03125$) inch.

The front portion of the lock shall not be recessed or allowed to extend more than 0.1875 inch from the face of the door. Means shall be provided to prevent water from leaking into the cabinet between the Best Lock key shaft and the shaft hole of the cabinet. The locks shall be mounted on the door in such a position that the tumblers are in the upper quadrant. A gravity or spring cover shall be provided for each lock to protect from dust and moisture intrusion.

6.2.6 DOOR LATCHES

The latching mechanism shall be a three-point draw roller type. The center catch shall be plated steel, the pushrods shall be plated steel or aluminum. The pushrods shall be turned edgewise at the outward supports and have a cross section of 0.250 inch by 0.750 inch minimum. Supports shall be 0.105 inch minimum, and of the same material as specified for the housing. Rollers shall have a minimum diameter of 0.875 inch and shall be equipped with ball bearings and nylon wheels. The mounting hardware shall be 1/4 inch. The center catch shall be fabricated of 0.1875 inch plated steel, minimum.

6.2.7 DOOR HINGES

Stainless Steel hinges (two bolts per leaf) shall be provided to bolt the housing to the doors. The housing shall have three hinges per door. Each hinge shall be 3.5 inch minimum length and have a fixed pin. Hinge pins and bolts shall be made of stainless steel. Hinge pins shall be welded at each end to form a cap and the welds filed or ground smooth. The pins and bolts shall be covered by the door edge and not accessible when the door is closed.

Front and rear doors shall be provided with catches to hold the door open at both 90 and 180(+10) degrees. The catches shall be 0.375 inch diameter minimum, plated steel rods.

6.2.8 LIFTING EYES

The cabinet shall be provided with two (2) removable lifting eyes. The lifting eyes shall be located to provide reasonable balance when the cabinet is lifted. Each eye opening shall have a minimum diameter of 1 inch and shall be capable of lifting 1,000 pounds. All dimensions shall be as shown on the Plans. The lifting eye mounts shall be mechanically designed to eliminate any possibility of water entry into the cabinet. The lifting screws shall be Carriage Bolt Steel Screws or compression sleeve with Allen head capable of lifting 1,000 pounds.

6.2.9 AIR INTAKE

The front door shall be provided with a louvered air intake. A disposable cotton/synthetic fiber filter shall be housed behind the intake (refer to appendix A for filter specification). The filter's working area shall cover the intake opening area and be held firmly in place with bottom and side brackets and a spring loaded upper clamp. The filter supports shall be so structured that no incoming air shall bypass the filter.

6.2.10 POLICE PANEL

The Police Panel Door shall be equipped with a lock keyed for a master police key and shall be mounted on the front door of the cabinet as shown in the Plans. The police door shall provide access to the "Auto-Flash" and "Signals Off" switches. The police panel door shall not protrude more than 0.500 inch maximum from the surface of the cabinet. The police panel assembly including switches shall not extend into the cabinet more than 1.50 inches. Each police key shall have a shaft at least 1.75 inches in length. Keys shall be furnished for the police lock as specified in each purchase order.

- ? The police panel shall contain two (2) DPDT toggle switches. The switches shall be positioned so that the ON position is up. One (1) switch shall be labeled "ON-OFF" and the other "FLASH/AUTO". The switches shall have contacts rated for 15 Amps at 120 VAC.
- ? Police panel components connected to the line voltage shall be enclosed with a rigid metal covering to prevent electrical shock. The police panel doors that are flush mounted must be true to the surface of the cabinet and not misaligned in the closed position. There shall not be more than a 0.125 inch gap between the police door and the cabinet.

6.2.11 RAILS

Rails shall be provided, both front and rear, as an integral part of the cabinet as shown on the plans. Rails shall extend the full height of the cabinet and shall conform to dimensional requirements of Standard EIA RS-310-C, except equipment mounting holes shall be provided with 10-32 threads and shall be located to secure equipment provided as shown on the plans.

Two (2) plated supporting angles shall be supplied to support the controller unit. The angles shall be designed to support a minimum of 50 pounds each. The horizontal side of each angle shall be a minimum of 3 inches and the length a minimum of 11 inches.

6.2.12 GASKETS

Gaskets shall be provided on all door openings and shall be dust-tight. Gaskets shall be 0.250 inch minimum thickness closed cell neoprene and shall be permanently bonded to the metal. The mating surface of the gaskets shall be covered with a silicone lubricant to prevent sticking to the mating surface. Should a substance other than a silicone lubricant be employed, the Supplier shall submit a sample to the City for testing and evaluation. No cabinets employing the new substance shall be shipped without the prior written approval of the City.

6.2.13 FAN AND EXHAUST VENT

Each cabinet shall be equipped with an electric fan with ball or roller bearings and a minimum capacity of 100 CFM.

- ? The fan shall be mounted within the cabinet directly above the controller unit and vented near the top of the cabinet.
- ? The fan shall be thermostatically controlled and shall be manually adjustable to turn on between 33 degrees C. and 65 degrees C. with a differential of not more than 6 degrees C. between automatic turn-on and turn-off. The cabinet fan circuit shall be fused at 125% of the ampacity of the fan motor.
- ? The intake and exhaust areas (including filter) shall pass a minimum of 26 cubic feet of air per minute. The exhaust vent shall be so designed as to prevent water from entering the cabinet interior.

6.2.14 INPUT FILE

The input file shall be wired and connected as shown on the plans. The wiring harnesses from the Field Input Terminal Blocks to the rear of the Input File from the detector inputs shall have lugs on both ends that have been crimped and soldered. The file shall utilize no more than 5.25 inches of EIA rack height. The file shall mate with and support 14 two-channel loop detector units. The file shall allow air circulation through the top and bottom of the assembly.

- ? The file shall provide a 22 pin, single readout PC edge connector centered vertically for each two-channel detector. The edge connectors shall be double-sided having contacts on 0.156 inch centers with the number and letter sides of each pin shorted internally. Pins D, E, F, J, K, L and W shall be brought out to an 8 position terminal block on the back of the file. The output emitters shall be commonly connected terminating at TB15, position 4.
- ? The input file shall have PC card guides both top and bottom. The Card guides shall begin 1.0 ± 0.50 inches from the front face of the file. The input file shall be provided with marker strips above and below the isolators and detectors in the file in order to identify them.

6.2.15 OUTPUT FILE

Card guides (top and bottom) shall be provided to support the switchpacks and Conflict Monitor unit.

- ? The Output File shall be provided with marker strips to identify switchpacks in the file. The marker strips shall be made of a material that can be easily and legibly written on using a pencil or ball point pen. Marker strips shall be located immediately below the switchpack they are to identify.
- ? Switchpack sockets, monitor unit sockets, flash transfer relay sockets and flash programming sockets shall be accessible, via a hinged swing down rear panel, from the back of the output file without the use of tools.
- ? Field wire terminal blocks shall be mounted vertically on the back of the assembly. The 3 terminal blocks shall be the 12 terminal type. (A description of the block is found in Section 6.1.25 of these specifications.)
- ? Output files and 120 VAC circuits shall be hand-wired. Printed circuit boards will not be acceptable for high current circuits.
- ? The Conflict Monitor unit compartment including the housed monitor unit exclusive of handle shall extend no farther than 1.25 inches in front of the 19.00 inch rack front surface. The front surface of the switchpack socket shall be no more than 8.50 inches in depth from the front surface of the output file.
- ? The output file shall utilize 10.50 inches of rack height and shall accommodate (12) Model 200 switchpacks, four (4) flash transfer relays, and the Conflict Monitor unit. Four (4) flash transfer relays and one (1) Conflict Monitor unit shall be furnished with each output file. The depth of the assembly shall not exceed 14.50 inches from the front cabinet rails including terminal blocks and relays.
- ? The controller unit outputs to the output file shall be connected through connector C4.
- ? The red and yellow signal circuits of all vehicle switchpacks shall be available at a Molex Type 1375 plug to allow flash programming. Plug connectors, with programming jumpers shall be furnished for each circuit.. Connectors shall be readily accessible without the removal of any other equipment. Wires to plug pins shall be crimped and soldered.
- ? The Conflict Monitor connector shall be a rigidly supported printed circuit board edge connector, having two (2) rows of 28/56 independent double readout bifurcated contacts on 0.156 inch centers. The connector shall mate with the Model 2018 Monitor Unit. Anti-static sheeting shall line the sides of the Monitor housing.

- ? It **shall not** be possible to remove the Conflict Monitor without causing the intersection to go into flash operation. The cabinet shall be wired so that with the monitor unit removed, the intersection shall go into flash operation. The cabinet shall contain a conspicuous warning against operation with the monitor unit removed.
- ? The Conflict Monitor connector shall be wired in accordance with the pin assignment shown on the Plans.
- ? A connector and terminal assembly designated as P20 (Magnum P/N 722120 or equivalent) for monitoring the absence of red shall be an integral part of the output file. The connector shall mate and be compatible with the cable and connector of a Type 2018 CMU capable of monitoring the absence of red. The pin assignments of the P20 connector and terminal assembly shall be as shown on the Plans.
- ? The P20 connector and the CMU ribbon connector shall be keyed physically alike to prevent the absence-of-red cable connector from being inserted into P20 180 degrees out of alignment.

6.2.16 POWER DISTRIBUTION ASSEMBLY

The power distribution assembly shall be furnished and mounted on the EIA 19.00 inch rack utilizing no more than 7 inches of rack height. All equipment shall be readily accessible for ease of replacement. The depth of the assembly including terminal blocks shall not exceed 10.5 inches. Wiring exiting the rear of the PDA shall be of sufficient length and flexibility to allow access to the internal components.

- ? The following equipment shall be provided as part of the power distribution assembly:
 - 1- Main Circuit Breaker
 - 5- Signal Bus Circuit Breakers
 - 2- Single Pole Flash Bus Circuit Breakers
 - 1- Equipment Circuit Breaker
 - 1- Auto/Flash Switch
 - 1- 24 VDC Power Bypass Pushbutton Switch
 - 1- K-1 Relay
 - 1- K-2 Relay
 - 1- 24 Vdc Power Supply
 - 1- Solid State Signal Bus Switch
 - 1- EDCO Transient Voltage Surge Suppressor
 - 1- Controller Unit Duplex Receptacle
 - 2- Equipment Duplex Receptacles
 - 2- Model 204 Flasher Units
 - 1- Flash Status Indicator Light
 - 1- Solid State Switch Failure Indicator

- ? The main circuit breaker shall be rated for 30 Amps at 120VAC. Five Signal Bus Circuit Breakers shall be rated for 10 Amps at 120VAC. The rating for each circuit breaker shall be shown on the face of the breaker or handle. The breaker function shall be labeled below each breaker on the front panel.
- ? The five (5) signal bus circuit breakers shall not be mechanically ganged however the opening of any one or more of the five (5) signal breakers shall initiate a "flash transfer" and only those breakers that opened shall indicate so. The circuit breakers shall be of the same type as Potter and Brumfield single pole, 10 Amps, 120 VAC, 50/60 Hz, curve 3 type breakers that have the auxiliary switch feature.
- ? The circuit breakers for the two flash circuits shall be single pole and not ganged. The Flash Bus Breakers shall be rated for 10 Amps at 120VAC. The circuit breakers shall be of the same type as Potter and Brumfield single pole, 10 Amps at 120VAC, 50/60 Hz, curve 3 type breakers that have the auxiliary switch feature.
- ? Equipment receptacles shall be NEMA 5-15R duplex type and the first receptacle in the circuit shall have ground-fault circuit interruption as defined in the National Electrical Code. Circuit interruption shall occur on 6 mA of ground-fault current and shall not occur on less than 4 mA of ground-fault current.
- ? A "Auto/Flash" switch shall be provided which, when placed in the "Flash" position (down), shall interrupt control power to the Solid State Signal Bus Switch to initiate flash transfer. The switch must be placed in the "Auto" position (up) for normal signal operation. The shall be a single-pole, double-throw toggle switch rated for 15 Amps at 120VAC.
- ? The Switch Fail indicator shall be a 120 VAC neon lamp, Dialight 507 Series Type 507-4537-0937-640 or equivalent. The lamp labeled "Switch Fail" shall be provided on the front panel of the PDA assembly to indicate failure of the solid state signal bus switch.
- ? The Flash Status indicator shall be a 24 VDC lamp that is energized when the cabinet is in "Flash" operation.
- ? The Controller Unit receptacle shall be a hospital grade NEMA 5-15R mounted on the back panel of the PDA assembly.
- ? Terminal blocks shall be provided and mounted on the back panel of the assembly. All conductors from the power distribution assembly routed to the cabinet wiring shall be connected to the terminal block on the common side, except for the AC power conductor between the service terminal block and main circuit breaker. All internal wiring terminating at the blocks shall be connected to the opposite side of the blocks. Terminal position assignments shall be as shown on the plans.

- ? K-1 is a 24VDC Relay normally de-energized and driven from the Stop Time output at less than 36 milliamperes from the CMU to provide redundant Fault/Flash operation. K-1 shall not be physically interchangeable with K-2.
- ? K-2 is a 120 VAC DPDT Relay that provides a logic input to the controller unit "Flash Sense" isolator when the cabinet is in flash operation. The secondary contacts of the relay interrupt 24 VDC control power to the switchpacks when the Signal Bus is de-energized.
- ? The 24 VDC power bypass switch is a 1 amp N.O. S.P.S.T. snap action momentary pushbutton switch.
- ? The operation of the Flasher circuit breaker FL-1 or FL-2 shall provide an "input" to the Input File J11-D position.

6.2.16.1 Solid State Switch

A **Crydom** model CWA4850 solid state switch shall control power to the Signal Bus. The switch will operate normally energized in the fail safe mode. Any interruption to the solid state switch control line by a power failure, conflict monitor fault, police panel or maintenance flash switch operation will cause the circuit to switch off and remove power to the signal bus.

The switch shall be mounted within the PDA using the heat transfer pad option per the switch manufacturer's recommendations regarding heat dissipation and electrical isolation requirements. The switch shall be wired as shown in the drawings and adhere to the specifications of a **Crydom** model CWA4850 solid state switch.

Output Specifications

Operating Voltage-	48-660 VAC at 47-63 Hz
Load Current-	0.15-50 Amps
Transient Over voltage-	1200 Vpk
Max Surge Current-	850 Apk
Max Off State Leakage-	1.0 mA

Input Specifications

Control Voltage Range-	90-280 VAC
Max Turn-On Voltage-	90 VAC
Min Turn-Off Voltage-	10 VAC
Typical Input Current-	6 mA @ 120 VAC

6.2.16.2 Transient Voltage Surge Suppressor

A **EDCO** model SHA-1220 or equivalent, transient voltage surge suppressor shall be installed as part of the PDA to filter and absorb power line noise and switching transients. It shall be connected on the back of the PDA chassis using a 12-pin Beau Connector and mounted in such a way so as to be easily removable. The unit shall be designed to the following specifications:

Operating Voltage-	120 VAC nominal
Continuous Current-	10 Amps max @ 120 VAC
Peak Current-	20,000 Amps
Clamp Voltage-	280 Volt typical @ 20 kAmps
Operating Temperature-	-40 to +85 degrees C.

6.2.16.3**CABINET POWER SUPPLY ASSEMBLY**

A power supply shall be provided in a model 206 housing installed in the PDA to supply 24 VDC to the Input and Output Files for use by their associated devices. The design shall be a switching power supply with fuse protection on the AC line side. The supply shall have a rated MTBF greater than 211.3k hours per MIL-HDBK-217F (25 degrees C) and comply with the following specifications:

Electrical & Environmental**Output**

Output Voltage: +24 Vdc
 Rated Current: 0-4.2 Amps
 Rated Power: 100 Watts
 Voltage Tolerance: +/- 1.0%
 Line Regulation: +/- 0.5%
 Load Regulation: +/- 0.5%
 Ripple & Noise: ? 150 mVp-p

Input

Voltage Range: 90-132 VAC
 Frequency Range: 57-63 Hz
 Power Factor: ? 0.98 at full load

Protection

Over Load: 105-150% rated output power; Constant current limiting, automatic recovery; a internal line fuse rated according to manufacturer's overload parameters.

Over Voltage: shut down o/p voltage, re-power on to recover

Environment

Working Temp: -37 to +74 degrees C
 Cooling: Convection only, no fan

Safety & EMC

The design must meet the requirements for safety, noise and transient immunity per UL60950-1; TUV EN60950-1; EN61000-3-2,-3; EN61000-4-2,3,4,5,6,8,11

6.2.16.4 Mechanical

The power supply unit shall be located within the model 206 chassis. It shall be mounted on a vertical plane or in such a manner as to maximize convection cooling of the device per the manufacturer's recommendation without use of a fan. Electrical connection to the cabinet shall be accomplished by plug connector **BEAU P-5406-LAB** or equivalent at the rear of the chassis per the drawing.

The front panel shall include the AC line fuse, AC and DC power indicator lights and 24 VDC test points with 1K resistor in series for monitoring the output voltage. The power supply assembly including terminals shall be protected to prevent accidental contact with energized parts.

- ? The Power Indicator labeled "AC Power" shall be a 120 VAC lamp, Dialight 507 Series Neon Cartridge type 507-4537-0937-640 or equivalent with Dialight Datalamp holder type 508-8745-504 or equivalent. The lamp circuit shall be connected to the load side of the fuse.
- ? The DC power indicator labeled "24 VDC PWR" shall be a 24 VDC lamp, Dialight 507 Series LED cartridge type 507-4761-3331-500 or equivalent with Dialight Datalamp Cartridge Holder type 508-8738-504 or equivalent. The lamp circuit shall be connected to the output of the power supply.
- ? 24 VDC test points shall be provided on the front panel of the 206 chassis using banana jacks connected in parallel with the indicator light through a 1 Kohm resistor. The jacks shall be labeled as to polarity and the positive jack shall be red in color, the negative jack shall be black in color.

6.2.17 CABINET MOUNTING ADAPTORS

The 336 cabinet shall mechanically interface with a mounting adaptor as shown on the plans for installation on a type 8 Post Top, C-5 or type 332 foundation. Each cabinet assembly purchase order will specify the type and quantity required.

6.2.18 CONNECTORS

Connector C1P shall contain 104 pin contact positions and shall mate with Connector C1S mounted on the controller chassis. Corner guide pins for connector C1P shall be stainless steel and shall be 1.097 inches in length. Corner guide socket assemblies shall be stainless steel and shall be 0.625 inches in length.

- ? Connector C4 shall contain 24 contacts and shall be the circular plastic type with quick connect/disconnect capability and thread assist, positive detent coupling. The plug Connector C4 shall be mounted on the Rack Assembly.

Connector blocks for Connector C1 pin and socket connectors shall be constructed of diallyl phthalate or better. Contacts shall be secured in the blocks with springs of stainless steel.

All wires terminating in connectors, unless otherwise noted, shall be crimped or soldered. Any other Type of connectors shall be approved by the City of Los Angeles prior to submitting the sample unit.

Data or signal carrying connectors shall have redundant areas of contact that will insure a contact resistance of 12 milliohms maximum at a rating of 3.0 Amps of current.

Power carrying connectors shall have redundant areas of contact that will insure 12 milliohms maximum of contact resistance at 15 Amps of current.

All connectors shall have a operating temperature range of -55 C to 105 C.

Some method of internal or external keying shall be present in every connector. If any two (2) or more connectors in an assembly are of the same type, all such connectors shall be keyed differently and shall be permanently labeled in a way that will identify their correct interconnection.

6.2.19 CABINET WIRING DIAGRAM

Two (2) sets of non-fading cabinet wiring diagrams shall be supplied with each cabinet. The diagrams shall be nonproprietary. They shall identify all circuits in such a manner as to be readily interpreted. The cabinet drawing shall show complete, on a single plan sheet, the C-1 listing and the Input File assignments, the component layout in an elevation view (as viewed from the rear of the cabinet with the left and right cabinet walls shown in their relative positions).

The diagrams shall be placed in the plastic envelope on the front door (see Section 6.2.4 of this Specification).

Detailed equipment layout scale drawings and wiring diagrams of all equipment installed in the cabinet shall be submitted for approval prior to production. Review and/or approval does not lessen the Vendor's responsibility to meet the specifications.

6.2.20 CONDUCTORS

Conductors used in cabinet wiring shall terminate with properly sized spring-spade type terminals or shall be soldered to a through-panel solder lug on the rear side of the terminal block. All crimp-style connectors shall be applied with a power tool which prevents opening of the handles until the crimp is completed. Crimp type connectors shall not be used on solid wires within any assembly unless they are soldered.

- ? Conductors in the controller cabinet between the service terminals and the signal bus breakers, including the chassis ground conductor to the Power Distribution Assembly, shall be No. 10 AWG 19 stranded wire.
- ? The loop detector lead-in, from the field terminals in the cabinet to the sensor unit rack connector shall be a cable containing two (2) No. 22 gauge conductors or larger with a minimum of seven (7) strands. The connections at each end of the cable shall be soldered as well as crimped. Each conductor shall be insulated with either:
 - ? A minimum of 10 mils of polyvinylchloride and 2 mils of nylon, or
 - ? A minimum of 14 mils of polyethylene or polypropylene.

The conductors shall be twisted and the twisted pair shall be protected with a shield. The shield or a stranded tinned copper drain wire shall be connected to a terminal on the input file terminal block. This input terminal shall be connected to the equipment grounding bus through a single conductor. The cable shall be provided with a polyethylene or polyvinyl chloride outer jacket with a minimum thickness of 20 mils, or with a chrome vinyl outer jacket with a minimum thickness of 25 mils.

- ? All conductors, except those which can be readily traced, shall be labeled. Labels attached to each end of the conductor shall identify the destination of the other end of the conductor.

6.1.21.1 Conductor Color Codes

- ? The grounded conductors of AC circuits shall be identified by a continuous white color.
- ? The ungrounded AC+ conductors shall be identified by a solid black or black with colored stripes.
- ? The conductors for the filtered AC+ power from the EDCO line transient suppressor shall be identified by a solid light blue color.
- ? The equipment grounding conductors shall be identified by a solid green color or by a continuous green color with one (1) or more yellow stripes.
- ? The DC common conductors shall be identified by a solid white color with a red stripe.

All cabinet wiring harnesses shall be neat, firm and routed to minimize crosstalk and electrical interference. Printed circuit motherboards are to be used where possible to eliminate or reduce cabinet wiring.

- ? Wiring containing AC shall be routed and bundled separately or shielded separately from all logic voltage control circuits.
- ? Cabling shall be routed to prevent conductors from being in contact with metal edges whenever possible. If cabling must be in contact with metal edges, those edges shall be covered with a nylon (or equivalent) non-abrasive, smooth shield. Cabling shall be arranged so that any removable assembly may be removed without disturbing conductors not associated with that assembly.
- ? All conductors, terminals or energized parts which could be hazardous to maintenance personnel, shall be protected with suitable insulating material.
- ? Within the cabinet wiring, the DC common and equipment ground shall be electrically isolated from the AC grounded conductor and each other by 500 megohms when tested at 250 VDC with the power line surge protection disconnected.
- ? Conductors from connector C1 to the input files shall be of sufficient length to allow any conductor to be connected to any detector output terminal (positions S, F, W).
- ? The AC- copper terminal bus shall not be grounded to the cabinet or connected to the logic common and shall provide a minimum of 10 terminals for connection to field conductors. Nylon screws with a minimum diameter of 0.250 inches shall be used for securing the bus to the service panel.
- ? An equipment ground (earth ground) bus shall be provided in each cabinet. The bus shall be copper and grounded to the cabinet.
- ? A No. 8, or larger, copper conductor shall be connected between equipment ground bus and rack rails.

6.2.21 CABINET LIGHT

Each 336 cabinet shall be equipped with one (1) fluorescent lighting fixture NICOR model 10333EB or equivalent mounted inside the top front portion of the cabinet. Any fixture other than the specified unit shall be submitted to the City for approval, prior to the delivery of the sample unit. The fixture shall use a 16 watt T-4 lamp; operated from a normal power factor and UL listed ballast. A weather resistant, snap-action door actuated switch shall be installed to turn the cabinet light on when the front door is opened.

6.2.22 CABINET VERIFICATION PROGRAM

The Vendor shall furnish Cabinet Verification Test Program software and associated hardware with each contract. The program shall execute from the front panel in a ITS Siemens 2070 controller unit designed per LADOT Specification 54-055-02. The program in conjunction with any necessary test jigs shall verify the integrity of cabinet wiring related to the output file, input file, the police panel, and flash switches. It shall be possible by front panel selection to test each cabinet input in a given sequence. The controller will acknowledge each correct input test with an audible tone and display the C-1 pin assignment before advancing to the next test interval in the sequence.

It shall be possible by front panel selection to generate and observe controller unit outputs in sequence by phase-color, port-bit allocation, C-1 pin assignment or conflict monitor channel for either a 332 or 336 style cabinet assembly. The output feature shall be selectable for manual control of an individual output or automatic advance which activates one output at a time in sequence.

- ? 10 copies of Cabinet Verification Program operational manuals shall be supplied per contract. The manual shall give a full and complete description of the specific tests and procedures.

6.2.23 TERMINAL BLOCKS

Terminal blocks shall be provided for terminating field conductors. They shall be readily accessible through the cabinet rear door and shall be rated for 20 Amps at 600 VAC RMS, minimum.

- ? The terminal blocks for detector field conductors, auxiliary field wires and control wires shall be the heavy duty barrier type and shall be provided with 8-32 by 0.3125 inch nickel plated brass, combination slotted/phillips binder head screws and nickel plated brass inserts.
- ? The terminal blocks for field wires to the signal indications and power distribution assembly shall be the barrier type and shall be provided with 10-32 by 0.3125 inch nickel plated brass, combination slotted/phillips, binder head screw and nickel plated brass inserts.
- ? The terminal blocks for the input file and power supply shall be the barrier type and shall be provided with 8-32 by 0.3125 inch nickel plated brass, combination slotted/phillips, binder head screws and nickel plated brass inserts.
- ? The terminals of the power line service terminal block shall be labeled "L1" and "AC-", and shall be covered with a clear insulating material to prevent inadvertent contact. Terminating lugs large enough to accommodate No.2 conductors shall be furnished for the service terminal block. The terminal block shall be rated for 50 amps at 600 volts peak, minimum.
- ? A 12 position barrier type terminal block provided with 10-32 by 0.3125 inch nickel plated brass, combination slotted/phillips, binder head screws and nickel plated brass inserts labeled "TB0" shall be provided. The block shall be located a minimum 22" (± 1 "), from the bottom, and 1.375 ($\pm .125$) inches, from the right edge of the 332 cabinet "service panel".

6.2.24 TRANSIENT VOLTAGE SURGE SUPPRESSOR

A **EDCO** model SHA-1250 transient voltage surge suppressor shall be installed in the PDA to filter power line noise and switching transients. It shall plug in externally on the back of the PDA chassis and mounted in such a way so as to be mechanically and electrically accessible. The unit shall be designed to the specifications outlined in **6.1.17.2**.

6.2.25 TRANSIENT SUPPRESSION

Transient suppression circuits shall be provided at the relay bases (across relay coils), fan and cabinet light door switch.

6.2.26 COMMUNICATIONS TERMINATION PANEL

Each model 336 Cabinet shall be provided with a Communication Termination Panel as shown in the drawings that provides cable termination blocks, over voltage protection devices, termination points for the C2P and C20P harnesses and connectors.

? Panel Construction

The panel shall be fabricated from 0.125 inch sheet aluminum, and shall have the dimensions shown in the Plans. The panel shall be drilled and tapped as necessary to mount the terminal blocks and other attachments described below, as well as to mount the panel to the EIA rack within the cabinet. Sharp edges or burrs caused by the cutting or drilling process shall be removed. Corners shall be rounded with a 0.750 inch radius.

? Communications Cable Terminal Block (CTB-1)

Communications Cable Terminal Blocks shall be quick-connected blocks consisting of 50 horizontal rows of six (6) clips per row, mounted in a molded self-extinguishing plastic case. The horizontal rows of six (6) clips shall be divided into two (2) sets of three (3) electrically common clips. The two (2) sets of three (3) clips shall be connected by a bridge clip. These blocks, commonly referred to "66B Type" blocks, shall terminate 25 pairs of 20 through 24 AWG solid unstripped conductors. The blocks shall be equipped with integral fanning strips and an enclosed back to prevent grounding of clips to the panel. The block shall be mounted on the panel, as shown in the Plans.

? C-2 Termination Block (CTB-2)

A four (4) position, double row, closed back design terminal block, **Kulka** part No. 671-GP-04 or equivalent, labeled CTB-2 shall be mounted on the Communications Termination Panel, as shown in the Plans. The strip shall be rated at 15 Amps and shall be provided with 6-32 by 0.250 inch nickel plated brass binder head screws.

? C-20 Termination Block (CTB-3)

A four (4) position, double row, closed back design terminal block, **Kulka** part No. 671-GP-04 or equivalent, labeled CTB-3 shall be mounted on the Communications Termination Panel, as shown in the Plans. The strip shall be rated at 15 Amps and shall be provided with 6-32 by 0.250 inch nickel plated brass binder head screws.

? **Over voltage Protection**

An over voltage surge protector shall be provided for each active communications cable pair (Audio-In pair, and Audio-Out pair) terminating at CTB-2 and CTB-3. Protectors shall be of the Three-Electrode Gas Tube type, and shall have the following ratings:

- ? Impulse Life (1,000 Amp, 10/1000 waveshape at one minute intervals each direction, with 500 Amps on each side to ground simultaneously): 1,000 surges minimum, 2,500 surges typical.
- ? AC Discharge Current, 11 cycles, 60 Hz: 400 Amps RMS, 200 Amps on each side to ground simultaneously
- ? Maximum Single Impulse Discharge Current, 8/20 waveshape: 40 kA maximum, 20 kA/side simultaneously
- ? Capacitance: Line-ground = 4 pf, Line-line = 2 pf
- ? DC Holdover: 180 VDC typical at 200 mA, 150 VDC minimum
- ? DC Arc Voltage: 30 volts typical
- ? Glow to Arc Transition Current: 1.0 Amp typical
- ? Transition Time: 0.5 microseconds maximum
- ? Line-Ground Impulse Breakdown Voltage at 10 kV/sec: 1000 volts maximum average

? **Insulation Resistance**

1,000 megohms minimum at 100 VDC (line-ground)

The protectors shall be encapsulated, and shall be equipped with minimum 2 inches long, spade lug tipped leads. Maximum size of each protector shall be 0.5 x 0.5 x 2.0 -inches. The grounding lead shall be attached to the panel's grounding stud.

? **Grounding Stud**

A grounding stud shall be provided. The stud shall extend through the panel. The over voltage protection devices' ground leads shall be attached to the stud on the front side of the panel. A No. 8 AWG copper conductor shall connect to the stud on the back side of the panel, and shall connect to the cabinet's Equipment Grounding Bus.

? **C2P Harness and Connector**

4-conductor jacketed cables shall each be attached to terminal blocks CTB-2 and CTB-3 with soldered ring lugs, as shown in the Plans. The cables shall terminate with a standard C2P and C20P connectors, and shall be routed through the cabinet, 2 feet in length to reach the back of the 2070 Controller Unit, when the unit is installed in the equipment rack.

? **Feed-Through Opening**

As shown in the Plans, feed-through openings, complete with protective grommets, shall be provided on the panel to protect the C2P and C20P harnesses. A strain relief device shall also be provided for each.

? **Cable-Tie Openings**

Six (6) 0.250 inch diameter holes shall be provided, as shown in the Plans, for installation of cable ties.

? **A Allen Tel Distribution Ring model #GB 13 or equivalent shall be installed at the bottom of the panel CTB-1 as shown in the drawing.**

? **Attachment to Equipment Rack**

The panel shall be securely attached to the equipment rack using mounting keyholes sized to facilitate removal of the panel without removing the mounting screws.

6.3 337 CABINET

6.3.1 GENERAL

The cabinet shall be a rainproof, outdoor, pedestal-mounted type with dimensions as shown on the plans. The cabinet top shall be "crowned" a minimum of 0.250 inch to prevent standing water. Crown measurement is from cabinet top center to edge.

Each cabinet shall include City of Los Angeles identification. The name "City of Los Angeles" shall be stamped in 0.250 inch letters on the outside, top center area of the front cabinet door.

The controller cabinet assembly shall be provided with a full compliment of standard equipment, including, but not limited to:

- ? One (1) Slipfitter
- ? One (1) Monitor Unit
- ? One (1) Model 204 Flasher
- ? Three (3) Model 430 flash Transfer Relays
- ? One (1) Flash Relay
- ? One (1) Communications Termination Panel

All equipment requiring identification shall be clearly and "permanently" labeled (silkscreening preferred).

Whenever feasible, cabling from the PDA, Input, and output files to any terminals or connectors shall be routed between the cabinet wall and the rack assembly side panels.

6.3.2 MATERIAL AND STRUCTURE

The cabinet and doors shall be fabricated from 0.125 inch minimum thickness sheet aluminum. All exterior seams for cabinet and doors shall be continuously welded. All exterior welds shall be smooth. All edges shall be filed to a radius of 0.030 inch minimum.

The welding of the corners, sides and top of the cabinet shall be watertight and of equal or greater thickness than the base metal after the grinding and smoothing is completed. All construction shall be free of dents, scratches, weld burn-through and abrasions harmful to the strength and general appearance.

The bottom of the cabinet shall be reinforced in such a manner as to provide solid support for the entire weight of the cabinet assembly, fully equipped, on a 4 inch pedestal mount slipfitter. Reinforcing shall consist of two (2), 4½-by-3¼-inch support channels, opened face down, welded across the bottom front and rear of the cabinet, and extending from side to side. In addition, a 5 inch square slipfitter mounting support bracket shall be installed and welded to the two (2) support channels. Four (4), ¼ inch drain holes shall be provided through the lowest surface of each of the support panels. Four (4) 1/8" drain holes shall be provided at the cabinet bottom as shown in the plans. Any bottom support configuration other than that specified must be approved by the City.

Cabinets fabricated from aluminum sheet shall conform to the requirements of ASTM Designation: B 209 for 5052-H32 aluminum sheet.

Welding on aluminum cabinets shall be done by the gas metal arc (Mig) or gas tungsten arc (Tig) process using bare aluminum welding electrodes. Electrodes shall conform to the requirements of the American Welding Society (AWS) A5.10 for ER5356 aluminum alloy bare welding electrodes.

Procedures, welders and welding operators for welding on aluminum shall be qualified in accordance with the requirements of AWS B3.0, "Welding Procedure and Performance Qualification". and to the practices recommended in AWS C5.6.

6.3.3 CABINET FINISH

The surface of each aluminum cabinet shall be finished using an anti-graffiti clear coat procedure as described below.

- ? All exterior surfaces shall be cleaned with laquer thinner.
- ? Wash all surfaces using a high pressure washer with liquid heated to 165 degrees F.
- ? Rinse all surfaces with clean water. Do not re-use rinse water.
- ? Suspend all components to dry in such a manner as to prevent contamination on visible surfaces.
- ? Place cabinet into oven for drying and initial heating for 15 minutes at 400 degrees F.
- ? Coat the entire cabinet exterior and doors with a base coat using TCI Wheel Silver #9811-0110. The film build shall not exceed 2 mils total thickness.
- ? Place coated items into oven and cycle for 10 minutes at 380 degrees F to gel the silver base coat. Do not cure completely as this will result in poor inter-coat adhesion of the clear coat to the base coat.

- ? Remove items from oven and once cool, apply a protective coat with a film build of 2.5 to 3.0 mils using TCI Anti-Graffiti Clear #9810-0231 or equivalent. Do not apply coat while surfaces are still hot.
- ? Return items to oven and fully cure at 380 degrees F for 40 minutes.
- ? The City, at its option, may require the winning bidder or Contractor to submit written certification of compliance to the requirements listed in Section 6.2.3 of these Specifications.

6.3.4 DOORS

The cabinet shall have a front and a rear door, each equipped with a lock. When each door is closed and latched, the door shall be locked. The latching handles shall have provision for padlocking in the closed position. The operating handle shall be cast aluminum or stainless steel with 7.50 inch handle and 0.500 inch minimum shank. The handle shall open to the right away from the cabinet on the front door, and to the left away from the cabinet on the rear door. The cabinet door frame shall provide strikers to hold tension and form a firm seal between door gaskets and cabinet door frame. Doors shall be fitted to ensure a maximum gap between door flange and cabinet side of 0.125 inch. The cabinet door opening shall be a minimum 19.60 inches wide x 34.60 inches high.

The cabinet doors shall be reinforced with "L" channels 0.0625 inch minimum thickness by 0.500 inch height and width. This channel shall be installed on all door perimeters as close to the gaskets as practical and shall not interfere with closing of the door or any equipment in the EIA mounting Rack. Door reinforcement other than that specified above, must be approved by the City prior to being delivered in the sample unit.

Means shall be provided on the front and rear doors to hang a plastic envelope, which are to be supplied and installed by the vendor. The envelopes shall be the side opening "zip" type, fabricated of heavy-duty clear plastic, measuring 11.00 x 15.00 (± 1.00) inches. Two (2), 0.375 inch (hole size), brass grommets shall be mounted on each envelope, spaced 12.625 inches center-to-center. The envelope installed on the front door shall not cover the police panel and shall open towards the locking mechanism.

The door handle shall be installed 17 1/4" ($\pm 1/4$ "), from the top edge of the door, to the center of the handle shaft.

6.3.5 LOCKS

Cabinet locks shall be solid brass rim type comparable to Best Lock 5L series with inter-changeable cores. For reference purposes, Best Lock numbers are:

Right Hand -- 5L6RL3XA7559-606

Left Hand -- 5L6RL4X47559-606

Each cabinet will be supplied with two (2) locks, each with a "LA-1" core, keyed alike. LA-1 Keys and Core Keys shall be supplied separately, the quantity will be specified at the time of each purchase order. Contractor cores must be available upon request through the parts contract.

The locks shall have rectangular, spring-loaded bolts. The bolts shall have a 0.281 inch throw and shall be 0.750 inch wide by 0.375 inch thick (dimension tolerance is ± 0.035 inch). Locks shall be rigidly mounted with two (2) stain-less steel machine screws. In the locked position, the throw shall extend a minimum of 0.250 ($\pm .03125$) inch.

The front portion of the lock shall not be recessed or allowed to extend more than 0.1875 inch from the face of the door. Means shall be provided to prevent water from leaking into the cabinet between the Best Lock key shaft and the shaft hole of the cabinet. The locks shall be mounted on the door in such a position that the tumblers are in the upper quadrant.

6.3.6 LATCHES

The latching mechanism shall be a three-point type. The center catch and pushrods shall be stainless steel. Pushrods shall be 0.375 inch diameter minimum and shall be supported within 1.50 inches of their respective striker. The center catch shall be fabricated of 0.074 inch, minimum thickness, stainless steel. Details of alternative designs shall be submitted for review and approval prior to fabrication of the cabinets.

6.37 HINGES

Each door's hinging shall be either a continuous hinge or three (3) butt hinges. Each hinge shall have a fixed pin. Front and rear doors shall be provided with catches to hold the door open at 90 degrees, plus or minus 10 degrees. The catches shall be 0.250 inch diameter, minimum stainless steel. Additionally, provision shall be made to ensure that it would require a conscious act on the part of the person opening the door to open it more than 90 degrees. Door hinges and pins shall be made of stainless steel. The hinges shall be bolted to the cabinet. Hinge bolts shall not be accessible to vandals. Hinge pins shall be welded top and bottom on each hinge.

6.3.8 LIFTING EYES

The cabinet shall be provided with two (2) removable lifting eyes to be used when placing the cabinet on the pedestal. The lifting eyes shall be located to provide reasonable balance when the cabinet is lifted. Each eye opening shall have a minimum diameter of 1 inch and shall be capable of lifting 1,000 pounds. All dimensions shall be as shown on the Plans. The lifting eye mounts shall be mechanically designed to eliminate any possibility of water entry into the cabinet. The lifting screws shall be Button Head Steel Socket Screws with Allen head driver or the compression type sleeve with round Allen head.

6.3.9 AIR INTAKE

Each cabinet shall be provided with a louvered air intake in the front door with a disposable cotton/synthetic fiber filter housed behind the intake (refer to appendix A for filter specification) to provide a minimum of 20 square inches of flow area. The filter's working area shall cover the intake opening and shall be held firmly in place by a bottom bracket and an upper spring or spring-loaded clamp.

The bottom filter bracket shall be formed into a waterproof sump with drain holes to the outside. The louvered intake shall be designed and constructed such that a stream of water from a pressure head, such as an impulse or other type sprinkler, will not enter the cabinet.

6.3.10 POLICE PANEL

The Police Panel Door shall be equipped with a lock keyed for a master police key and shall be mounted on the front door of the cabinet as shown in the Plans. The police door shall provide access to the "Auto-Flash" and "Signals Off" switches mounted on the front panel of the Power Distribution Assembly. Police access shall be limited to those two (2) switches. The police panel door shall not protrude more than 0.500 inch maximum from the surface of the cabinet (as per Section 6.2.30 of this Specification)

6.3.11 RAILS

Rails shall be provided, both front and rear, as an integral part of the cabinet. Rails shall extend the full height of the cabinet and shall conform to dimensional requirements of Standard EIA RS-310-C, except equipment mounting holes shall be provided with 10-32 threads and shall be located to secure equipment provided as shown on the plans.

Two (2) plated supporting angles shall be supplied to support the controller unit. The angles shall be designed to support a minimum of 50 pounds each. The horizontal side of each angle shall be a minimum of 3 inches and the length a minimum of 11 inches.

6.3.12 GASKETS

Gaskets shall be provided on all door openings and shall be dust-tight. Gaskets shall be 0.250 inch minimum thickness closed cell neoprene and shall be permanently bonded to the metal. The mating surface of the gaskets shall be covered with a silicone lubricant to prevent sticking to the mating surface. Should a substance other than a silicone lubricant be employed, the Supplier shall submit a sample to the City for testing and evaluation. No cabinets employing the new substance shall be shipped without the prior written approval of the City.

6.3.13 FAN AND EXHAUST VENT

Each cabinet shall be equipped with an electric fan with ball or roller bearings and a capacity of at least 100 CFM.

The fan shall be mounted within the cabinet directly above the controller unit power supply and vented near the top of the cabinet, through a grill arrangement incorporated in the right side of the cabinet when viewed from the front door.

The fan shall be thermostatically controlled and shall be manually adjustable to turn on between 33 degrees C. and 65 degrees C. with a differential of not more than 6 degrees C. between automatic turn-on and turn-off. The cabinet fan circuit shall be fused at 125% of the ampacity of the fan motor.

The intake and exhaust areas (including filter) shall pass a minimum of 50 cubic feet of air per minute. The exhaust vent shall be so designed as to prevent water from entering the cabinet interior. All exhaust vent seams, between the vent housing and the cabinet, shall be continuously welded.

6.3.14 RACK ASSEMBLY

The Rack Assembly shall be self-supporting with side panels extending to the bottom support channels of the cabinet and shall allow a minimum free space beneath the lowest horizontal surface and between the side panels of 17.00 inches wide x 15.00 inches deep x 9.00 inches high with both cabinet doors closed. The assembly shall be equipped with mounting "ears" to allow mounting in rails. Overall width of the assembly shall conform to Standard EIA RS-310-C.

The Rack Assembly shall be fabricated and mounted according to the dimensions shown on the Plans.

The Rack Assembly shall provide a space which shall mate with and support a Model 204 flasher. The flasher shall be wired as shown on the Plans, with its load balanced among switchpacks 1 through 6.

An Auto-Flash switch shall be provided for use by Maintenance Personnel. The switch shall be located as shown on the Plans. Provide an "input" to the controller unit's "Flash Sense" input, utilizing the Isolation Relay, when the Auto-Flash switch is in the "flash" position.

A Maintenance Interlock Switch (MIS), MFG. Cherry P/N-50KX Series E-23 or equivalent shall be provided to supply emergency power to the flasher and flash transfer relays in the event that the Power Distribution Assembly is removed. This shall be accomplished in a manner which prevents the application of emergency power unless the maintenance Auto-Flash switch is in the Flash position. Emergency power to the flasher and transfer relays shall be independently fused. **Any other switch MUST be approved by the LADOT prior to shipment**

The Rack Assembly shall provide a receptacle which shall mate with and support the Power Distribution Assembly (PDA). The receptacle shall be equipped with a connector (BEAU SG 5413 ABT or equiv.). Dimensions for the receptacle and location and pin assignments for the connector shall be as shown on the plans. Means shall be provided to secure the PDA.

The front face of all plug-in assemblies shall be flush with the front face of the Rack Assembly. The sole exception shall be the Flash Relay, which may be mounted with its socket on the same plane as the flash transfer relay sockets.

The front face of the Rack Assembly may be inset from the mounting rails a minimum of 0.500 inch.

The Rack Assembly depth shall not exceed 13.00 inches from the front surface of the front mounting rails.

The Assembly shall allow air circulation from bottom to top.

Field wire terminal blocks and bus bars shall be mounted on the back panel of the assembly. The three (3) signal output terminal blocks shall be mounted vertically and shall be the six (6) position type. The power line service terminal block and bus bars shall be mounted as shown on the plans. Other designs must be approved by the City prior to submitting the Sample Unit.

The rear panel shall be hinged to allow it to swing down and provide access to terminals, relays and connections as detailed elsewhere in these Specifications and on the Plans.

The Rack Assembly shall provide for an Input File subassembly and an Output File subassembly, both of which shall be integral to the Rack Assembly as shown on the Plans and specified in detail under separate headings.

6.3.15 INPUT FILE

The wiring harnesses from the Field Input Terminal Blocks to the rear of the Input File from the detector inputs shall have lugs on both ends that have been crimped and soldered. The Input File shall mate with and support 11 two-channel loop detector units. The file shall utilize no more than 5.25 inches of rack height.

The input file shall provide card guides (top and bottom) and a 22-pin single-readout edge-connector centered vertically for each detector unit. The card guide shall begin .725 $\pm$.250 inches back from the front of the file. The file shall allow air circulation through the top and bottom of the assembly.

Pins D,E,J & K on each edge connector shall be wired to the field terminals to provide for two (2) loop detector channels or one magnetometer channel.

Loop #1 and #2 output collectors and emitters (pins F, H, W and X) for each slot shall terminate on a terminal block mounted on the rear of the input file and shall connect to the proper controller unit inputs in the Connector C1S wiring harness. Common connection of output emitters will be permitted.

The input file shall be connected as shown on the Plans.

The edge connectors shall be double sided connectors with the numbered side shorted to its respective lettered side internally.

The input shall be provided with marker strips to identify items in the file. The marker strips shall be made of a material that can be easily and legibly written on using a pencil or ball point pen. Marker strips shall be located immediately above and below the item they are to identify.

6.3.16 OUTPUT FILE

Card guides shall be provided to support the switchpacks and monitor unit.

The Output File shall be capable of containing six (6) Model 200 switchpacks, three (3) Model 430 flash transfer relays, one (1) Model 2018 monitor unit and one (1) Flash Relay.

The Output File shall be provided with marker strips to identify items in the file. The marker strips shall be made of a material that can be easily and legibly written on using a pencil or ball point pen. Marker strips shall be located immediately below the item they are to identify.

Output files and 120 VAC circuits shall be hand-wired; Printed circuit boards will not be acceptable for current carrying circuits.

Switchpack, flash transfer relay and monitor unit sockets shall be accessible from the back of the file without the use of tools.

The controller unit outputs to the Output File shall be connected through Connector C4.

The red and yellow signal circuits of all vehicle switchpacks shall be available at a Molex Type 1375 receptacle which shall mate with a Molex Type 1375 plug to allow flash programming. Plug connectors, with programming jumpers, shall be furnished for each circuit to allow red, yellow or pedestrian flash programming. Requirements are: Four (4) red, three (3) yellow and three (3) pedestrian. Connectors shall be readily accessible without the removal of any other equipment. Plug pins shall be crimped and soldered.

The monitor unit connector shall be a rigidly supported printed circuit board edge connector, having two (2) rows of 28/56 independent double readout bifurcated contacts on 0.156 inch centers. The CMU connector shall be mounted on a printed circuit board that provides the capability of changing the channel assignments by wire jumper. Jumper wires shall be installed to enable the pedestrian switchpack centers to be used as shown on the plans. The connector shall mate with the monitor unit.

It shall be possible to remove the monitor unit without causing the intersection to go into flashing operation. The cabinet shall be wired so that with the front door closed and the monitor unit removed, the intersection shall go into flashing operation. The cabinet shall contain a conspicuous warning against operation with the monitor unit removed.

A connector and terminal assembly designated as P20 (MFG. - Magnum P/N 722120 or equivalent) for monitoring the absence of red shall be an integral part of the output file. The connector shall mate and be compatible with the cable and connector of a type 2070 CMU capable of monitoring the absence of red. The pin assignments of the P20 connector and terminal assembly shall be as shown in the plan. Any P20 incorporating variations or additions to this specification shall be submitted to the City for approval prior to delivery of the sample unit.

The P20 connector and the CMU connector shall be keyed physically alike to prevent the absence of red cable connector from being inserted into the P20 180 degrees out of alignment.

6.3.17 POWER DISTRIBUTION ASSEMBLY (PDA)

The PDA shall not have any protrusions (screw heads, rivets, etc.) extending beyond the outer surface of the side and back panels, except for the pins on the Cinch Jones connector. The PDA shall be electrically and mechanically interchangeable with any model 337 cabinet assembly unit.

The PDA shall be furnished and installed in the Rack assembly. Maximum dimensions are 12.05 inches wide by 3.90 inches high by 7.240 inches deep. The top and bottom of the PDA shall be open faced without any mounting support plates of any size obstructing air flow.

The PDA shall be equipped with a connector to mate with its associated connector in the Rack Assembly. Pin assignments shall be as shown on the plans.

? The following equipment shall be provided with the PDA:

- 1-Main Circuit Breaker
- 1-Equipment Circuit Breaker
- 1-Signals Circuit Breaker
- 1-Flasher Circuit Breaker
- 1-24 VDC Power Supply
- 1-Power Relay and socket
- 1-Auto-Flash Switch (Police)
- 1-Signals-Off Switch
- 1-Power Indicator labeled "24 VDC PWR"
- 1-Flash Indicator
- 2-Test Points
- 2-Power Supply Fuses (AC and DC)

All circuit breakers shall be rated for 120 Volts AC with the following ampacity ratings:

Main and Signals *	30 Amps
Flasher *	20 Amps
Equipment	15 Amps

* The Signal and Flasher circuit breakers shall have the Potter and Brumfield "Curve 3" type operating characteristics.

The "Auto-Flash" switch, when placed in "Flash" position, shall energize the Power Relay coil and apply stop time to the controller. When the switch is placed in the "Auto" (up) position the switchpacks shall control the signal indications. The switch shall be a double pole, single throw switch rated for 15 Amps at 120 VAC.

The Signals-OFF switch, when placed in the "OFF" position (down), shall energize the Power Relay coil and interrupt power to the flasher. The switch shall be a three pole double throw switch rated for 15 Amps at 120 VAC. Two (2) of the three (3) poles shall be tied in parallel to provide sufficient switching capacity for flasher power.

The Power Indicator, labeled "24 VDC PWR", shall be a 24 VDC lamp, Dialight 507 Series LED Cartridge Type 507-4761-3331-500 with Dialight Datalamp Cartridge Holder Type 508-8738-504 or equivalent. The lamp shall be tied across the Power supply output on the fused side.

The Flash Indicator shall be a 120 VAC lamp, Dialight 507 Series Neon Cartridge Type 507-4537-0937-640 with Dialight Datalamp Holder Type 508-8745-504 or equivalent. The lamp shall be tied across the Power Relay coil.

The Power Relay shall be a Model 430 relay wired as shown on the plans. When the relay is energized, it shall interrupt power to the switchpacks.

The Power Supply shall be of ferro-resonant design having no active components and shall conform to the following requirements:

- ? Line Regulation: Line regulation shall be 2 percent from 95 to 135 VAC to 60 Hz plus an additional 1.6 percent for each 1 percent deviation in frequency.
- ? Load Regulation: Load regulation shall be 5 percent from 1 to 3 Amps with a maximum temperature rise of 30 degrees C above ambient temperature.
- ? Design Voltage: Design voltage shall be +24.00 (± 0.30) volts DC at half load and 40 degrees C. No-load voltage shall not exceed +27 VDC.
- ? Full Load Current: Shall be 3 Amps, minimum.

- ? Ripple Noise: Shall be 2 volts peak-to-peak and 500 millivolts RMS at full load.
- ? Line Voltage: 95 to 135 VAC.
- ? Efficiency: 60 percent, minimum.
- ? Minimum Voltage : 22.8 VDC

The Test Points shall be banana jacks and shall be connected in parallel with the Power Indicator. They shall be labeled by polarity with the positive jack red in color and the negative jack black in color.

The Power Supply Fuses shall protect the input (AC) and output (DC) circuitry of the Power Supply. The fuses shall be rated at 125 percent of the full load current in their respective circuits.

The isolation relay shall provide an input to the controller unit "Flash Sense" input when either the Signals circuit breaker is in the "off " position or the Auto-Flash switch (Police Panel) is in the "Flash" position.

The operation of the Flasher circuit breaker shall provide an "input" to the Input File 8-D position.

6.3.18 FLASH TRANSFER RELAY

A leakage resistor, which shall permit a small amount of current to pass through the coil if the contacts should remain closed after the coil circuit is opened, shall be installed across the relay socket to overcome the effects of residual magnetism.

The coil of the flash transfer relay shall be energized only when the signals are in flashing operation.

The flash transfer relay shall transfer switchpack output to flash control. Transfer of the flash transfer relay to flash control shall not prohibit the operation of the controller unit.

6.3.19 SPECIAL PURPOSE RELAYS

The flash Relay shall be normally energized by the Power Relay output and, when de-energized, shall apply power to the Flash Transfer Relay coils. The Flash Relay shall be P&B KRP11 style, DPDT or equivalent.

The Isolation Relay shall energize with the flash transfer relays and provide an input to the controller unit's "Flash Sense" input during flash operation. The relay shall be P&B R10 style, DPDT or equivalent.

The Logic Relay shall be energized as long as the monitor unit remains plugged in. When de-energized, it shall provide continuity between the front door switch and the power relay coil, energizing the power relay in the event the door is closed while the monitor unit is removed.

The Remote Flash Relay, when energized by a logic common signal from the controller unit or external source, shall energize the Power Relay.

Both the logic Relay and Remote Flash Relay shall be P&B KUP style, DPDT or equivalent.

6.3.20 OUTLET PANEL

An Outlet Panel shall be provided at a convenient location. It shall contain the following:

- 1-Equipment Receptacle
- 1-Controller Receptacle
- 1-Terminal Block (TB1)

The Equipment Receptacle shall be NEMA 5-15R duplex type and shall have ground fault circuit interruption as defined in the National Electrical Code. Circuit interruption shall occur on 6 mA of ground fault current and shall not occur on less than 4 mA of ground fault current.

The Controller Receptacle shall be a NEMA type 5-15R.

TB1 shall be a 6-position double-row terminal block and shall be wired as shown on the plans.

6.3.21 PEDESTAL ADAPTER COLLAR

Each cabinet shall be provided with an bronze pedestal adapter collar, slipfitter type painted silver, with straight top for mounting fabricated aluminum cabinets on a pedestal with a 4.50 inch O.D.

6.3.22 CONNECTORS

Connector C1P shall contain 104 pin contact positions and shall mate with Connector C1S mounted on the controller chassis. Corner guide pins for connector C1P shall be stainless steel and shall be 1.097 inches in length. Corner guide socket assemblies shall be stainless steel and shall be 0.625 inches in length.

Connector C4 shall contain 24 contacts and shall be the circular plastic type with quick connect/disconnect capability and thread assist, positive detent coupling. The plug Connector C4 shall be mounted on the Rack Assembly. Contact assignments are shown on the plans.

Connector blocks for Connector C1 pin and socket connectors shall be constructed of diallyl phthalate or better. Contacts shall be secured in the blocks with springs of stainless steel.

All wires terminating in connectors, unless otherwise noted, shall be crimped or soldered. Any other Type of connectors shall be approved by the City of Los Angeles prior to submitting the sample unit.

Data or signal carrying connectors shall have redundant areas of contact that will insure a contact resistance of 12 milliohms maximum at a rating of 3.0 Amps of current.

Power carrying connectors shall have redundant areas of contact that will insure 12 milliohms maximum of contact resistance at 15 Amps of current.

All connectors shall have a operating temperature range of -55 C to 105 C.

Some method of internal or external keying shall be present in every connector. If any two (2) or more connectors in an assembly are of the same type, all such connectors shall be keyed differently and shall be permanently labeled in a way that will identify their correct interconnection.

6 .3.23 CABINET WIRING DIAGRAM

Two (2) sets of non-fading cabinet wiring diagrams shall be supplied with each cabinet. The diagrams shall be nonproprietary. They shall identify all circuits in such a manner as to be readily interpreted. The cabinet drawing shall show complete, on a single plan sheet, the C-1 listing and the Input File assignments, the component layout in an elevation view (as viewed from the rear of the cabinet with the left and right cabinet walls shown in their relative positions).

Alternatively, the supplier may choose to have two (2) plan sheets, one (1) for the ATSAC Program and one (1) for the Universal Program. If this option is chosen, both plan sheets shall be supplied with each cabinet assembly as per this Specification.

The diagrams shall be placed in the plastic envelope on the front door (see Section 6.2 of this Specification).

Detailed equipment layout scale drawings and wiring diagrams of all equipment installed in the cabinet shall be submitted for approval prior to production. Review and/or approval does not lessen the Vendor's responsibility to meet the specifications.

6.3.24 CONDUCTORS

Conductors in the controller cabinet between the service terminals and the switchpack power bus shall be No. 10, or larger.

All conductors used in the controller cabinet shall be No. 22, or larger, with a minimum of 19 strands. Conductors shall conform to Military Specification: MIL-W-16878D, Type B or better. The insulation shall have a minimum thickness of 10 mils and shall be nylon jacketed polyvinyl chloride except that conductors No. 14 and larger may be UL Type THHN, with a minimum of seven (7) strands.

The loop detector lead-in, from the field terminals in the cabinet to the sensor unit rack connector, shall be a cable containing two (2) No. 22, or larger, conductors with a minimum of seven (7) strands. Each conductor shall be insulated with either:

- ? A minimum of 10 mils of polyvinyl chloride and 2 mils of nylon, or
- ? A minimum of 14 mils of polyethylene or polypropylene.

The conductors shall be twisted and the twisted pair shall be protected with a shield. The shield or a stranded tinned copper drain wire shall be connected to a terminal on the input file terminal block. This input terminal shall be connected to the equipment grounding bus through a single conductor. The cable shall be provided with a polyethylene or polyvinyl chloride outer jacket with a minimum thickness of 20 mils, or with a chrome vinyl outer jacket with a minimum thickness of 25 mils.

All conductors, except those which can be readily traced, shall be labeled. Labels attached to each end of the conductor shall identify the destination of the other end of the conductor.

All conductors used in the controller cabinet shall conform to the following color code requirements:

- ? The grounded conductors of AC circuits shall be identified by a continuous white color.
- ? The equipment grounding conductors shall be identified by a continuous green color or by a continuous green color with one (1) or more yellow stripes.
- ? The DC common conductors shall be identified by a solid white color with a red stripe.
- ? The ungrounded conductors shall be identified by any color not specified in above.

All cabinet wiring harnesses shall be neat, firm and routed to minimize crosstalk and electrical interference. Wiring containing AC shall be routed and bundled separately or shielded separately from all logic voltage control circuits.

Cabling shall be routed to prevent conductors from being in contact with metal edges whenever possible. If cabling must be in contact with metal edges, those edges shall be covered with a nylon or similar non-abrasive, smooth shield. Cabling shall be arranged so that any removable assembly may be removed without disturbing conductors not associated with that assembly.

All conductors, terminals or parts, which could be hazardous to maintenance personnel shall be protected with suitable insulating material.

Within the cabinet wiring, the DC common and equipment ground shall be electrically isolated from the AC grounded conductor and each other by 500 megohms when tested at 250 volts DC, with the power line surge protector disconnected.

Conductors from Connector C1 to the Input Files shall be of sufficient length to allow any conductor to be connected to any detector output terminal.

The AC- copper terminal bus shall not be grounded to the cabinet or connected to logic common and shall provide a minimum of 8 terminals for connection of field conductors.

An equipment grounding (earth ground) bus shall be provided in each cabinet. The bus shall be copper and grounded to the cabinet.

6.3.25 CABINET LIGHT

Each cabinet shall be equipped with a fluorescent lighting fixture mounted inside the top front of the cabinet. The fixture shall have an 8 watt lamp F8T5, operated from a normal power factor, U.L. listed Ballast. The lamp shall be shaded to diffuse the light. A door actuated switch shall be installed to turn the cabinet light on when the front door is opened. The door switch shall be on a separate circuit by itself; and used only to turn on the cabinet light.

6.3.26 TERMINAL BLOCKS

Terminal blocks shall be provided for terminating field conductors.

The terminal blocks for detector field conductors, auxiliary field wires and control wires shall be the barrier type with marker strips and shall be provided with 8-32 by 0.3125 inch minimum nickel plated brass binder head screws and inserts.

The terminal blocks for field wires to the signal indications and for service connections shall be the barrier type with marker strips and shall be provided with 10-32 by 0.3125 inch nickel plated brass binder head screws and inserts.

The terminal blocks shall be readily accessible through the cabinet rear door and shall be rated for 30 Amps at 600 volts, minimum.

The terminal blocks for the Input File shall be the barrier type and shall be provided with 8-32 by 0.3125 inch nickel plated brass binder head screws and inserts. They shall be rated for 20 Amps at 600 volts, minimum.

Terminal block TB01 shall be as specified for the Input File terminal blocks.

6.3.27 POWER LINE SURGE PROTECTORS

Two (2) types of power line surge protectors shall be provided between both line conductors (AC+ and AC-) and equipment ground. The protectors shall be installed at the service terminal block.

The first type of surge protector shall be a Three-Electrode Gas Tube Type and shall have the following ratings:

Impulse Breakdown: less than 1,000 volts in less than 0.1 microseconds at 10 kilovolts/microsecond.

- ? Standby Current: less than one mA
- ? Striking Voltage: greater than 212 volts DC.
- ? Capable of withstanding 15 pulses of peak current each of which will rise in 8 microseconds and fall in 20 micro-seconds to one half the peak voltage at 3 minute intervals.
- ? Peak current rating shall be 20,000 Amps.
- ? The second type of surge protector shall be a Metal Oxide Varistor (MOV). One shall be installed between AC+ and equipment ground, AC- and equipment ground, and AC+ and AC-. The MOVs shall have the following ratings:
 - ? Recurrent Peak Voltage: 212 volts
 - ? Energy Rating Maximum: 50 joules
 - ? Power Dissipation: Average 0.85 watt
 - ? Peak Current for Pulses: 2,000 Amps for less than 6 microseconds
 - ? Standby Current: Less than 1 mA

6.3.28 TRANSIENT SUPPRESSION

Transient suppression circuits shall be provided at the Relay bases (across relay coils), the fan, and the cabinet light door switch.

6.3.29 COMMUNICATIONS TERMINATION PANEL

Each Model 337 Cabinet shall be provided with a Communications Termination Panel, which provides a mounting location for communications cable termination blocks, over voltage protection devices, and the termination points for the C2P harness and connector.

? Panel Construction

The panel shall be fabricated of 0.125 inch sheet aluminum, and shall have the dimensions shown on the Plans.

The panel shall be drilled and tapped as necessary to mount the terminal blocks and other attachments described below, as well as to mount the panel to the rack within the cabinet. Sharp edges and burrs caused by the cutting or drilling process shall be removed. Corners shall be rounded with a 0.750 inch radius.

? Communications Cable Termination Block (CTB-1)

Communications Cable Termination Blocks shall be quick-connected blocks consisting of 24 horizontal rows of eight (8) clips per row. The horizontal rows of eight (8) clips shall be divided into two (2) sets of four (4) electrically common clips. The two (2) sets of four (4), shall be connected with a bridge clip. It shall be mounted in a molded self-extinguishing plastic case. These blocks, commonly referred to as "66B" blocks, shall terminate 12 pairs of No. 20 through 24 AWG solid unstripped conductors.

The blocks shall be equipped with integral fanning strips and an enclosed back to prevent grounding of clips to the panel. The block shall be mounted on the panel, as shown on the Plans.

? Active Pairs Termination Block (CTB-2)

A six-position dual screw, closed back barrier strip shall be mounted on the Communications Termination Panel, as shown on the Plans. The strip shall be rated at 15 Amps, and shall be provided with 6-32 x 0.250 inch nickel-plated brass binder head screws.

? Test Point Termination Block (CTB-3)

An eight (8) position single screw, closed back barrier strip shall be mounted on the Communications Termination Panel, as shown on the Plans. The strip shall be rated at 15 Amps and shall be provided with 6-32 x 0.250 inch nickel-plated brass binder head screws.

? Over voltage Protection

An over voltage surge protector shall be provided on each of the three (3) active communications cable pairs (the Voice Pair, Audio-In Pair, and Audio-Out Pair) terminating in the cabinet.

The protectors shall be installed on the Active Pairs Termination Block (CTB-2).

Protectors shall be of a Three-Electrode Gas Tube type, and shall have the following ratings:

- ? Impulse Life (1000 amp, 10/1000 waveshape at one minute intervals each direction, with 500 amp on each side to ground simultaneously): 1000 surges minimum, 2500 surges typical.
- ? AC Discharge Current, 11 cycles, 60 Hz: 400 Amp RMS, 200 Amp each side to ground simultaneously.
- ? Maximum Single Impulse Discharge Current, 8/20 waveshape: 40 ka maximum, 20 ka/side simultaneously.
- ? Capacitance: Line-ground = 4 pf, Line-line = 2 pf.
- ? DC Holdover: 180 VDC typical at 200 mA, 150 VDC minimum.
- ? DC Arc Voltage: 30 volts typical.
- ? Glow to Arc Transition Current: 1.0 Amp typical.
- ? Transition Time: 0.5 microseconds maximum.
- ? Line-Ground Impulse Breakdown Voltage at 10 kv/sec: 1,000 volts maximum average.
- ? Insulation Resistance: 1,000 megohms minimum at 100 VDC (line-ground).

The protectors shall be encapsulated, and shall be equipped with spade lug tipped leads, 2 inches long minimum. Maximum size of each protector shall be 0.500 x 0.500 inch x 2 inches. The grounding lead shall be attached to the panel's grounding stud.

? Grounding Stud

A grounding stud shall be provided on each panel. The stud shall extend through the panel. The over voltage protection devices' ground leads shall be attached to the stud on the front side of the panel. A No. 8 AWG copper conductor shall connect to the stud on the front side of the panel and shall connect to the cabinet's Equipment Grounding Bus.

? C2P Harness and Connector

A 12-conductor jacketed cable shall be attached to terminal blocks CTB-2 and CTB-3 with soldered ring lugs, as shown on the Plans. The cable shall terminate in a standard C2P connector, and shall be routed through the cabinet and be of sufficient length to reach the C2S connector on the back of the 170 Controller Unit, when the unit is installed in the equipment rack.

? Cable-Tie Openings

Two (2), 0.250 inch diameter holes shall be provided, as shown on the Plans, for future installation of cable ties.

? Attachment to Cabinet

The panel shall be securely attached to the rack assembly left side panel, as shown on the Plans.

A **APPENDIX A** **AIR FILTERS FOR 332, 337 & 336 CABINET ASSEMBLIES**

A.1 **PURPOSE**

The purpose of this appendix is to describe the minimum acceptable design and operating requirements for a 332, 337 and 336 cabinet air filter to be used with the Department of Transportation's traffic control equipment. Bidders shall be required to furnish, for inspection and test prior to purchase, a sample of the filter offered. Final authority over acceptance of the sample filter with regard to the interpretation of this specification shall reside with the City of Los Angeles.

A.2 **DIMENSIONS**

A.2.1 **332 CABINET**

The overall dimensions of a 332 cabinet filter shall be:

Height = 12.00 inches, (*tolerance of: plus zero (0) inches and minus 0.500 inch*)

Length = 16.00 inches, (*tolerance of: plus zero (0) inches and minus 0.500 inch*)

Width = 1.00 inch, (*tolerance of: plus zero (0) inches and minus 0.125 inch*)

The filter shall have a minimum of four hundred thirty (430) square inches of media area.

A.2.2 **336 CABINET**

The overall dimensions of a 336 cabinet filter shall be:

Height = 6.00 inches, (*tolerance of: plus zero (0) inches and minus 0.500 inch*)

Length = 16.00 inches, (*tolerance of: plus zero (0) inches and minus 0.500 inch*)

Width = 1.00 inch, (*tolerance of: plus zero (0) inches and minus 0.125 inch*)

A.2.3 337 CABINET

The overall dimensions of a 337 cabinet filter shall be:

Height = 8.00 inches, *(tolerance of: plus zero (0) inches and minus 0.500 inch)*

Length = 15.00 inches, *(tolerance of: plus zero (0) inches and minus 0.500 inch)*

Width = 1.00 inch, *(tolerance of: plus zero (0) inches and minus 0.125 inch)*

The filter shall have a minimum of two-hundred fifty (250) square inches of media area.

A.3 CONSTRUCTION

The filter shall be constructed of non-woven cotton/synthetic fibers, 25 to 35 percent efficient per ASHRAE test standard 52-76.

A.4 MEDIA SUPPORT

The media shall be continuously laminated to an expanded aluminum or galvanized metal grid on the air leaving side.

A.5 PLEAT DESIGN

The media material shall be radial wedge pleated, thereby allowing total media usage.

A.6 MEDIA FRAME

The enclosing frame shall be constructed from moisture-resistant chipboard. The entire unit shall be sealed to insure a positive media-to-frame bond, eliminating any possibility of air bypass.

A.7 UNDERWRITERS LABORATORIES RATING

The filter shall be Underwriters Laboratory rated as a Class II filter unit per U.L. Standard 900.

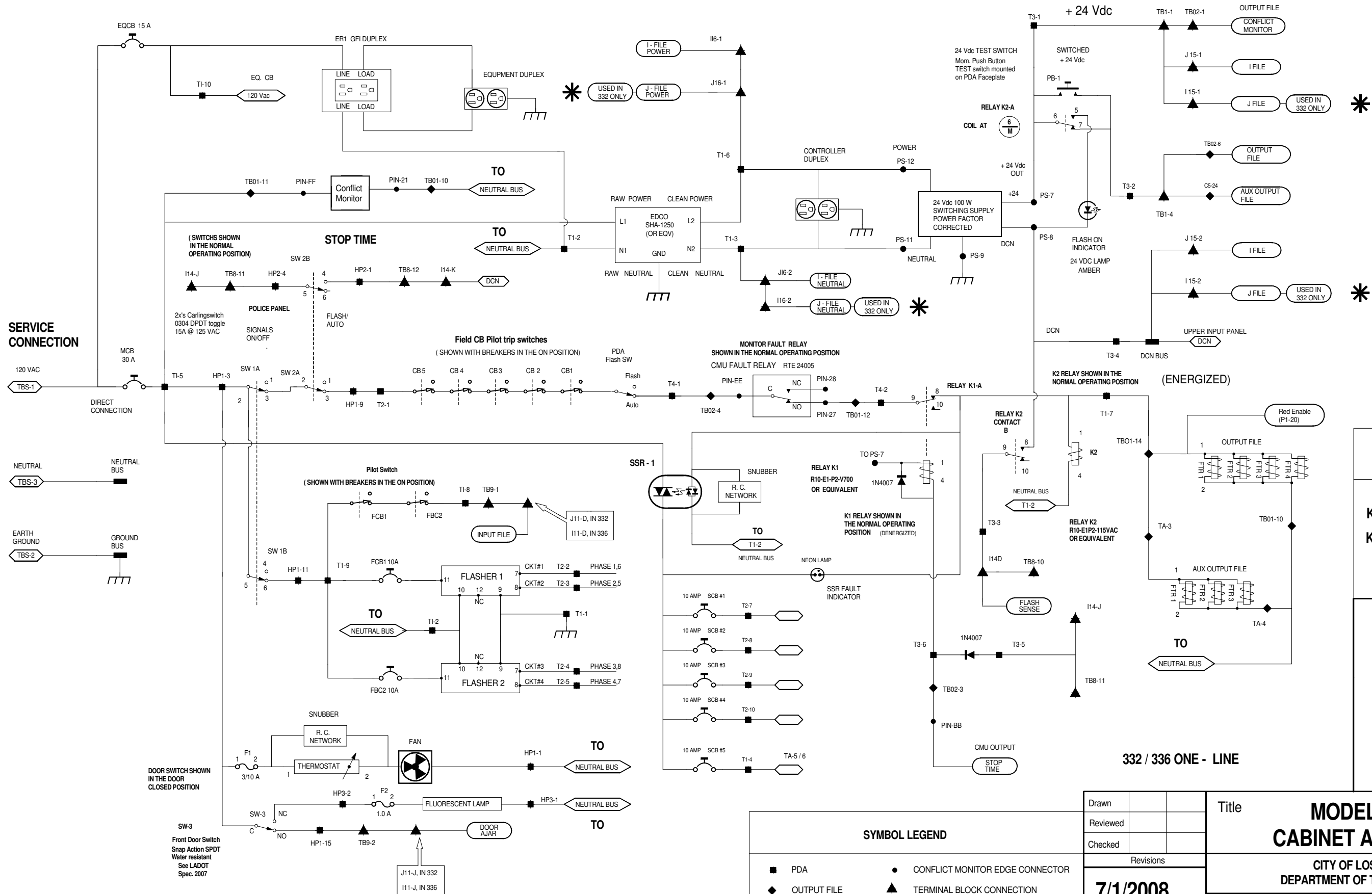
A.8 IDENTIFICATION

Each filter shall be printed with manufacturer's name and location, air flow direction, nominal and actual size, and UL Class II rating.

DRAWINGS- MODEL 332 CABINET ASSEMBLY

1. One Line Diagram model 332 and model 336 Cabinet Assemblies
2. Terminal Block Layout
3. Input File Port Bit and C-1 Pin Assignment
4. 332 Cabinet Assembly Connector Pin Assignments
5. Input File Backplane and Wiring Details
6. Output File Details
7. 332/336 Power Distribution Assembly (PDA) Details
8. C-1 Connector Assembly
9. 332/336 Communications Terminal Panel
10. 332/336 Housing details
11. 332 Cabinet Lifting Plates and Shipping Pallet

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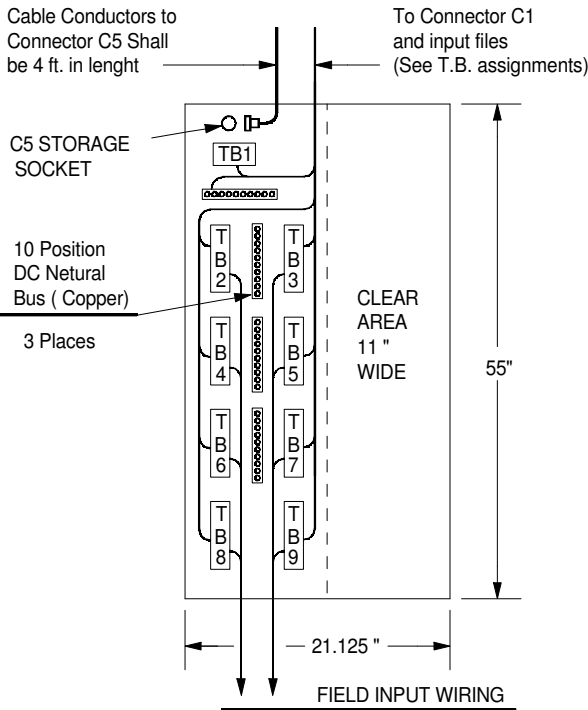
REVISIONS
CHANGES

K1 RELAY
K2 RELAY

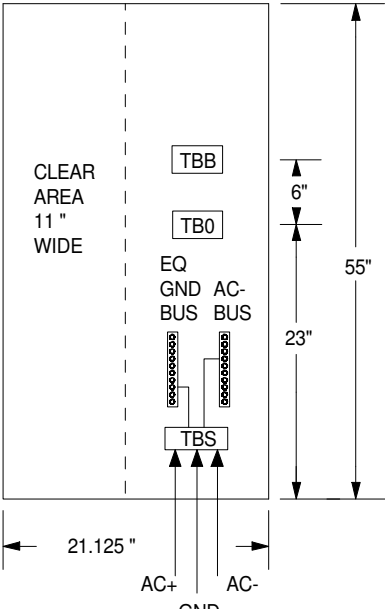
SYMBOL LEGEND	
■ PDA	● CONFLICT MONITOR EDGE CONNECTOR
◆ OUTPUT FILE	▲ TERMINAL BLOCK CONNECTION
▲ INPUT FILE	◻ TERMINAL CONNECTION
■ BUSS	○ FUNCTION DESCRIPTION
■ POLICE PANEL	

Drawn		Title MODEL 332 CABINET ASSEMBLY	1 / 11
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		Signature _____	

SIDE PANEL DETAILS REAR DOOR VIEW



332 INPUT PANEL No. 1



332 SERVICE PANEL No. 1

LEGEND

NA	—	Not Assigned
OF	—	Output File
IFI	—	Input file # 1
IFJ	—	Input File # J
M	—	Monitor Module
I-1D	—	IFI Slot 1 Connector, Pin D
RR25	—	Railroad Preempt, Ø2 and Ø5
EM25	—	Emergency Vehicle, Ø2 and Ø5
O11	—	Output File Terminal Block, Position 11

332 CONNECTOR C4 WIRING LIST

PIN	SOURCE (SOCKET)	DEST. PLUG
1	C1-2	SWPK 4P-6
2	C1-3	SWPK 4P-10
3	C1-4	SWPK 4-6
4	C1-5	SWPK 4-8
5	C1-6	SWPK 4-10
6	C1-7	SWPK 3-6
7	C1-8	SWPK 3-8
8	C1-9	SWPK 3-10
9	C1-10	SWPK 2P-6
10	C1-11	SWPK 2P-10
11	C1-12	SWPK 2-6
12	C1-13	SWPK 2-8
13	C1-15	SWPK 2-10
14	C1-16	SWPK 1-6
15	C1-17	SWPK 1-8
16	C1-18	SWPK 1-10
17	C1-19	SWPK 8P-6
18	C1-20	SWPK 8P-10
19	C1-21	SWPK 8-6
20	C1-22	SWPK 8-8
21	C1-23	SWPK 8-10
22	C1-24	SWPK 7-6
23	C1-25	SWPK 7-8
24	C1-26	SWPK 7-10
25	C1-27	SWPK 6P-6
26	C1-28	SWPK 6P-10
27	C1-29	SWPK 6-6
28	C1-30	SWPK 6-8
29	C1-31	SWPK 6-10
30	C1-32	SWPK 5-6
31	C1-33	SWPK 5-8
32	C1-34	SWPK 5-10
33	C1-35	SWPK 2P-8
34	C1-36	SWPK 6P-8
35	C1-37	SWPK 4P-8
36	C1-38	SWPK 8P-8
37	C1-103	WD TIMER-MU22

332 CONNECTOR C5 WIRING LIST

PIN	SOURCE (SOCKET)	DEST. PLUG
1	C1-83	SWPK 6-PIN 6
2	C1-84	SWPK 6-PIN 10
3	C1-85	SWPK 5-PIN 6
4	C1-86	SWPK 5-PIN 8
5	C1-87	SWPK 5-PIN 10
6	C1-88	SWPK 4-PIN 6
7	C1-89	SWPK 4-PIN 8
8	C1-90	SWPK 4-PIN 10
9	C1-91	SWPK 3-PIN 6
10	C1-93	SWPK 3-PIN 10
11	C1-94	SWPK 2-PIN 6
12	C1-95	SWPK 2-PIN 8
13	C1-96	SWPK 2-PIN 10
14	C1-97	SWPK 1-PIN 6
15	C1-98	SWPK 1-PIN 8
16	C1-99	SWPK 1-PIN 10
17	C1-100	SWPK 6-PIN 8
18	C1-101	SWPK 3-PIN 8
19	NC	NC
20	NC	NC
21	NC	NC
22	NC	NC
23	NC	NC
24	SWITCHED + 24 VDC	TB1-4

NOTES

- ALL DIMENSIONS SHOWN ARE IN INCHES
- SHOWN IN 332 INPUT AND SERVICE PANELS; TERMINAL BLOCKS SHALL BE 12 POSITION BARRIER TYPE EXCEPT TB1 WHICH SHALL BE A 6 POSITION AND TBS WHICH SHALL BE A 3 POSITION. PANEL SURFACES SHALL BE PAINTED WITH A BAKED WHITE ENAMEL FINISH CABLE CONDUCTORS TO C5 SHALL BE 4 FT. IN LENGHT.
- TERMINAL BLOCKS TB2 AND TB3 SHALL BE MOUNTED BELOW CONTROLLER UNIT SUPPORT ANGLES

INPUT PANEL — TERMINAL BLOCK ASSIGNMENT DETAIL

POS	A	B	POS	B	A	POS	B	A	POS	B	A	POS	B	A
TB1 — 1	+ 24 VDC	T3-1	TB2 — 1	Det I1U	I-1D	TB4 — 1	Det I4U	I-4D	TB6 — 1	Det I7U	I-7D	TB8 — 1	ADVANCE	I-11D
2	M RESET	NA	2		I-1E	2		I-4E	2		I-7E	2	ADV ENA	I-11J
3	+ 24 VDC	NA	3		I-1J	3		I-4J	3		I-7J	3	11 COM	I-11K
4	SWITCHED	T3-4	4		I-1K	4		I-4K	4		I-7K	4	PED Ø2	I-12D
5	NA	NA	5		I-2D	5		I-5D	5		I-8D	5	PED Ø4	I-12J
6	NA	NA	6		I-2E	6		I-5E	6		I-8E	6	12 COM	I-12K
			7		I-2J	7		I-5J	7		I-8J	7	PED Ø6	I-13D
			8		I-2K	8		I-5K	8		I-8K	8	PED Ø8	I-13J
			9		I-3D	9		I-6D	9		I-9D	9	13 COM	I-13K
			10		I-3E	10		I-6E	10		I-9E	10	FLH SENSE	I-14D
			11		I-3J	11		I-6J	11		I-9J	11	STOP TIME	I-14J
			12		I-3K	12		I-6K	12		I-9K	12	14 COM	I-14K

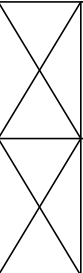
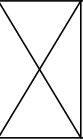
POS	B	A	POS	A	B	POS	A	B	POS	A	B
TBB — 1		I-10D	TB3 — 1	Det J1U	J-1D	TB5 — 1	Det J4U	J-4D	TB7 — 1	Det J7U	J-7D
2	Det I10U	I-10E	2		J-1E	2		J-4E	2		J-7E
3		I-10L	3		J-1J	3		J-4J	3		J-7J
4		I-10J	4		J-1K	4		J-4K	4		J-7K
5		I-10K	5		J-2D	5		J-5D	5		J-8D
6		I-10L	6		J-2E	6		J-5E	6		J-8E
7		J-10D	7		J-2J	7		J-5J	7		J-8J
8		J-10E	8		J-2K	8		J-5K	8		J-8K
9		J-10L	9		J-3D	9		J-6D	9		J-9D
10		J-10J	10		J-3E	10		J-6E	10		J-9E
11		J-10K	11		J-3J	11		J-6J	11		J-9J
12		J-10L	12		J-3K	12		J-6K	12		J-9K

POS	A	B	POS	A	B	POS	A	B	POS	A	B
TB9 — 1	FLASH BUS	J-11D									
2	DOOR AJAR	J-11J									
3	COM	J-11K									
4	EVA	J-12D									
5	EVC	J-12J									
6	COM	J-12K									
7	EVB	J-13D									
8	EVD	J-13J									
9	COM	J-13K									
10	RR1	J-14D									
11	RR2	J-14J									
12	14 COM	J-14K									

TERMINAL CONNECTOR

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			Signature _____	

332 CABINET INPUT FILE
Port-Bit and C1 Pin Assignment Layout

SLOT #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
FILE I	3-2 (56)	1-1 (39)	4-5 (63)	2-1 (47)	3-4 (58)	1-3 (41)	4-7 (65)	2-3 (49)	3-6 (60)		6-6 (80)	5-1 (67)	5-2 (68)	6-7 (81)
		1-5 (43)	6-2 (76)			1-7 (45)	6-4 (78)		3-8 (62)		2-7 (53)	5-3 (69)	5-4 (70)	6-8 (82)
FILE J	3-1 (55)	1-2 (40)	4-6 (64)	2-2 (48)	3-3 (57)	1-4 (42)	4-8 (66)	2-4 (50)	3-5 (59)		2-8 (54)	5-5 (71)	5-6 (72)	2-5 (51)
		1-6 (44)	6-3 (77)			1-8 (46)	6-5 (79)		3-7 (61)		6-1 (75)	5-7 (73)	5-8 (74)	2-6 (52)

P-B = PORT-BIT ASSIGNMENTS
(XX) = C1 PIN ASSIGNMENTS



332 CABINET INPUT FILE

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Checked	RD	8/8/01			
Revisions			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION		
			Approved <u>Ed / 08 / 2001</u>		Drawing No. S-75.9.1
			<u>Sean Skehan</u>		
			Signature		

332 CABINET CONNECTOR PIN ASSIGNMENTS

CONNECTOR C1 PIN ASSIGNMENT																			
C1	PIN	SOURCE	FUNCTION	CONN	TO		C1	PIN	SOURCE	FUNCTION	CONN	TO		C1	PIN	SOURCE	FUNCTION	CONN	TO
1		DC GND	LOGIC GND	DC	GND		27	04-1	SWPK 9 RED	C4S-25				53	I2-7	AD ENABLE	I11-W		
2	01-1	SWPK 6 RED	C4S-1				28	04-2	SWPK 9 GREEN	C4S-26				54	I2-8	FLASH BUS	J11-F		
3	01-2	SWPK 6 GREEN	C4S-2				29	04-3	SWPK 8 RED	C4S-27				55	I3-1	DETECTOR	J1-F		
4	01-3	SWPK 5 RED	C4S-3				30	04-4	SWPK 8 YELLOW	C4S-28				56	I3-2	DETECTOR	I1-F		
5	01-4	SWPK 5 YELLOW	C4S-4				31	04-5	SWPK 8 GREEN	C4S-29				57	I3-3	DETECTOR	J5-F		
6	01-5	SWPK 5 GREEN	C4S-5				32	04-6	SWPK 7 RED	C4S-30				58	I3-4	DETECTOR	I5-F		
7	01-6	SWPK 4 RED	C4S-6				33	04-7	SWPK 7 YELLOW	C4S-31				59	I3-5	DETECTOR	J9-F		
8	01-7	SWPK 4 YELLOW	C4S-7				34	04-8	SWPK 7 GREEN	C4S-32				60	I3-6	DETECTOR	I9-F		
9	01-8	SWPK 4 GREEN	C4S-8				35	05-1	SWPK 3 YELLOW	C4S-33				61	I3-7	DETECTOR	J9-W		
10	02-1	SWPK 3 RED	C4S-9				36	05-2	SWPK 9 YELLOW	C4S-34				62	I3-8	DETECTOR	I9-W		
11	02-2	SWPK 3 GREEN	C4S-10				37	05-3	SWPK 6 YELLOW	C4S-35				63	I4-5	DETECTOR	I3-F		
12	02-3	SWPK 2 RED	C4S-11				38	05-4	SWPK 12 YELLOW	C4S-36				64	I4-6	DETECTOR	J3-F		
13	02-4	SWPK 2 YELLOW	C4S-12				39	I1-1	DETECTOR	I2-F				65	I4-7	DETECTOR	I7-F		
14	LOG GND	LOGIC GND	I15-4				40	I1-2	DETECTOR	J2-F				66	I4-8	DETECTOR	J7-F		
15	02-5	SWPK 2 GREEN	C4S-13				41	I1-3	DETECTOR	I6-F				67	I5-1	2 PED Ppb	I12-F		
16	02-6	SWPK 1 RED	C4S-14				42	I1-4	DETECTOR	J6-F				68	I5-2	6 PED Ppb	I13-F		
17	02-7	SWPK 1 YELLOW	C4S-15				43	I1-5	DETECTOR	I2-W				69	I5-3	4 PED Ppb	I12-W		
18	02-8	SWPK 1 GREEN	C4S-16				44	I1-6	DETECTOR	J2-W				70	I5-4	8 PED Ppb	I13-W		
19	03-1	SWPK 12 RED	C4S-17				45	I1-7	DETECTOR	I6-W				71	I5-5	EVA	J12-F		
20	03-2	SWPK 12 GREEN	C4S-18				46	I1-8	DETECTOR	J6-W				72	I5-6	EVB	J13-F		
21	03-3	SWPK 11 RED	C4S-19				47	I2-1	DETECTOR	I4-F				73	I5-7	EVC	J12-W		
22	03-4	SWPK 11 YELLOW	C4S-20				48	I2-2	DETECTOR	J4-F				74	I5-8	EVD	J13-W		
23	03-5	SWPK 11 GREEN	C4S-21				49	I2-3	DETECTOR	I8-F				75	I6-1	DOOR AJAR	J11-W		
24	03-6	SWPK 10 RED	C4S-22				50	I2-4	DETECTOR	J8-F				76	I6-2	DETECTOR	I3-W		
25	03-7	SWPK 10 YELLOW	C4S-23				51	I2-5	RR1	J14-F				77	I6-3	DETECTOR	J3-W		
26	03-8	SWPK 10 GREEN	C4S-24				52	I2-6	RR2	J14-W				78	I6-4	DETECTOR	I7-W		

CONNECTOR C4 PIN ASSIGNMENT			
C4 NO	PIN NO	SOURCE	CONN TO
1	C1-2	SWPK 6-6	
2	C1-3	SWPK 6-10	
3	C1-4	SWPK 5-6	
4	C1-5	SWPK 5-8	
5	C1-6	SWPK 5-10	
6	C1-7	SWPK 4-6	
7	C1-8	SWPK 4-8	
8	C1-9	SWPK 4-10	
9	C1-10	SWPK 3-6	
10	C1-11	SWPK 3-10	
11	C1-12	SWPK 2-6	
12	C1-13	SWPK 2-8	
13	C1-15	SWPK 2-10	
14	C1-16	SWPK 1-6	
15	C1-17	SWPK 1-8	
16	C1-18	SWPK 1-10	
17	C1-19	SWPK 12-6	
18	C1-20	SWPK 12-10	
19	C1-21	SWPK 11-6	
20	C1-22	SWPK 11-8	
21	C1-23	SWPK 11-10	
22	C1-24	SWPK 10-6	
23	C1-25	SWPK 10-8	
24	C1-26	SWPK 10-10	
25	C1-27	SWPK 9-6	
26	C1-28	SWPK 9-10	
27	C1-29	SWPK 8-6	
28	C1-30	SWPK 8-8	
29	C1-31	SWPK 8-10	
30	C1-32	SWPK 7-6	
31	C1-33	SWPK 7-8	
32	C1-34	SWPK 7-10	
33	C1-35	SWPK 3-8	
34	C1-36	SWPK 9-8	
35	C1-37	SWPK 6-8	
36	C1-38	SWPK 12-8	
37	C1-103	CMU -22	

CONNECTOR C5 PIN ASSIGNMENT			
C5 PIN NO	SOURCE	CONN TO	
1	C1-83	AUX SWPK 6-6	
2	C1-84	AUX SWPK 6-10	
3	C1-85	AUX SWPK 5-6	
4	C1-86	AUX SWPK 5-8	
5	C1-87	AUX SWPK 5-10	
6	C1-88	AUX SWPK 4-6	
7	C1-89	AUX SWPK 4-8	
8	C1-90	AUX SWPK 4-10	
9	C1-91	AUX SWPK 3-6	
10	C1-93	AUX SWPK 3-10	
11	C1-94	AUX SWPK 2-6	
12	C1-95	AUX SWPK 2-8	
13	C1-96	AUXSWPK 2-10	
14	C1-97	AUX SWPK 1-6	
15	C1-98	AUX SWPK 1-8	
16	C1-99	AUX SWPK 1-10	
17	C1-100	AUX SWPK 6-8	
18	C1-101	AUX SWPK 3-8	
19			
20			
21			
22			
23			
24	TB1-4	SWPK 6-9 +24 (SW)	

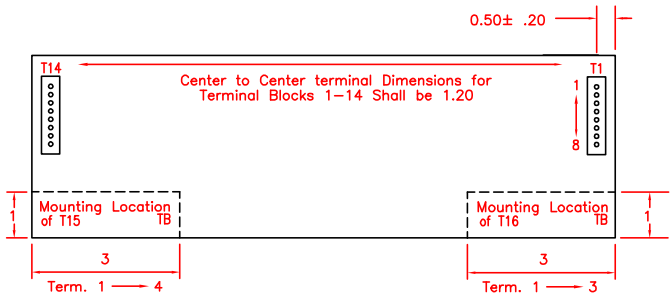
18 CHANNEL CMU EDGE CONN ASSIGNMENT				
PIN	CHANNEL	FUNCTION	CONN TO	
1	CH -2G	SWPK 2 GREEN	130	
2	CH-13G	SWPK 3 GREEN	115	
3	CH-6Y	SWPK 8 YELLOW	135	
4	CH-4G	SWPK 5 GREEN	103	
5	CH-14G	SWPK 6 GREEN	106	
6	CH-8Y	SWPK 11 YELLOW	108	
7	CH-5G	SWPK 7 GREEN	133	
8	CH-13Y	SWPK 3 YELLOW	114	
9	CH-1Y	SWPK 1 YELLOW	126	
10	CH-7G	SWPK 10 GREEN	124	
11	CH-14Y	SWPK 6 YELLOW	105	
12	CH-3Y	SWPK 4 YELLOW	117	
13	CH-9G	SWPK 3 YELLOW	114*	
14	CH-17G	AUX SWPK 3 GREEN	AUX 113	
15	CH-11Y	AUX SWPK 4 YELLOW	AUX 115	
16	CH-9Y	SWPK 6 YELLOW	105*	
17	CH-18G	AUX SWPK 6 GREEN	AUX 106	
18	CH-12Y	AUX SWPK 5 YELLOW	AUX 102	
19	CH-17R	AUX SWPK 3 RED	AUX 111	
20		EQ GROUND	TBO1-9	
21		AC-	TBO1-10	
22		WATCHDOG	C4-37	
23		+24 Vdc	TBO2-1	
24				
25				
26		NC		
27		CMU K1 N.O.	TBO1-12	
28		CMU K1 N.C.	TBO1-13	

*OLA GREEN/YELLOW
optional conn. To AUX file

18 CHANNEL CMU EDGE CONN ASSIGNMENT				
PIN	CHANNEL	FUNCTION	CONN TO	
A	CH -2Y	SWPK 2 YELLOW	129	
B	CH-6G	SWPK 8 GREEN	136	
C	CH-15G	SWPK 9 GREEN	121	
D	CH-4Y	SWPK 5 YELLOW	102	
E	CH-8G	SWPK 11 GREEN	109	
F	CH-16G	SWPK 12 GREEN	112	
H	CH-5Y	SWPK 7 YELLOW	132	
J	CH-1G	SWPK 1 GREEN	127	
K	CH-15Y	SWPK 9 YELLOW	120	
L	CH-7Y	SWPK 10 YELLOW	123	
M	CH-3G	SWPK 4 GREEN	118	
N	CH-16Y	SWPK 12 YELLOW	111	
P	CH-17Y	AUX SWPK 3 YELLOW	AUX 112	
R	CH-10G	SWPK 9 YELLOW	120**	
S	CH-11G	AUX SWPK 4 GREEN	AUX 116	
T	CH-18Y	AUX SWPK 6 YELLOW	AUX 105	
U	CH-10Y	SWPK 12 YELLOW	111**	
V	CH-12G	AUX SWPK 5 GREEN	AUX 103	
W	CH-18R	AUX SWPK 6 RED	AUX 104	
X		NC		
Y		DC GND	TBO2-2	
Z		EXT RESET	TBO2-5	
AA		+24 Vdc	TBO2-1	
BB		STOP TIME	TBO2-3	
CC		NC		
DD		NC		
EE		CMU K1 COMMON	TBO2-4	
FF		AC LINE	TBO1-11	

**OLB GREEN/YELLOW
optional conn. To AUX file

RED MONITOR CABLE ASSIGNMENT				
BOARD PIN	RIBBON PIN	CHANNEL	FUNCTION	CONN TO
P2-3	1	15	PH 6P RED	NC
P2-4	2	16	PH 8P RED	NC
P2-2	3	14	PH 4P RED	NC
P4-4	4			
P2-1	5	13	PH 2P RED	NC
P4-3	6		SPECIAL FUNCTION 2	NC
P1-12	7	12	OLD RED	AUX 101
P4-2	8		SPECIAL FUNCTION 1	NC
P1-10	9	10	OLB RED	AUX 124
P1-11	10	11	OLC RED	AUX 114
P1-9	11	9	OLA RED	AUX 121
P1-8	12	8	PH 8 RED	107
P1-7	13	7	PH 7 RED	122
P1-6	14	6	PH 6 RED	134
P1-5	15	5	PH 5 RED	131
P1-4	16	4	PH 4 RED	101
P1-3	17	3	PH 3 RED	116
P1-2	18	2	PH 2 RED	128
P1-1	19	1	PH 1 RED	125
P4-1	20		RED ENABLE	TBO1-14



INPUT FILE DETAIL

T1-T14 TERMINAL ASSIGNMENT

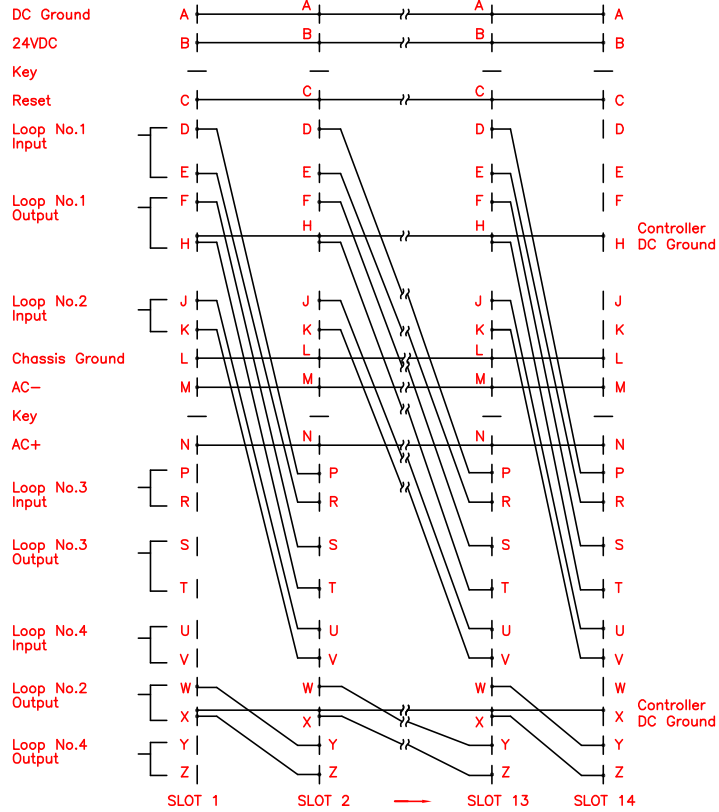
Term	Pin	Function
1	SP	Spare
2	F	Ch 1 Output
3	W	Ch 2 Output
4	D	Ch 1 Input
5	E	Ch 1 Input
6	J	Ch 2 Input
7	K	Ch 2 Input
8	L	Eq. GND

T15 TERMINAL ASSIGNMENT

Term	Pin	Function
1		+24 VDC
2		DC GND
3		Det Reset
4		CTR DC Gnd

T16 TERMINAL ASSIGNMENT

Term	Pin	Function
1		AC+
2		AC-
3		Equip. Gnd



FRONT VIEW

INPUT FILE WIRING DIAGRAM

NOTES:

- ALL DIMENSIONS SHOWN ARE IN INCHES
- SHOWN IN INPUT FILE DETAIL, TERMINAL BLOCKS T1-T14 SHALL BE THE BARRIER TYPE AND SHALL BE ATTACHED TO THE CHASSIS OF THE FILE WITH 8 8-32 x 0.3125 INCH NICKEL PLATED BRASS BINDER SCREWS AND NICKEL PLATED BRASS INSERTS.
- SHOWN IN INPUT FILE WIRING DIAGRAM, CONNECTOR PIN FUNCTIONS ARE THE SAME FOR ALL SLOTS. CENTER TO CENTER SPACING BETWEEN SLOTS SHALL BE 1.2 INCHES (± 0.02").



INPUT FILE WIRING

Drawn	IW	8/7/01	Title MODEL 332 CABINET ASSEMBLY		5/13
Reviewed	RV	8/8/01			
Checked	RD	8/8/01			
Revisions			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION		
			Approved	Oct / 03 /2001	Drawing No.
			Sean Skehan		S-75.9.1
			Signature		

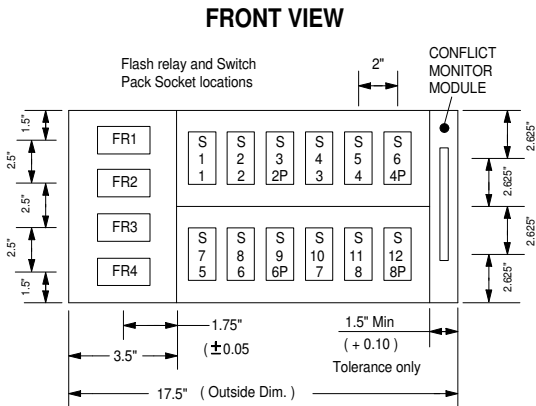
OUTPUT FILE No. 1
OUTPUT FIELD TERMINAL ASSIGNMENT DETAILS

FIELD TERMINAL	FUNCTION	FIELD TERMINAL	FUNCTION	FIELD TERMINAL	FUNCTION
101	SWPK 4-RED	113	SWPK 2P-RED	125	SWPK 1-RED
102	SWPK 4-YEL	114	SWPK 2P-YEL	126	SWPK 1-YEL
103	SWPK 4-GRN	115	SWPK 2P-GRN	127	SWPK 1-GRN
104	SWPK 4P-RED	116	SWPK 3-RED	128	SWPK 2-RED
105	SWPK 4P-YEL	117	SWPK 3-YEL	129	SWPK 2-YEL
106	SWPK 4P-GRN	118	SWPK 3-GRN	130	SWPK 2-GRN
107	SWPK 8-RED	119	SWPK 6P-RED	131	SWPK 5-RED
108	SWPK 8-YEL	120	SWPK 6P-YEL	132	SWPK 5-YEL
109	SWPK 8-GRN	121	SWPK 6P-GRN	133	SWPK 5-GRN
110	SWPK 8P-RED	122	SWPK 7-RED	134	SWPK 6-RED
111	SWPK 8P-YEL	123	SWPK 7-YEL	135	SWPK 6-YEL
112	SWPK 8P-GRN	124	SWPK 7-GRN	136	SWPK 6-GRN

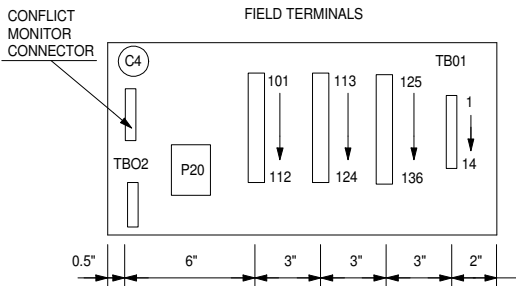
A CINC H JONES-SOCKET S-2412-SB OR EQUAL CONNECTED AS FOLLOWS:

PIN No.	CIRCUIT	PIN No.	CIRCUIT
1	AC +	7	GREEN OUTPUT
2	CHASSIS GROUND	8	YELLOW INPUT
3	RED OUTPUT	9	DC + (24 VDC)
4	RESERVED FOR DIMMER CIRCUIT	10	GREEN INPUT
5	YELLOW OUTPUT	11	AC -
6	RED INPUT	12	SEE NOTE 7

OUTPUT FILE No.1 DETAIL

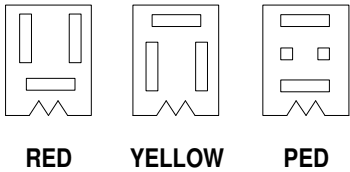


REAR VIEW

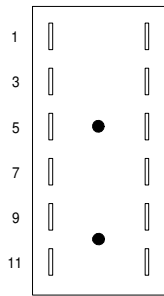


FLASH PROGRAM JUMPERS

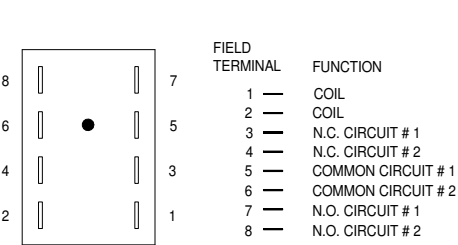
REAR VIEW



LOAD SWITCH SOCKET



FLASH RELAY SOCKET



TERMINAL BLOCK SCHEDULE

TB01-1	1	—	POWER CKT 1 S.P. 1, 2, 2P
	2	—	POWER CKT 2 S.P. 3, 4, 4P
	3	—	POWER CKT 3 S.P. 5, 6, 6P
	4	—	POWER CKT 4 S.P. 7, 8, 8P
	5	—	FLASHER UNIT # 1 CKT 1
	6	—	FLASHER UNIT # 1 CKT 2
	7	—	FLASHER UNIT # 2 CKT 1
	8	—	FLASHER UNIT # 2 CKT 2
	9	—	EQUIP. GROUND
	10	—	AC -
	11	—	AC +
	12	—	FLASH CONTROL C.M.U.
	13	—	FLASH STATUS INDICATOR
	14	—	FLASH TRANSFER RELAY COILS

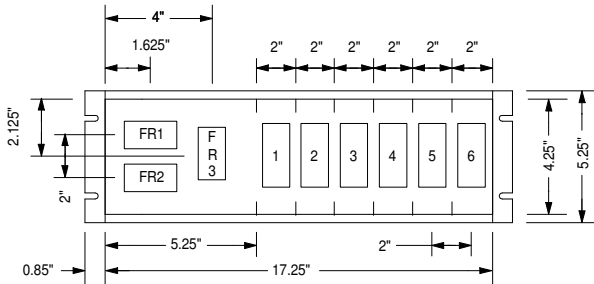
TB02-1	1	—	+ 24 VDC
	2	—	DC GROUND
	3	—	STOP TIME
	4	—	FLASH CONTROL POLICE PANEL
	5	—	EXT. RESET
	6	—	+ 24 VDC SWITCHED FROM TBI-4

OUTPUT FILE No. 2
AUXILIARY OUTPUT FILE TERMINAL ASSIGNMENT DETAIL

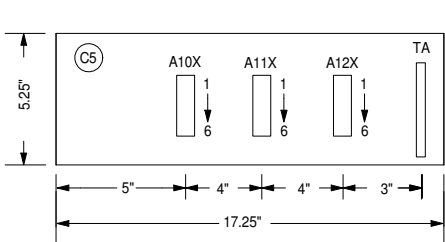
FIELD TERMINAL	FUNCTION	FIELD TERMINAL	FUNCTION	FIELD TERMINAL	FUNCTION
A101	SWPK 5-RED	A111	SWPK 3-RED	A121	SWPK 1-RED
A102	SWPK 5-YEL	A112	SWPK 3-YEL	A122	SWPK 1-YEL
A103	SWPK 5-GRN	A113	SWPK 3-GRN	A123	SWPK 1-GRN
A104	SWPK 6-RED	A114	SWPK 4-RED	A124	SWPK 2-RED
A105	SWPK 6-YEL	A115	SWPK 4-YEL	A125	SWPK 2-YEL
A106	SWPK 6-GRN	A116	SWPK 4-GRN	A126	SWPK 2-GRN

OUTPUT FILE No. 2
AUXILIARY OUTPUT FILE DETAIL

FRONT VIEW



REAR VIEW



TA ASSIGMENTS

POSITION	FUNCTION
1	FLASHER UNIT # 1 CKT 1
2	FLASHER UNIT # 2 CKT 2
3	FR RELAY COILS
4	AC -
5	POWER CIRCUIT, CKT 5
6	POWER, CIRCUIT 5
7	EQUIPMENT GROUND BUS
8	FLASHER UNIT # 2 CKT 1

NOTES:

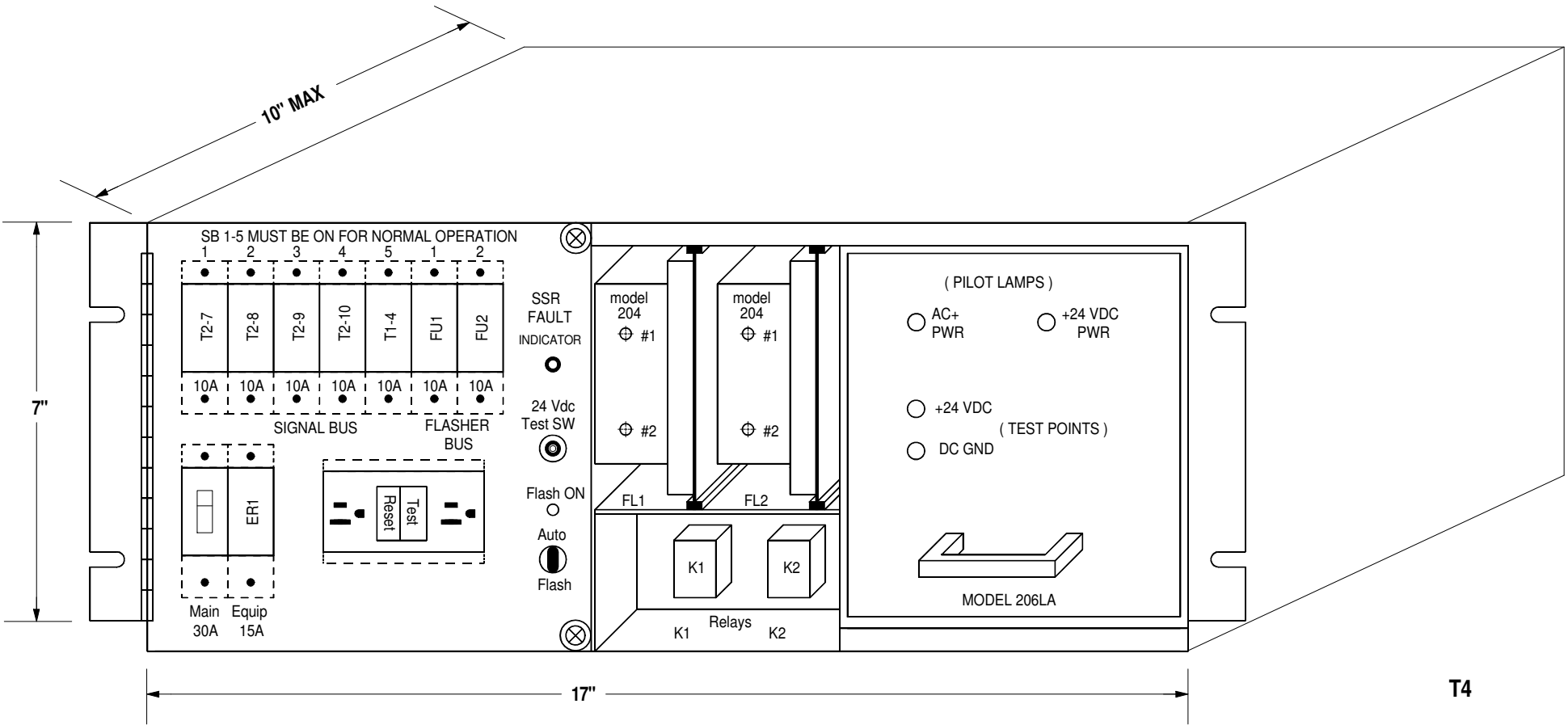
- ALL DIMENISONS SHOWN ARE IN INCHES.
- SWITCHPACK OUTPUT SHOWN IN OUTPUT FILE SHALL CONNECT TO THE FIELD TERMINALS 101 - 136.
- SWITCHPACK OUTPUT SHOWN IN AUXILIARY OUTPUT FILE SHALL CONNECT TO THE FIELD TERMINALS A101 - A126.
- TOP OF RELAYS SHALL BE FLUSH WITH FACE OF FILE.
- FLASH RELAY AND SWITCHPACK SOCKETS LOCATIONS ARE TYPICAL.
- FLASH RELAY SOCKET SHALL BE BEAU S-5408-SB OR EQUAL.
- ALL SWITCHPACK SOCKETS PIN 12 TO BE WIRED IN PARALLEL AND BUNDLED AS A SPARE.
- SIX FLASH PROGRAM JUMPERS SHALL BE PROVIDED IN AUXILIARY OUTPUT FILE.

OUTPUT FILE WIRING

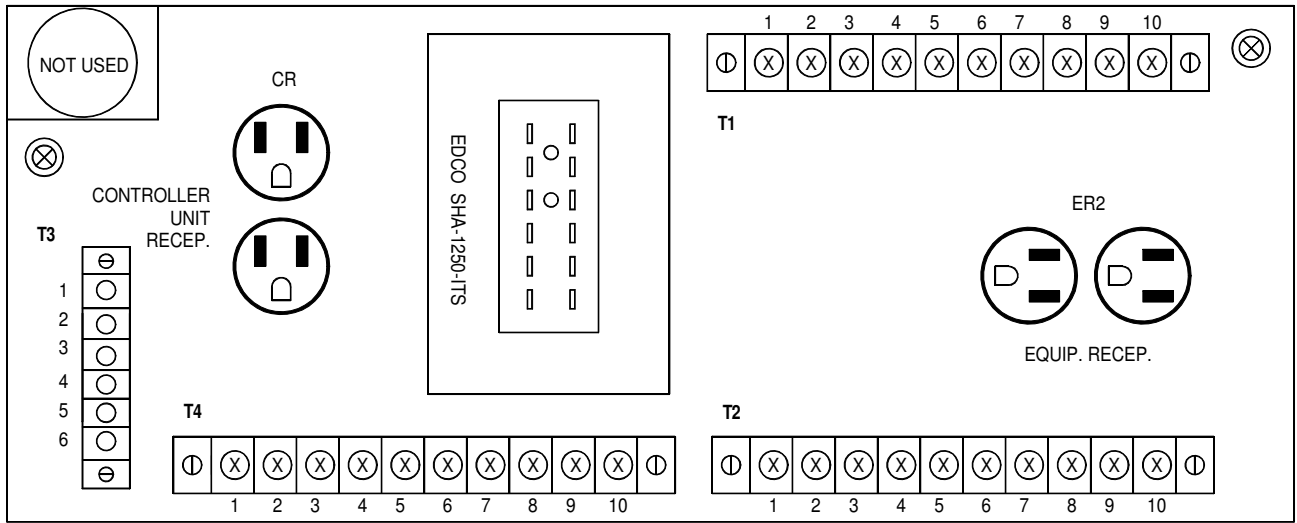
Drawn			Title	MODEL 332 CABINET ASSEMBLY
Reviewed				
Checked				
Revisions			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION	
			Approved	/ / 200
			Signature	Drawing No.

POWER DISTRIBUTION ASSEMBLY No. 1 (PDA No. 1)

FRONT VIEW



REAR VIEW



NOTE: 1. PDA T1, T2, AND T4 TERMINAL BLOCKS SHALL BE 10 POSITION BARRIER TYPE.

POWER DISTRIBUTION ASSEMBLY T1 TO T4

TERMINAL BLOCK ASSIGNMENT DETAIL

T1

POSITION	A (INT)	B (EXT)
1	EQ GROUND	EQ GND BUS
2	NOISE FILTER NEUTRAL (IN)	TBS-3
3	FILTER, CLEAN NEUTRAL (OUT)	J16-2, I16-2
4	C.B. 5, SIG BUS	AUX. CB.
5	MAIN C.B. SECONDARY	HP1-3
6	FILTER, CLEAN AC + (OUT)	J16-1, I16-1
7	FLASH BUS	TB01-14
8	FLASH BUS STATUS	TB9-1
9	FLASH CB.	HP1-11
10	EQ C.B. SEC.	NC

T2

POSITION	A (INT)	B (EXT)
1	TB01-12	C.B. 5 PILOT SW.
2	TB01-5	FLM Unit 1, pin 7
3	TB01-6	FLM Unit 1, pin 8
4	TB01-7	FLM Unit 2, pin 7
5	TB01-8	FLM Uint 2, pin 8
6	TB01-13	FLASH STATUS INDICATOR
7	TB0-1	SIG. CB, CKT - 1
8	TB0-2	SIG. CB, CKT - 2
9	TB0-3	SIG. CB, CKT - 3
10	TB0-4	SIG. CB, CKT - 4

T3

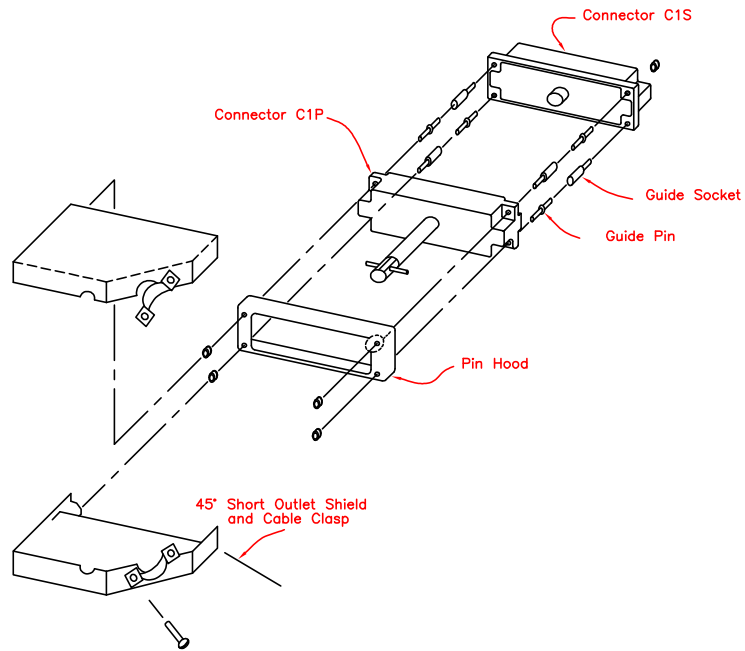
POSITION	A (INT)	B (EXT)
1	DC P.S. + 24 VDC	TB1-1
2	IR RELAY N.O.	TB1-4 SWITCHED DC BUS
3	SWITCHED DCN	FLASH SENSE
4	DC PS COMMON	DCN BUS

T4

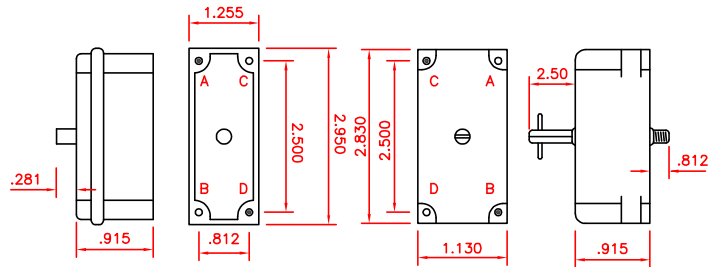
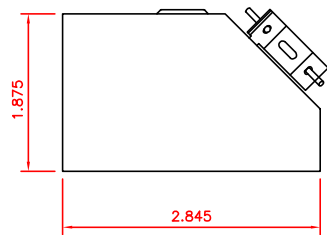
POSITION	A (INT)	B (EXT)
1	NC	NC
2	NC	NC
3	NC	NC
4	NC	NC
5	NC	NC
6	NC	NC
7	NC	NC
8	NC	NC
9	NC	NC
10	NC	NC

POWER DISTRIBUTION ASSEMBLY

Drawn			Title MODEL 332 CABINET ASSEMBLY	
Reviewed				
Checked				
Revisions			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION	
7/1/2008				
			Approved _____ / / 200	Drawing No.
			Signature _____	

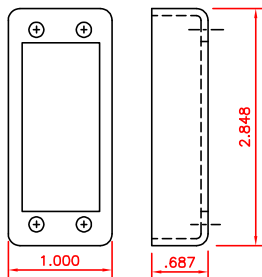


CONNECTORS C1 DETAIL

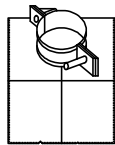


CONNECTOR C1S

CONNECTOR C1P



HOOD FOR C1P



SHIELD FOR C1P

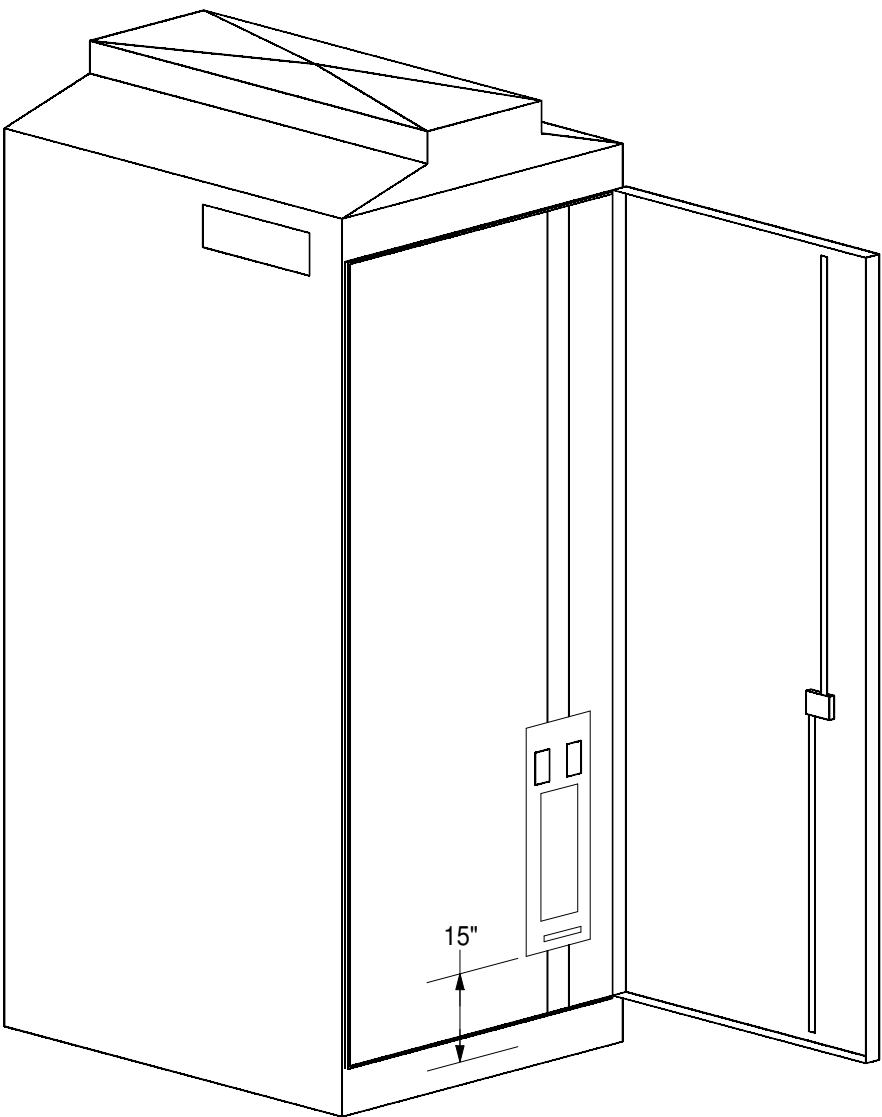
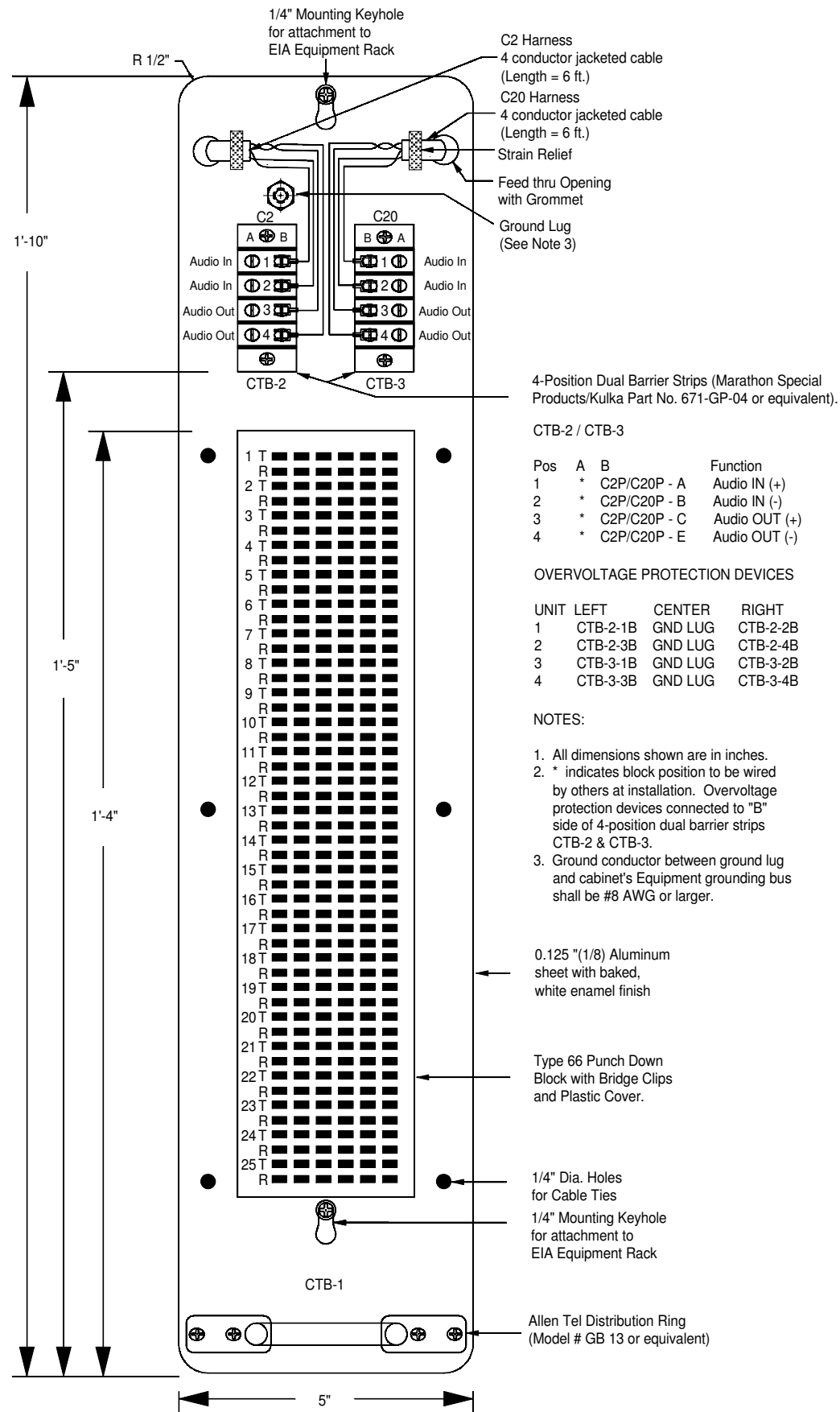
NOTES:

1. ALL DIMENSIONS SHOWN ARE IN INCHES
2. THE DARKER CIRCLES IN THE C1S AND C1P CONNECTOR DETAILS DENOTE GUIDE PIN LOCATIONS AND THE OPEN CIRCLES DENOTE GUIDE SOCKET LOCATIONS ON THE MATING SURFACES OF THE C1S AND C1P. CORNER GUIDES FOR THE C1S; PINS A AND D, SOCKETS B AND C. CORNER GUIDES FOR THE C1P; PINS B, C, SOCKETS A AND D.



C1 CONNECTOR

Drawn	IW	8/7/01	Title MODEL 332 CABINET ASSEMBLY		8/13
Reviewed	RV	8/8/01			
Checked	RD	8/8/01			
Revisions			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION		
			Approved	08 / 08 /2001	Drawing No.
			Sean Skehan		S-75.9.1
			Signature		



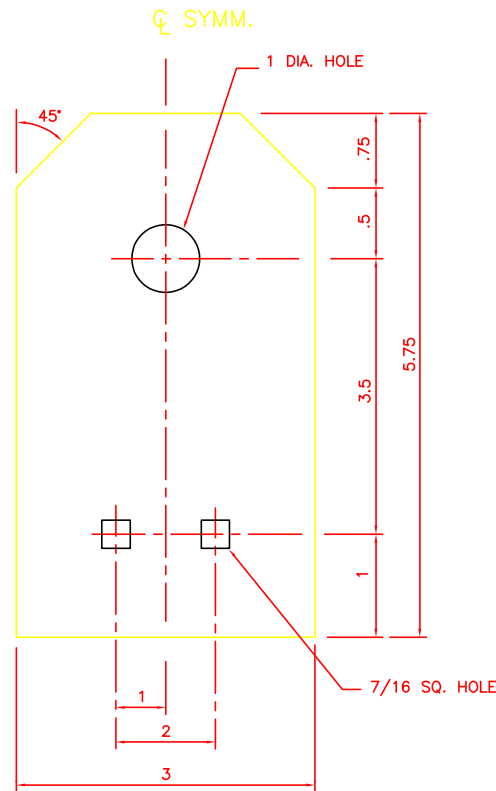
Panel to be attached to EIA Equipment Rack as shown

CONNECTORS C2 / C20
SOCKET ASSIGNMENT

Socket Contacts	Function	Socket Contacts	Function
A	Audio in (+)	J	RTS
B	Audio in (-)	K	Data IN
C	Audio Out (+)	L	Data OUT
D	+ 5 VDC	M	CTS
E	Audio Out (-)	N	DC GND.
F	- 5 VDC	P	
H	Carrier Det.	R	

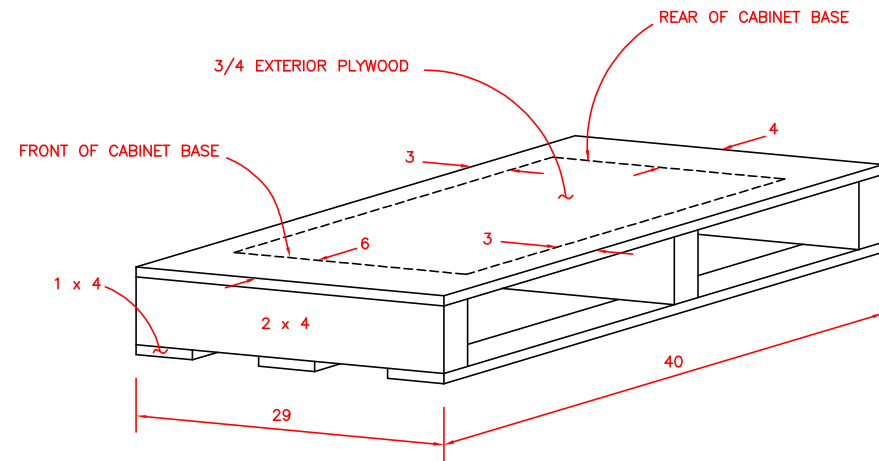
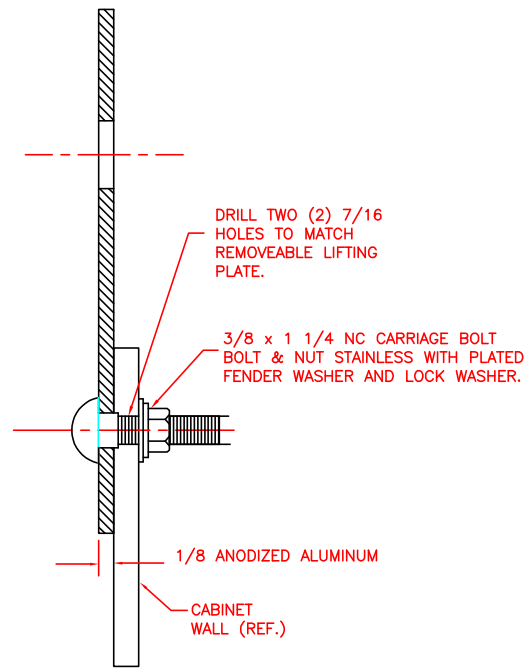
COMMUNICATION TERMINATION PANEL

Drawn			Title MODEL 332 CABINET ASSEMBLY	9/11
Reviewed				
Checked				
Revisions			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION	
			Approved _____ / / 200	Drawing No.
			Signature _____	



NOT TO SCALE

LIFTING PLATES



CABINET PALLET

NOTES:

1. ALL DIMENSIONS SHOWN ARE IN INCHES.
2. THE DASH LINES SHOWN ON THE CABINET PALLET DELINEATE THE POSITIONING OF THE CABINET ON THE PALLET.



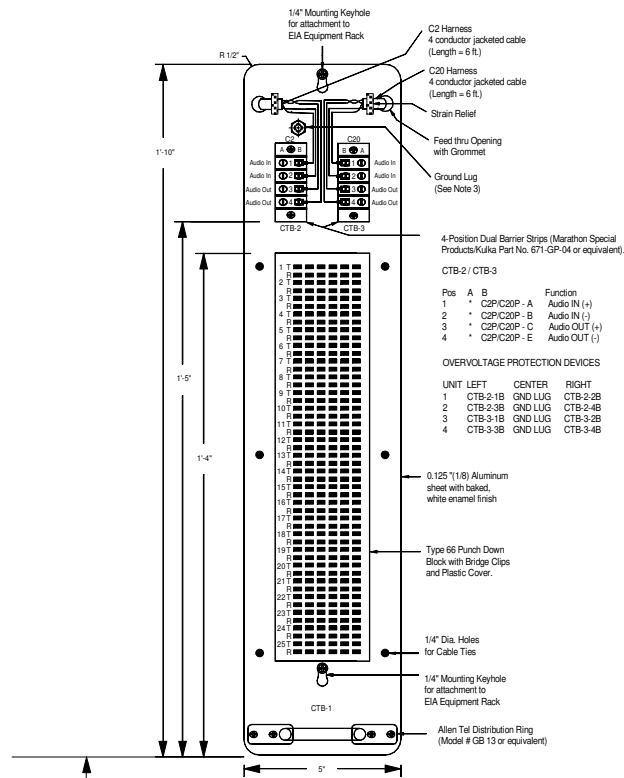
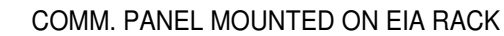
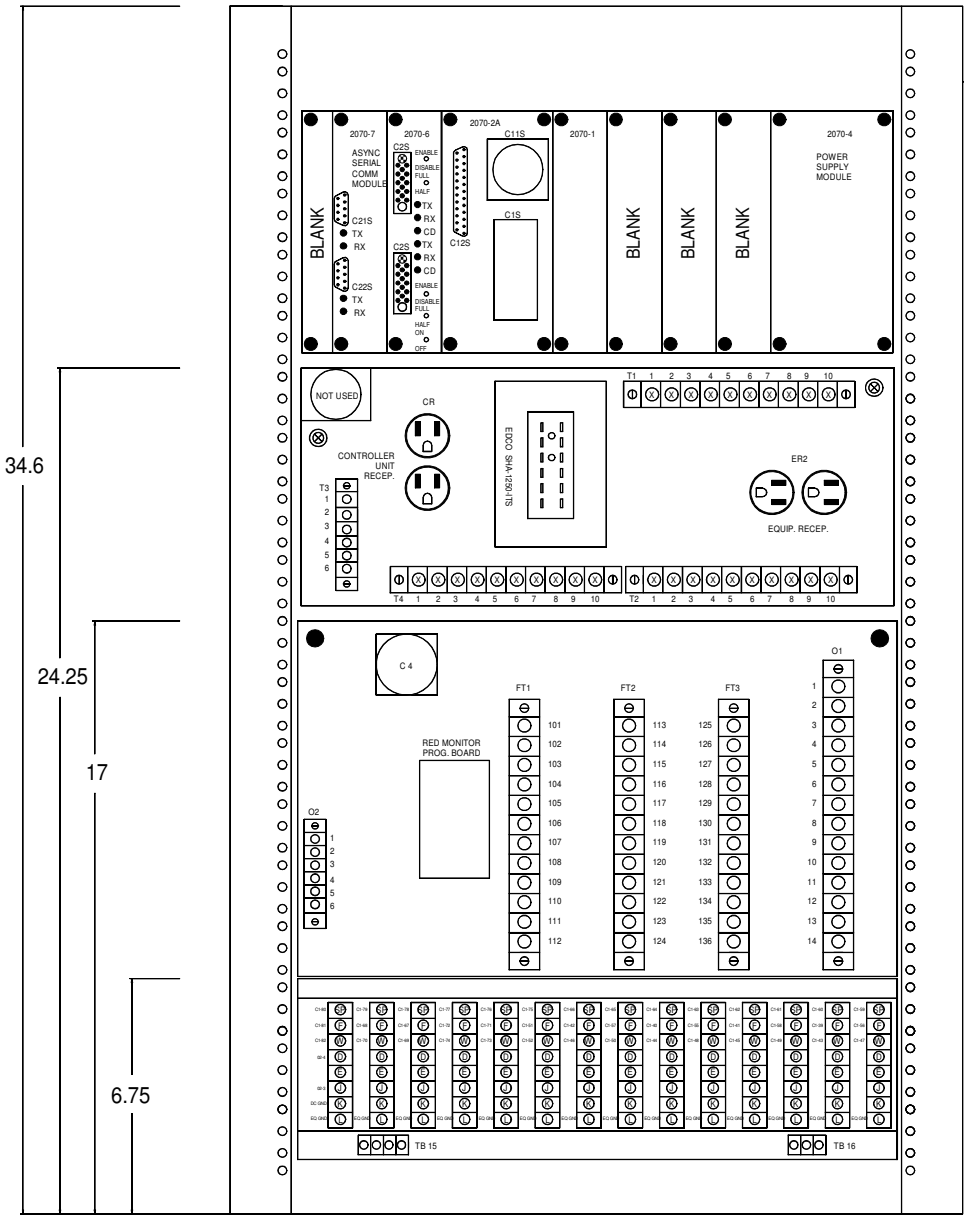
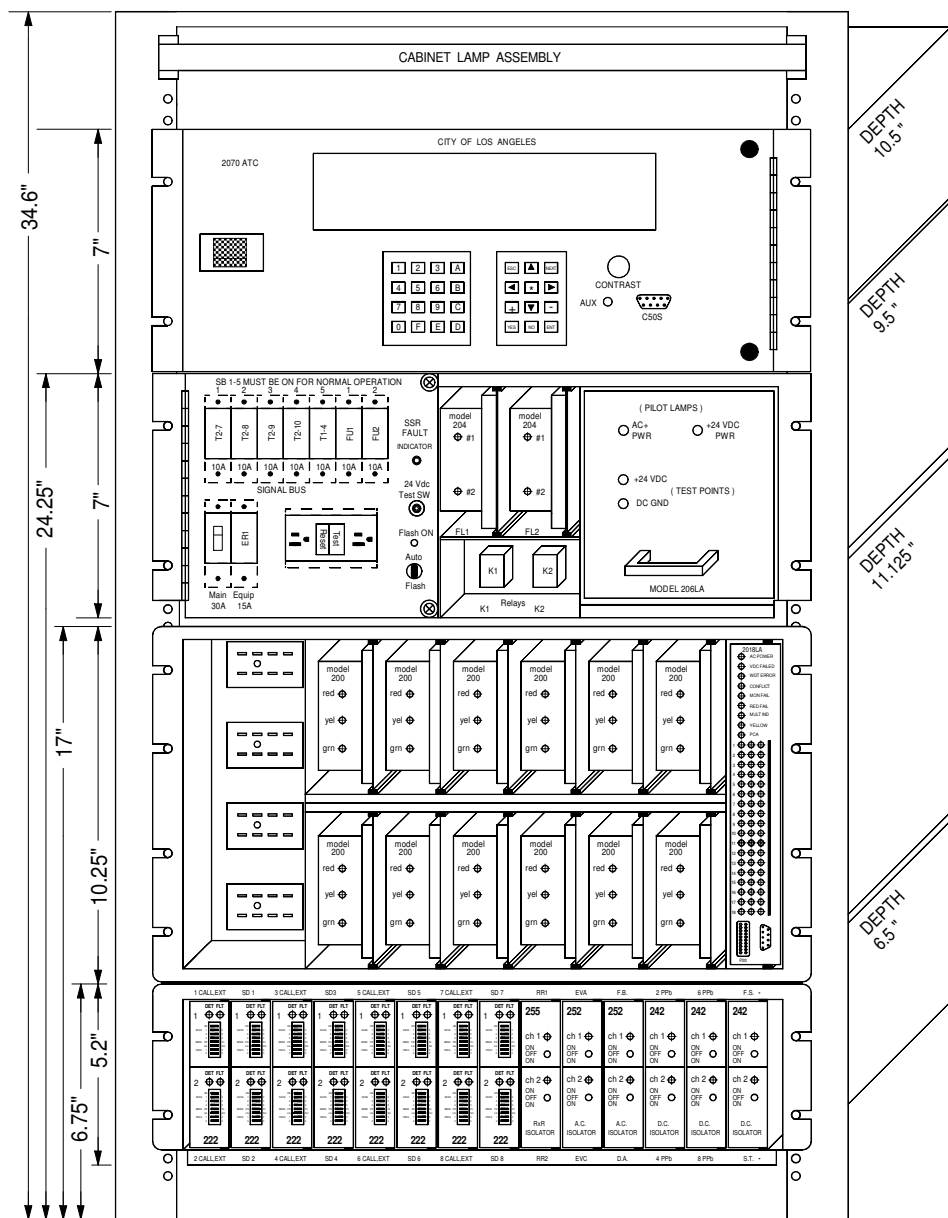
332 CABINET PALLET
AND LIFTING PLATES

Drawn	IW	8/7/01	Title MODEL 332 CABINET ASSEMBLY		13 13
Reviewed	RV	8/8/01			
Checked	RD	8/8/01			
Revisions			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION		
			Approved	08 / 08 /2001	Drawing No.
			Anson Nordby		S-75.9.1
			Signature		

DRAWINGS- MODEL 336 CABINET ASSEMBLY

1. 336 Cabinet Rack Assembly Details
2. 336 Cabinet Assembly Connector Pin Assignments
3. 336 Input File Port Bit/ C-1 Pin Assignment
4. 336 Cabinet Base Adaptors and Shipping Pallet

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NOTES

1. All dimensions shown are in inches.
2. * indicates block position to be wired by others at installation. Overvoltage protection devices connected to "B" side of 4-position dual barrier strips CTB-2 & CTB-3.
3. Ground conductor between ground lug and cabinet's Equipment grounding bus shall be #8 AWG or larger.

CONNECTORS C2 / C2 SOCKET ASSIGNMENT

<u>Socket</u> <u>Contacts</u>	<u>Function</u>	<u>Socket</u> <u>Contacts</u>	<u>Function</u>
A	Audio In (+)	J	RTS
B	Audio In (-)	K	Data IN
C	Audio Out (+)	L	Data OUT
D	+ 5 VDC	M	CTS
E	Audio Out (-)	N	DC GND.
F	- 5 VDC	P	
H	Carrier Det.	R	

10" MIN

336 INTERNAL RACK

Drawn			Title MODEL 336 CABINET ASSEMBLY 1 4	
Reviewed				
Checked				
Revisions			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION	
7/1/2008				
			Approved _____ / _____ / 200	Drawing No.

			Signature	

336 CABINET CONNECTOR PIN ASSIGNMENTS

CONNECTOR C1 PIN ASSIGNMENT																			
C1	PIN	SOURCE	FUNCTION	CONN	TO		C1	PIN	SOURCE	FUNCTION	CONN	TO		C1	PIN	SOURCE	FUNCTION	CONN	TO
	1	DC GND	LOGIC GND	DC	GND			27	04-1	SWPK 9 RED	C4S-25				53	I2-7	AD ENABLE	TB2-5A	
	2	01-1	SWPK 6 RED	C4S-1				28	04-2	SWPK 9 GREEN	C4S-26				54	I2-8	FLASH BUS	I11-F	
	3	01-2	SWPK 6 GREEN	C4S-2				29	04-3	SWPK 8 RED	C4S-27				55	I3-1	DETECTOR	I5-F	
	4	01-3	SWPK 5 RED	C4S-3				30	04-4	SWPK 8 YELLOW	C4S-28				56	I3-2	DETECTOR	I1-F	
	5	01-4	SWPK 5 YELLOW	C4S-4				31	04-5	SWPK 8 GREEN	C4S-29				57	I3-3	DETECTOR	I7-F	
	6	01-5	SWPK 5 GREEN	C4S-5				32	04-6	SWPK 7 RED	C4S-30				58	I3-4	DETECTOR	I3-F	
	7	01-6	SWPK 4 RED	C4S-6				33	04-7	SWPK 7 YELLOW	C4S-31				59	I3-5	DETECTOR	I1-SP	
	8	01-7	SWPK 4 YELLOW	C4S-7				34	04-8	SWPK 7 GREEN	C4S-32				60	I3-6	DETECTOR	I2-SP	
	9	01-8	SWPK 4 GREEN	C4S-8				35	05-1	SWPK 3 YELLOW	C4S-33				61	I3-7	DETECTOR	I3-SP	
	10	02-1	SWPK 3 RED	C4S-9				36	05-2	SWPK 9 YELLOW	C4S-34				62	I3-8	DETECTOR	I4-SP	
	11	02-2	SWPK 3 GREEN	C4S-10				37	05-3	SWPK 6 YELLOW	C4S-35				63	I4-5	DETECTOR	I5-SP	
	12	02-3	SWPK 2 RED	C4S-11				38	05-4	SWPK 12 YELLOW	C4S-36				64	I4-6	DETECTOR	I6-SP	
	13	02-4	SWPK 2 YELLOW	C4S-12				39	I1-1	DETECTOR	I2-F				65	I4-7	DETECTOR	I7-SP	
	14	LOG GND	LOGIC GND	I15-4				40	I1-2	DETECTOR	I6-F				66	I4-8	DETECTOR	I8-SP	
	15	02-5	SWPK 2 GREEN	C4S-13				41	I1-3	DETECTOR	I4-F				67	I5-1	2 PED Ppb	I12-F	
	16	02-6	SWPK 1 RED	C4S-14				42	I1-4	DETECTOR	I8-F				68	I5-2	6 PED Ppb	I13-F	
	17	02-7	SWPK 1 YELLOW	C4S-15				43	I1-5	DETECTOR	I2-W				69	I5-3	4 PED Ppb	I12-W	
	18	02-8	SWPK 1 GREEN	C4S-16				44	I1-6	DETECTOR	I6-W				70	I5-4	8 PED Ppb	I13-W	
	19	03-1	SWPK 12 RED	C4S-17				45	I1-7	DETECTOR	I4-W				71	I5-5	EVA	I10-F	
	20	03-2	SWPK 12 GREEN	C4S-18				46	I1-8	DETECTOR	I8-W				72	I5-6			
	21	03-3	SWPK 11 RED	C4S-19				47	I2-1	DETECTOR	I1-W				73	I5-7	EVC	I10-W	
	22	03-4	SWPK 11 YELLOW	C4S-20				48	I2-2	DETECTOR	I5-W				74	I5-8			
	23	03-5	SWPK 11 GREEN	C4S-21				49	I2-3	DETECTOR	I3-W				75	I6-1	DOOR AJAR	I11-W	
	24	03-6	SWPK 10 RED	C4S-22				50	I2-4	DETECTOR	I7-W				76	I6-2	DETECTOR	I10-SP	
	25	03-7	SWPK 10 YELLOW	C4S-23				51	I2-5	RR1	I9-F				77	I6-3	DETECTOR	I11-SP	
	26	03-8	SWPK 10 GREEN	C4S-24				52	I2-6	RR2	I9-W				78	I6-4	DETECTOR	I12-SP	

CONNECTOR C4 PIN ASSIGNMENT		
C4 NO	PIN SOURCE	CONN TO
1	C1-2	SWPK 6-6
2	C1-3	SWPK 6-10
3	C1-4	SWPK 5-6
4	C1-5	SWPK 5-8
5	C1-6	SWPK 5-10
6	C1-7	SWPK 4-6
7	C1-8	SWPK 4-8
8	C1-9	SWPK 4-10
9	C1-10	SWPK 3-6
10	C1-11	SWPK 3-10
11	C1-12	SWPK 2-6
12	C1-13	SWPK 2-8
13	C1-15	SWPK 2-10
14	C1-16	SWPK 1-6
15	C1-17	SWPK 1-8
16	C1-18	SWPK 1-10
17	C1-19	SWPK 12-6
18	C1-20	SWPK 12-10
19	C1-21	SWPK 11-6
20	C1-22	SWPK 11-8
21	C1-23	SWPK 11-10
22	C1-24	SWPK 10-6
23	C1-25	SWPK 10-8
24	C1-26	SWPK 10-10
25	C1-27	SWPK 9-6
26	C1-28	SWPK 9-10
27	C1-29	SWPK 8-6
28	C1-30	SWPK 8-8
29	C1-31	SWPK 8-10
30	C1-32	SWPK 7-6
31	C1-33	SWPK 7-8
32	C1-34	SWPK 7-10
33	C1-35	SWPK 3-8
34	C1-36	SWPK 9-8
35	C1-37	SWPK 6-8
36	C1-38	SWPK 12-8
37	C1-103	CMU -22

CONNECTOR C5 PIN ASSIGNMENT		
C5 PIN NO	SOURCE	CONN TO
1	N/C	
2	N/C	
3	N/C	
4	N/C	
5	N/C	
6	N/C	
7	N/C	
8	N/C	
9	N/C	
10	N/C	
11	N/C	
12	N/C	
13	N/C	
14	N/C	
15	N/C	
16	N/C	
17	N/C	
18	N/C	
19	N/C	
20	N/C	
21	N/C	
22	N/C	
23	N/C	
24	N/C	

18 CHANNEL CMU EDGE CONN ASSIGNMENT			
PIN	CHANNEL	FUNCTION	CONN TO
1	CH -2G	SWPK 2 GREEN	130
2	CH-13G	SWPK 3 GREEN	115
3	CH-6Y	SWPK 8 YELLOW	135
4	CH-4G	SWPK 5 GREEN	103
5	CH-14G	SWPK 6 GREEN	106
6	CH-8Y	SWPK 11 YELLOW	108
7	CH-5G	SWPK 7 GREEN	133
8	CH-13Y	SWPK 3 YELLOW	114
9	CH-1Y	SWPK 1 YELLOW	126
10	CH-7G	SWPK 10 GREEN	124
11	CH-14Y	SWPK 6 YELLOW	105
12	CH-3Y	SWPK 4 YELLOW	117
13	CH-9G	SWPK 3 YELLOW	114
14	CH-17G		
15	CH-11Y		
16	CH-9Y	SWPK 6 YELLOW	105
17	CH-18G		
18	CH-12Y		
19	CH-17R		
20		EQ GROUND	TBO1-9
21		AC-	TBO1-10
22		WATCHDOG	C4-37
23		+24 Vdc	TBO2-1
24			
25			
26		NC	
27		CMU K1 N.O.	TBO1-12
28		CMU K1 N.C.	TBO1-13

18 CHANNEL CMU EDGE CONN ASSIGNMENT			
PIN	CHANNEL	FUNCTION	CONN TO
A	CH -2Y	SWPK 2 YELLOW	129
B	CH-6G	SWPK 8 GREEN	136
C	CH-15G	SWPK 9 GREEN	121
D	CH-4Y	SWPK 5 YELLOW	102
E	CH-8G	SWPK 11 GREEN	109
F	CH-16G	SWPK 12 GREEN	112
H	CH-5Y	SWPK 7 YELLOW	132
J	CH-1G	SWPK 1 GREEN	127
K	CH-15Y	SWPK 9 YELLOW	120
L	CH-7Y	SWPK 10 YELLOW	123
M	CH-3G	SWPK 4 GREEN	118
N	CH-16Y	SWPK 12 YELLOW	111
P	CH-17Y		
R	CH-10G	SWPK 9 YELLOW	120
S	CH-11G		
T	CH-18Y		
U	CH-10Y	SWPK 12 YELLOW	111
V	CH-12G		
W	CH-18R		
X		NC	
Y		DC GND	TBO2-2
Z		EXT RESET	TBO2-5
AA		+24 Vdc	TBO2-1
BB		STOP TIME	TBO2-3
CC		NC	
DD		NC	
EE		CMU K1 COMMON	TBO2-4
FF		AC LINE	TBO1-11

RED MONITOR CABLE ASSIGNMENT				
BOARD PIN	RIBBON PIN	CHANNEL	FUNCTION	CONN TO
P2-3	1	15	PH 6P RED	NC
P2-4	2	16	PH 8P RED	NC
P2-2	3	14	PH 4P RED	NC
P4-4	4			
P2-1	5	13	PH 2P RED	NC
P4-3	6		SPECIAL FUNCTION 2	NC
P1-12	7	12		
P4-2	8		SPECIAL FUNCTION 1	NC
P1-10	9	10		
P1-11	10	11		
P1-9	11	9		
P1-8	12	8	PH 8 RED	107
P1-7	13	7	PH 7 RED	122
P1-6	14	6	PH 6 RED	134
P1-5	15	5	PH 5 RED	131
P1-4	16	4	PH 4 RED	101
P1-3	17	3	PH 3 RED	116
P1-2	18	2	PH 2 RED	128
P1-1	19	1	PH 1 RED	125
P4-1	20		RED ENABLE	TBO1-14

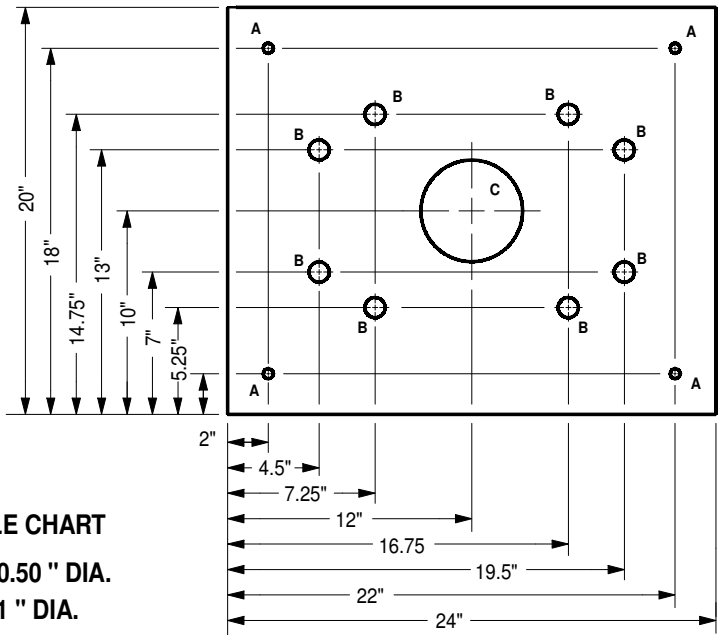
336 Cabinet

Port-Bit/ C-1 Pin
Assignment

C-1 Spares	59	60	61	62	63	64	65	66	67	76	77	78	79	80
Port C-1	2-1 47	1-1 39	3-4 58	1-3 41	3-1 55	1-2 40	3-3 57	1-4 42	2-5 51	5-5 71	2-8 54	5-1 67	5-2 68	6-7 81
Port C-1	3-2 56	1-5 43	2-3 49	1-7 45	2-2 48	1-6 44	2-4 50	1-8 46	2-6 52	5-7 73	6-1 75	5-3 69	5-4 70	6-8 82

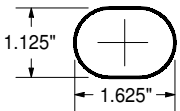
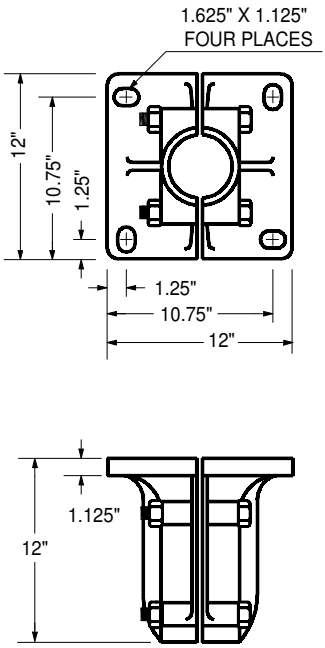
336 PEDESTAL ADAPTOR

SLIPFITTER BASE PLATE DETAIL
(0.375 IN ALUMINUM)

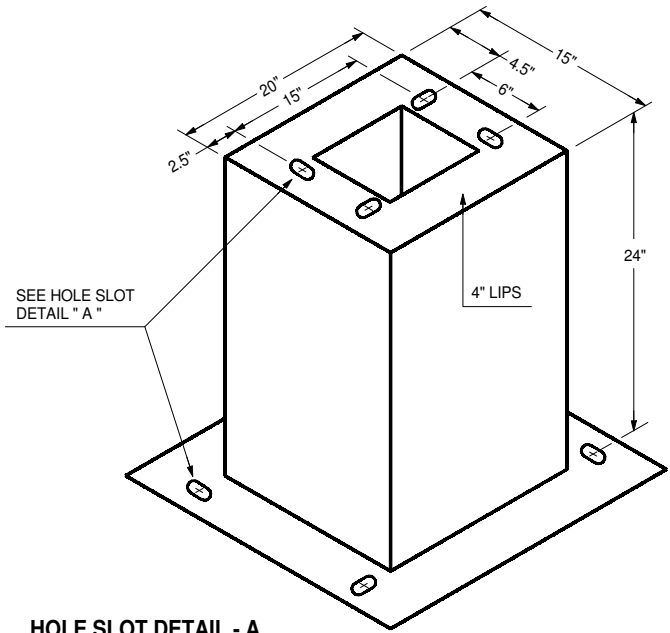


HOLE CHART
A = 0.50 " DIA.
B = 1 " DIA.
C = 5 " DIA.

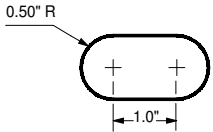
SLIPFITTER
(CAST ALUMINUM)
DETAIL



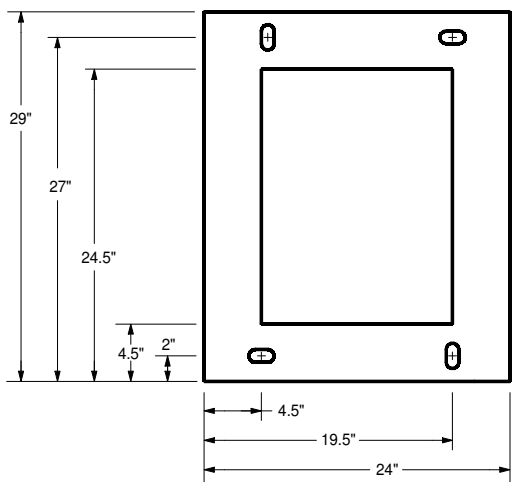
TYPE 332 / 336 ADAPTOR



HOLE SLOT DETAIL - A

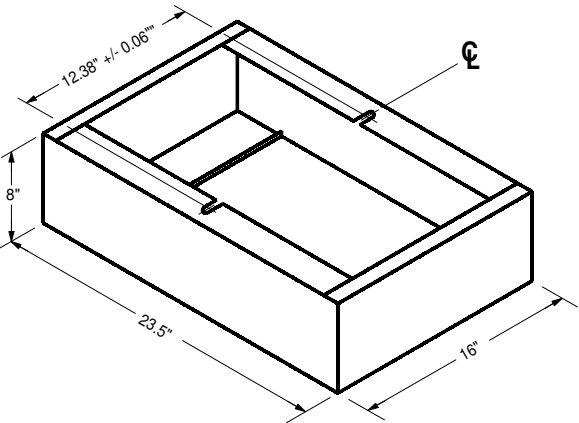
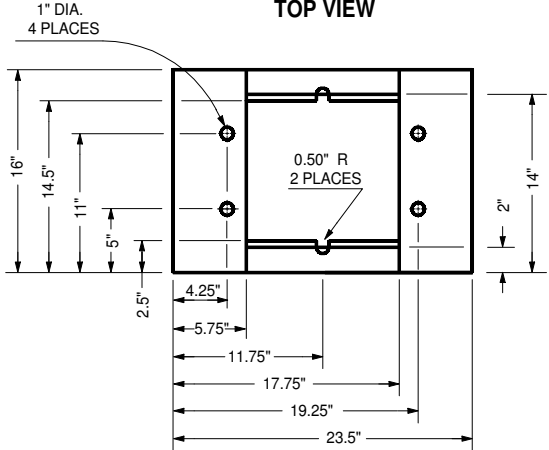


332 BASE VIEW



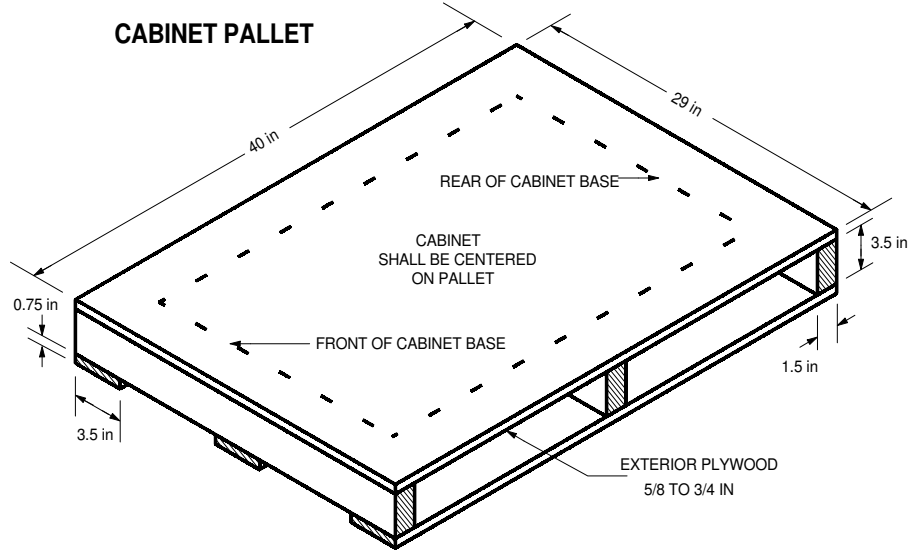
CABINET HOUSING 2
" M " BASE ADAPTOR DETAIL

TOP VIEW



BOTTOM VIEW

336 CABINET
BASE ADAPTORS



NOTE :

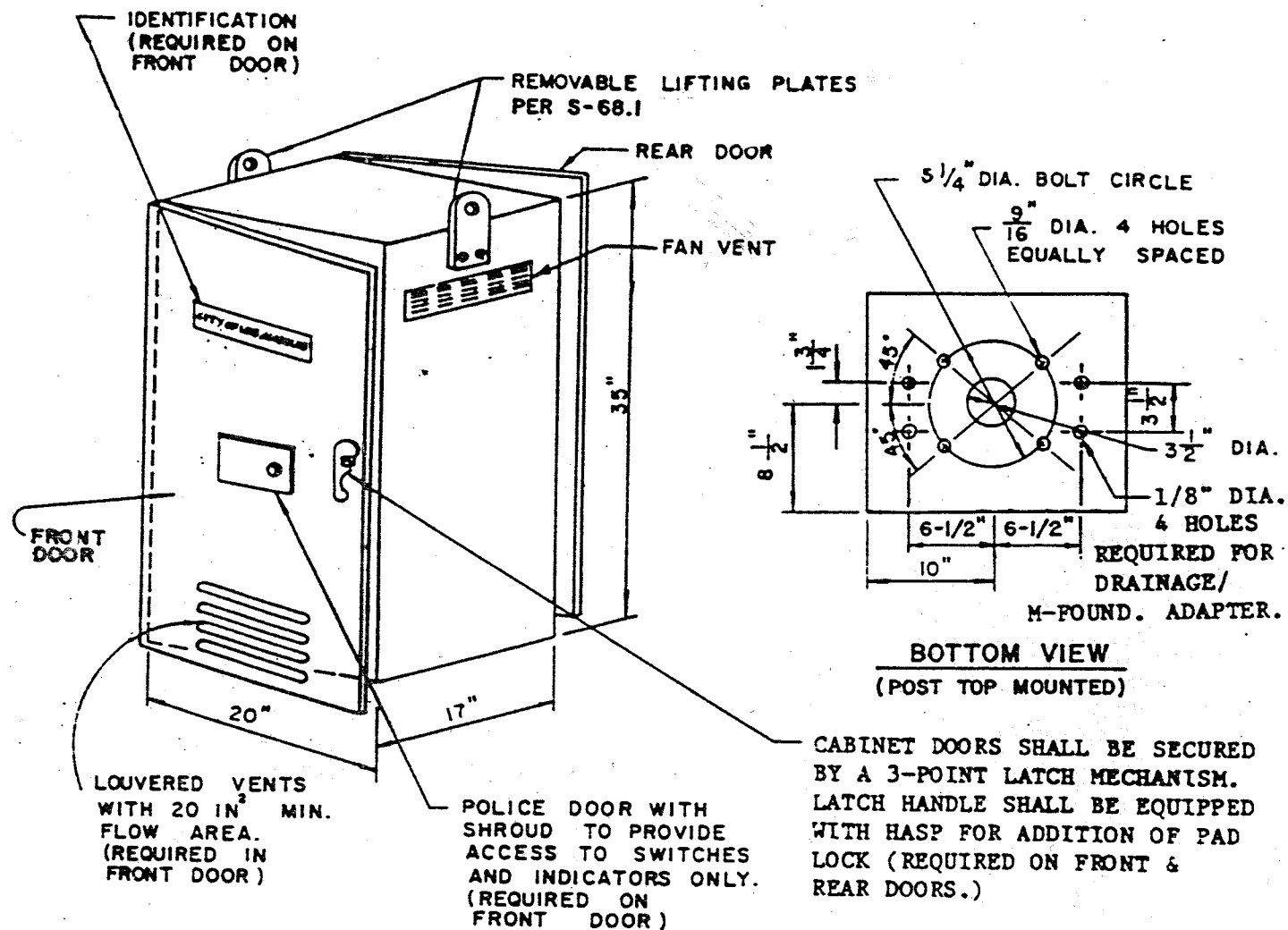
ALL ADAPTORS DELIVERED SEPARATELY SHALL
BE DELIVERED CENTERED AND BOLTED ON
A PLYBOARD SHIPPING PALLET.

Drawn			Title MODEL 336 CABINET ASSEMBLY 4 4	
Reviewed				
Checked				
Revisions			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION	
			Approved _____ / _____ / 200	Drawing No.
			Signature _____	

DRAWINGS- MODEL 337 CABINET ASSEMBLY

1. Cabinet Details
2. Cabinet Interior
3. One Line Cabinet Diagram
4. 337 Cabinet Input File
5. 337 Cabinet C-1 Pin Assignment
6. Terminal Block and Connector Pin Assignments
7. Input File Wiring
8. Power Distribution Assembly
9. Field Terminal Assignments
10. Input/Output Port Address
11. Peripheral Equipment
12. Communications Terminal Panel Wiring Detail
13. Solid State Switchpack Drawing
14. 337 Cabinet Lifting Plate

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BOTTOM VIEW
(POST TOP MOUNTED)

CABINET DOORS SHALL BE SECURED BY A 3-POINT LATCH MECHANISM. LATCH HANDLE SHALL BE EQUIPPED WITH HASP FOR ADDITION OF PAD LOCK (REQUIRED ON FRONT & REAR DOORS.)

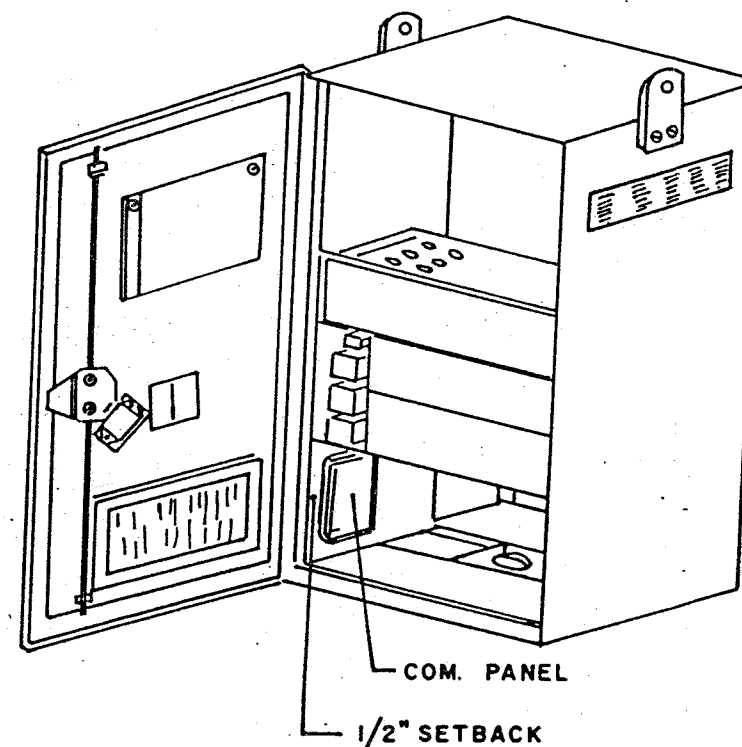
NOTES:

1. CABINET CONSTRUCTION, VENTILATION REQUIREMENTS AND OTHER NECESSARY ACCESSORIES SHALL CONFORM TO THE LATEST SPECIFICATION FOR "CABINET ASSEMBLY - TYPE 170 POST-TOP MOUNTED", DEPT. OF TRANSPORTATION, CITY OF LOS ANGELES.
2. CABINET SHALL BE EQUIPPED WITH RAILS FOR MOUNTING EQUIPMENT. RAILS SHALL BE OF STANDARD 19" RACK CONFIGURATION.

TYPE	FOUNDATION
TYPE 170 (POST - TOP MOUNTED)	F - 8

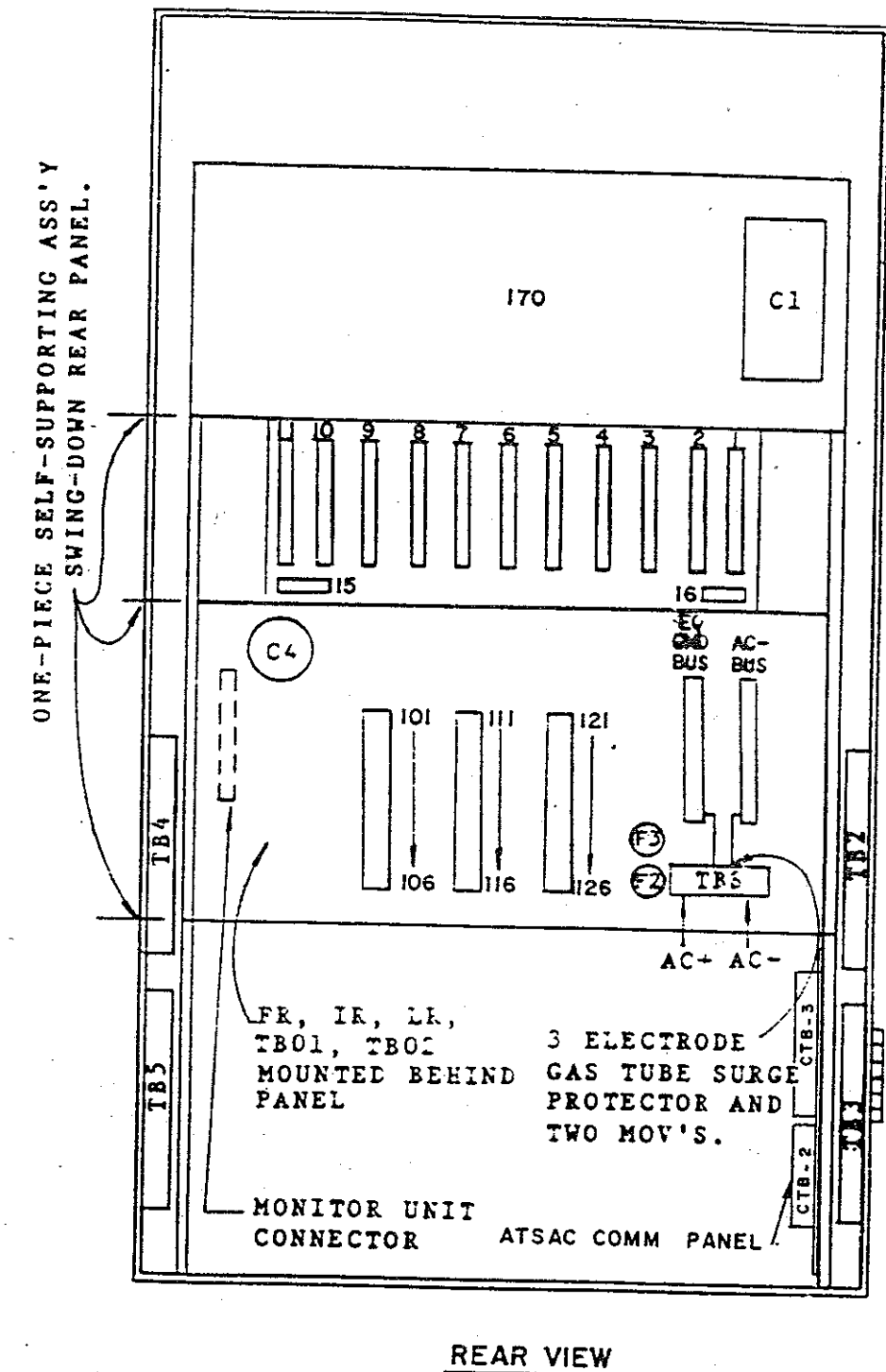
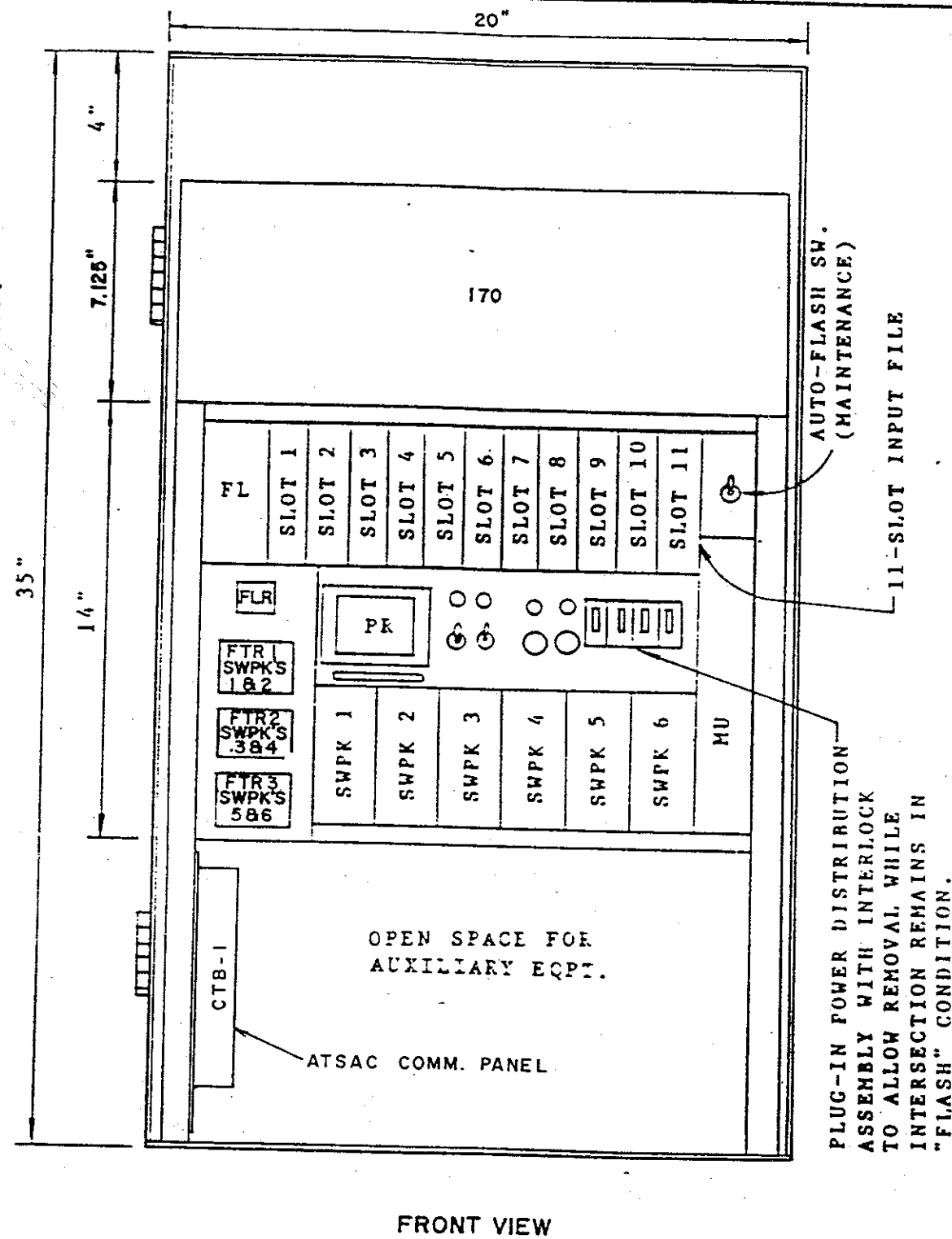
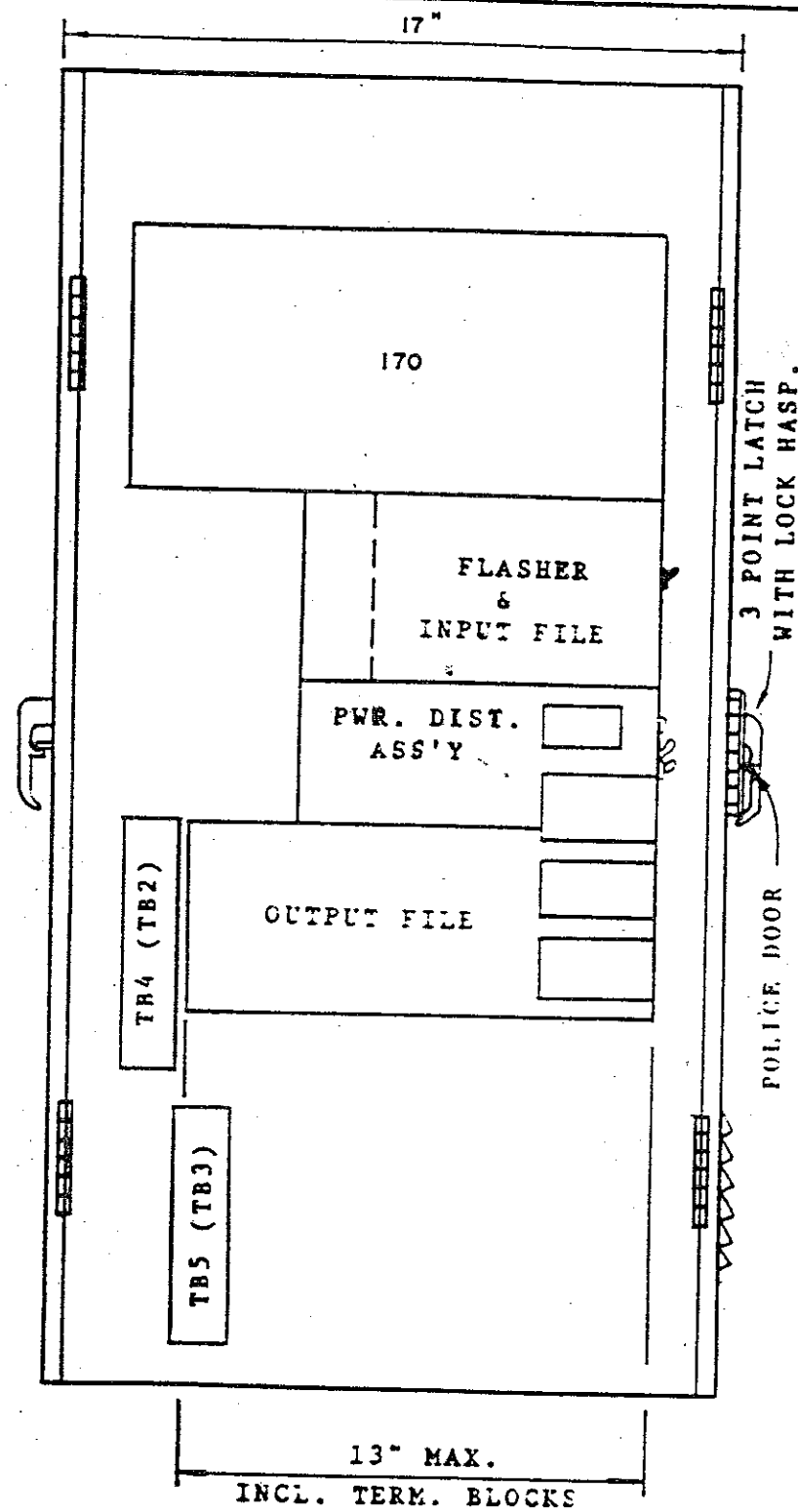
CABINET DETAILS

DIMENSION TOLERANCE ± 0.125 INCH.



CABINET DETAILS

Drawn By	RMO 5-14-88	Title	337 CABINET ASSEMBLY (POST-TOP MOUNTED) 1/4
Checked By	JEM 7/11/88		
Supervised By	JTF 8/10/88		
Reviewed By	DV 8/11/88		
Revisions		CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION S.E. ROWE, General Manager	
		Approved	9-14-88 S.E. Rowe General Manager
		DRAWING NO	S-76.0.1



FTR - TRANSFER RELAY
FLR - FLASH RELAY
PR - POWER RELAY
SWPK - SWITCHPACK
FL - FLASHER

MU - MONITOR UNIT
IR - ISOLATION RELAY
LR - LOGIC RELAY
FR - REM. FLASH RELAY
MIR - MAINTENANCE INTERLOCK RELAY

NOTE :

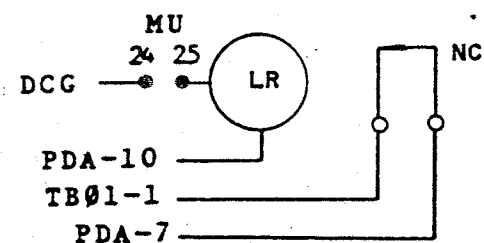
FLASH PROGRAM PLUGS (6), IR, LR, FR, MIR RELAYS
ACCESSIBLE BEHIND SWING-DOWN REAR PANEL

CABINET INTERIOR		Title	
Drawn By	J.C.	1-26-84	337 CABINET ASSEMBLY (2/14) (POST-TOP MOUNTED)
Checked By	JEM	7/19/87	
Supervised By	JFF	2/10/88	
Reviewed By	DV	3/11/88	
Revisions		CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION S.E. ROWE, General Manager	
		Approved	2-19-88 S.E. Rowe General Manager
			DRAWING NO S-76.0.1

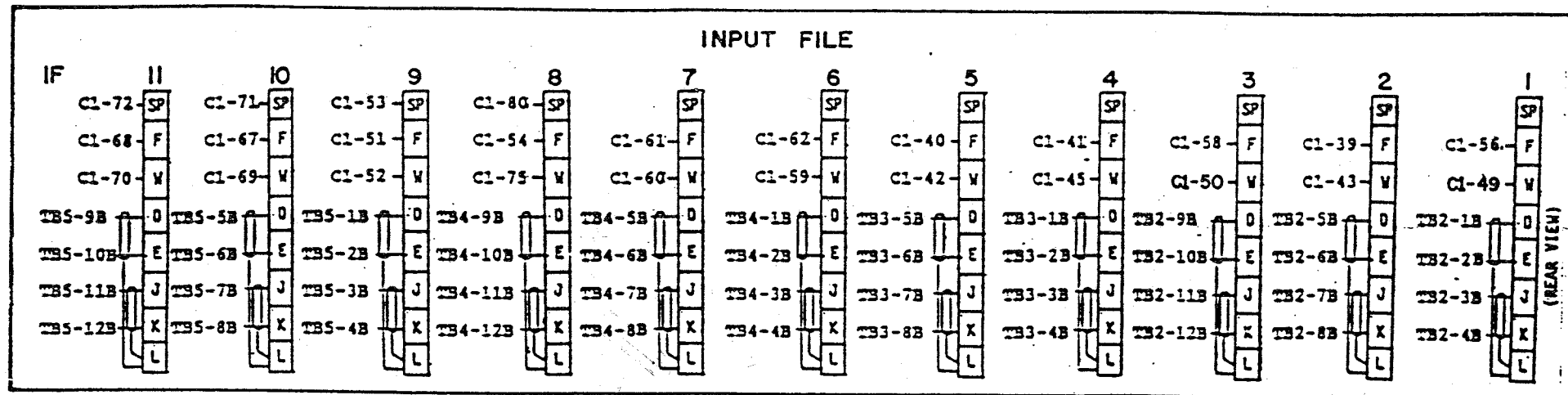
The diagram illustrates the electrical wiring for a vehicle, organized into several functional sections:

- Power Entry and Distribution:**
 - AC+:** The main power source, connected to a fuse **F2** (labeled "(AS SPECIFIED)").
 - MAIN IP 30A 125 V:** A main power inlet with a 30A fuse.
 - EQUIP. IP 15A 125V:** An equipment power inlet with a 15A fuse.
- Control and Monitoring:**
 - CONTROL UNIT:** Connected to a resistor **R** and a 14-gauge wire.
 - MONITOR UNIT:** Receives signals from various switches and relays.
- Lighting and Safety:**
 - CAB. LITE:** Cabin light, controlled by a switch and a 1A fuse **F4**.
 - DR. SW. (REAR):** Rear door switch.
 - DR. SW. (FRONT):** Front door switch, controlled by a switch and a 1A fuse **F1**.
 - FLASH LAMP:** Connected to a switch and a 10-gauge wire.
 - FLASH SW. (PDA):** Pedal-operated flash switch.
 - SIGNALS SW. (PDA):** Pedal-operated signal switch.
 - FLASH SW. (CAB):** Cabin flash switch.
- Relays and Switches:**
 - RELAY:** A relay with a coil and contacts, controlled by a switch and a 1A fuse **F3**.
 - FLASHER:** A relay used for flashing lights, controlled by a switch and a 1A fuse **F1**.
 - MIR:** Mirror switch.
 - FTR:** Front turn signal relay.
 - IR:** Rear turn signal relay.
- Wiring Gauge and Connections:**
 - Wires are labeled with gauge numbers: 10, 14, 16, 20.
 - Connections are made to various terminals and components throughout the system.

LOGIC RELAY DETAIL



Drawn By	J.C.	1-31-84	T-114	337 CABINET ASSEMBLY (POST-TOP MOUNTED)	
Checked By	JEM	7/18/88			
Supervised By	JFF	8/10/88			
Reviewed By	DV	8/11/88			
Revisions			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION S. E. ROWE, General Manager		
			Approved: <u>4-19-88</u> <u>S. E. Rowe</u> General Manager	DRAWING NO S-76.0.1	



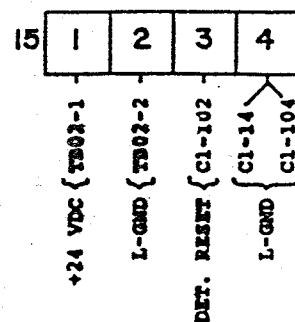
SLOT NO.

337 CABINET ATSAC INPUT FILE LAYOUT

SYSTEM DETECTORS

56 ø1 EXT, CT	39 ø4 EXT, CT	58 1	41 3	40 5	62 7	61 9	54 SPEC'L FUNC. 1	51 RR 1	67 ø2 PED	68 ø6 PED
49 ø3 EXT, CT	43 ø4 EXT, CT	50 2	45 4	42 6	59 8	60 10	75 DOOR AJAR	52 RR 2	69 ø4 PED	70 ø8 PED
1	2	3	4	5	6	7	8	9	10	11

SLOT NO.

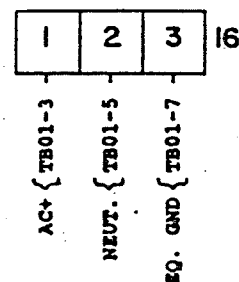


XX = C1 PIN ASSIGNMENTS

337 CABINET UNIVERSAL INPUT FILE LAYOUT

56 ø1 EXT, CT	39 ø2 EXT, CT	58 ø3 EXT, CT	41 ø4 EXT, CT	40 ø6 EXT, CT	ø3 62 EXT, CT R1	ø7 61 EXT, CT R3	54 ø4 D2	51 RR1	67 ø2 PED	68 ø6 PED
49 ø4 CALL	43 ø2 EXT, CT	50 ø8 CALL	45 ø4 EXT, CT	42 ø8 EXT, CT	ø5 59 EXT, CT R2	ø1 60 EXT, CT FL. FREE	75 ø7 D3	52 RR2	69 ø4 PED	70 ø8 PED
1	2	3	4	5	6	7	8	9	10	11

XX = C1 PIN ASSIGNMENTS



337 INPUT FILE

Drawn By	RMO/5-20-88	T. rts
Checked By	JEM 7/18/88	
Supervised By	RTF 8/10/88	
Reviewed By	DV 8/11/88	
Revisions		
337 CABINET ASSEMBLY (POST-TOP MOUNTED) 4/14		
CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION S. E. ROWE, General Manager		
APPROVED 9-19-88 S. E. Rowe		DRAWING NO S-76.0.1

CONFLICT MONITOR ASSIGNMENTS

PIN	SOURCE	UNIVERSAL OUTPUT FUNCTIONS	ATSAC OUTPUT FUNCTIONS	CONN. TO
1	DC-GND	L-GND	L-GND	C4-2
2	01-1	4P DW	4P DW	C4-10
3	01-2	4P W	4P W	C4-12
4	01-3	4 RED	4 RED	C4-19
5	01-4	4 YEL	4 YEL	C4-20
6	01-5	4 GRN	4 GRN	C4-21
7	01-6	3 RED	3 RED	C4-22
8	01-7	3 YEL	3 YEL	C4-23
9	01-8	3 GRN	3 GRN	C4-24
10	02-1	2P DW	2P DW	C4-16
11	02-2	2P W	2P W	C4-18
12	02-3	2 RED	2 RED	C4-13
13	02-4	2 YEL	2 YEL	C4-14
14	DC-GND	L-GND	L-GND	IF15-4
15	02-5	2 GRN	2 GRN	C4-15
16	02-6	1 RED	1 RED	C4-7
17	02-7	1 YEL	1 YEL	C4-8
18	02-8	1 GRN	1 GRN	C4-9
19	03-1	8P DW	8P DW	NC
20	03-2	8P W	8P W	NC
21	03-3	8 RED	8 RED	NC
22	03-4	8 YEL	8 YEL	NC
23	03-5	8 GRN	8 GRN	NC
24	03-6	7 RED	7 RED	NC
25	03-7	7 YEL	7 YEL	NC
26	03-8	7 GRN	7 GRN	NC
27	04-1	6P DW	6P DW	NC
28	04-2	6P W	6P W	NC
29	04-3	6 RED	6 RED	NC
30	04-4	6 YEL	6 YEL	NC
31	04-5	6 GRN	6 GRN	NC
32	04-6	5 RED	5 RED	NC
33	04-7	5 YEL	5 YEL	NC
34	04-8	5 GRN	5 GRN	NC
35	05-1	OLA RT.GRN. ARR./Ø8P WK	OLA RT.GRN. ARR./Ø8P WK	C4-17
36	05-2	6P YEL	6P YEL	NC
37	05-3	OLA RT.YEL. ARR./Ø8P DW	OLA RT.YEL. ARR./Ø8P DW	C4-11
38	05-4	8P YEL	8P YEL	NC
39	11-1	Ø2 E, CT	Ø4 E, CT	IF2-F
40	11-2	Ø6 E, CT	SYS.DET. 5	IF5-F
41	11-3	Ø4 E, CT	SYS.DET. 3	IF4-F
42	11-4	Ø8 E, CT	SYS.DET. 6	IF5-W
43	11-5	Ø2 E, CT	Ø4 E, CT	IF2-W
44	11-6	INPUT 6	INPUT 6	NC
45	11-7	Ø4 E, CT	SYS.DET. 4	IF4-W
46	11-8	INPUT 8	INPUT 8	NC
47	12-1	INPUT 9	INPUT 9	NC
48	12-2	INPUT 10	INPUT 10	NC
49	12-3	Ø4 CALL	Ø3 CALL	IF1-W
50	12-4	Ø8 CALL	SYS.DET. 2	IF3-W
51	12-5	RR1	RR1	IF9-F
52	12-6	RR2	RR2	IF9-W

PIN	SOURCE	UNIVERSAL OUTPUT FUNCTIONS	ATSAC OUTPUT FUNCTIONS	CONN. TO
53	12-7	ADV. EN	ADV. EN	IF9-SP
54	12-8	DIAL 2	FLASH BUS	IF8-F
55	13-1	INPUT 17	INPUT 17	NC
56	13-2	Ø1 E, CT	Ø1 E, CT	IF1-F
57	13-3	INPUT 19	INPUT 19	NC
58	13-4	Ø3 E, CT	SYS.DET. 1	IF3-F
59	13-5	Ø5E, CT/R2	SYS.DET. 8	IF6-W
60	13-6	Ø1E, CT/FL.FREE	SYS.DET.10	IF7-W
61	13-7	Ø7E, CT/R3	SYS.DET. 9	IF7-F
62	13-8	Ø3E, CT/R1	SYS.DET. 7	IF6-F
63	14-5	INPUT 25	INPUT 25	NC
64	14-6	INPUT 26	INPUT 26	NC
65	14-7	INPUT 27	INPUT 27	NC
66	14-8	INPUT 28	INPUT 28	NC
67	15-1	Ø2 PPB	Ø2 PPB	IF10-F
68	15-2	Ø6 PPB	Ø6 PPB	IF11-F
69	15-3	Ø4 PPB	Ø4 PPB	IF10-W
70	15-4	Ø8 PPB	Ø8 PPB	IF11-W
71	15-5	EVP A	EVP A	IF10-SP
72	15-6	EVP B	EVP B	IF11-SP
73	15-7	INPUT 35	INPUT 35	NC
74	15-8	INPUT 36	INPUT 36	NC
75	16-1	DIAL 3	DOOR AJAR IN	IF8-W
76	16-2	INPUT 38	INPUT 38	NC
77	16-3	INPUT 39	INPUT 39	NC
78	16-4	INPUT 40	INPUT 40	NC
79	16-5	INPUT 41	INPUT 41	NC
80	16-6	ADVANCE	ADVANCE	IF8-SP
81	16-7	FLASH SENSE	FLASH SENSE	C4-4
82	16-8	STOP TIME	STOP TIME	C4-5
83	06-1	NA	NA	NC
84	06-2	NA	NA	NC
85	06-3	NA	NA	NC
86	06-4	NA	NA	NC
87	06-5	NA	NA	NC
88	06-6	NA	NA	NC
89	06-7	NA	NA	NC
90	06-8	NA	NA	NC
91	07-1	NA	NA	NC
92	DC-GND	L-GND	L-GND	C4-3
93	07-2	NA	NA	NC
94	07-3	NA	NA	NC
95	07-4	NA	NA	NC
96	07-5	NA	NA	NC
97	07-6	NA	NA	NC
98	07-7	NA	NA	NC
99	07-8	NA	NA	NC
100	05-5	NA	NA	NC
101	05-6	FLASH	FLASH	C4-1
102	05-7	DET. RESET	DET. RESET	IF15-3
103	05-8	WATCH DOG	WATCH DOG	C4-6
104	DC-GND	L-GND	L-GND	IF15-4

PIN	CHANNEL	CONN. TO
J	1 GRN	SWPK 1 GRN
9	1 YEL	SWPK 1 YEL
I	2 GRN	SWPK 2 GRN
A	2 YEL	SWPK 2 YEL
M	3 GRN	SWPK 3 GRN
12	3 YEL	SWPK 3 YEL
4	4 GRN	SWPK 4 GRN
D	4 YEL	SWPK 4 YEL
7	5 GRN	SWPK 5 GRN
H	5 YEL	N/U
B	6 GRN	SWPK 6 GRN
3	6 YEL	N/U
10	7 GRN	SWPK 5 YEL
L	7 YEL	SWPK 6 YEL
E	8 GRN	N/U
6	8 YEL	N/U
13	9 GRN	N/U
16	9 YEL	N/U
R	10 GRN	N/U
U	10 YEL	N/U
S	11 GRN	N/U
15	11 YEL	N/U
V	12 GRN	N/U
18	12 YEL	N/U
2	13 GRN	N/U
8	13 YEL	N/U
5	14 GRN	N/U
11	14 YEL	N/U
C	15 GRN	N/U
K	15 YEL	N/U
F	16 GRN	N/U
N	16 YEL	N/U

NOTE:

1. DOOR AJAR SHALL BE WIRED FROM TB01-1 TO TB04-11B.
2. INSTALL A WIRE FROM "TB4-10" TO "TB4-12"

337 ATSAC/UNIVERSAL C1 PIN ASSIGNMENTS

Drawn By	RM05-20-88	337 CABINET ASSEMBLY (5/14) CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION S. E. ROWE, General Manager DRAWING NO S-76.0.1
Checked By	JEM 7/12/88	
Supervised By	JFF 8/10/88	
Reviewed By	DV 8/10/88	
Revisions		
	JFF 11/19/96	

<u>POSITION</u>	<u>A (INT)</u>	<u>B (EXT)</u>
1	POWER RELAY COIL	DOOR SWITCH (FRONT)
2	AC+ FLASHER CB (SEC)	AC+ FLASHER
3	AC+ MAIN CB (SEC)	AC+ R1, FAN LIGHT
4	AC+ EQPT. CB (SEC)	AC+ R2
5	AC- COILS & MISC.	AC- IF, R1, R2
6	AC- MU & PDA	NGB
7	EQ GND	EQ GND IF, R1, R2
8	EQ GND	CGB

<u>POSITION</u>	<u>A</u>	<u>B</u>
1	AC+ FAN, LIGHT, R1	AC+ MAIN CB (SEC)
2	AC+ R2	AC+ EQPT. CB (SEC)
3	AC- R1, FAN, LIGHT	AC-
4	AC- R2	AC-
5	EQ GND	EQ GND
6	DOOR SWITCH	POWER RELAY COIL

<u>POSITION</u>	<u>A (INT)</u>	<u>B (EXT)</u>
1	+24 VDC (PDA)	IF
2	DCG (PDA)	IF
3	MU RESET	—
4	FR COIL	—

<u>POSITION</u>	<u>A (INT)</u>	<u>B (EXIT)</u>
1	AC+ MAIN CB (PRI)	AC+ — SERVICE
2	CGB	EARTH GND — SERVICE
3	NCB	AC- — SERVICE

<u>POS.</u>	<u>A</u>	<u>B</u>	<u>POS.</u>	<u>A</u>	<u>B</u>
TB2-1	DET. 1	IF1-D	TB4-1	DET.11	IF6-D
TB2-2	DET. 1	IF1-E	TB4-2	DET.11	IF6-E
TB2-3	DET. 2	IF1-J	TB4-3	DET.12	IF6-J
TB2-4	DET. 2	IF1-K	TB4-4	DET.12	IF6-K
TB2-5	DET. 3	IF2-D	TB4-5	DET.13	IF7-D
TB2-6	DET. 3	IF2-E	TB4-6	DET.13	IF7-E
TB2-7	DET. 4	IF2-J	TB4-7	DET.14	IF7-J
TB2-8	DET. 4	IF2-K	TB4-8	DET.14	IF7-K
TB2-9	DET. 5	IF3-D	TB4-9	DET.15	IF8-D
TB2-10	DET. 5	IF3-E	TB4-10	DET.15	IF8-E
TB2-11	DET. 6	IF3-J	TB4-11	DET.16	IF8-J
TB2-12	DET. 6	IF3-K	TB4-12	DET.16	IF8-K
TB3-1	DET. 7	IF4-D	TB5-1	DET.17	IF9-D
TB3-2	DET. 7	IF4-E	TB5-2	DET.17	IF9-E
TB3-3	DET. 8	IF4-J	TB5-3	DET.18	IF9-J
TB3-4	DET. 8	IF4-K	TB5-4	DET.18	IF9-K
TB3-5	DET. 9	IF5-D	TB5-5	DET.19	IF10-D
TB3-6	DET. 9	IF5-E	TB5-6	DET.19	IF10-E
TB3-7	DET.10	IF5-J	TB5-7	DET.20	IF10-J
TB3-8	DET.10	IF5-K	TB5-8	DET.20	IF10-K
TB3-9	SPARE		TB5-9	DET.21	IF11-D
TB3-10	SPARE		TB5-10	DET.21	IF11-E
TB3-11	SPARE		TB5-11	DET.22	IF11-J
TB3-12	SPARE		TB5-12	DET.22	IF11-K

<u>PIN</u>	<u>SOURCE</u>	<u>DEST.</u>
1	C1-101	FR COIL
2	C1-1	TB02-2
3	C1-92	TB02-2
4	C1-81	IR - N.O.
5	C1-82	MU - BB
6	C1-103	MU - 22
7	C1-16	SWPK 1-6
8	C1-17	SWPK 1-8
9	C1-18	SWPK 1-10
10	C1-2	SWPK 6-6
11	C1-37	SWPK 6-8
12	C1-3	SWPK 6-10
13	C1-12	SWPK 2-6
14	C1-13	SWPK 2-8
15	C1-15	SWPK 2-10
16	C1-10	SWPK 5-6
17	C1-35	SWPK 5-8
18	C1-11	SWPK 5-10
19	C1-4	SWPK 4-6
20	C1-5	SWPK 4-8
21	C1-6	SWPK 4-10
22	C1-7	SWPK 3-6
23	C1-8	SWPK 3-8
24	C1-9	SWPK 3-10

POS.	CONN.	POS.	CONN.	POS.	CONN.
101	SWPK5-R	111	SWPK3-R	121	SWPK1-R
102	SWPK5-Y	112	SWPK3-Y	122	SWPK1-Y
103	SWPK5-G	113	SWPK3-G	123	SWPK1-G
104	SWPK6-R	114	SWPK4-R	124	SWPK2-R
105	SWPK6-Y	115	SWPK4-Y	125	SWPK2-Y
106	SWPK6-G	116	SWPK4-G	126	SWPK2-G

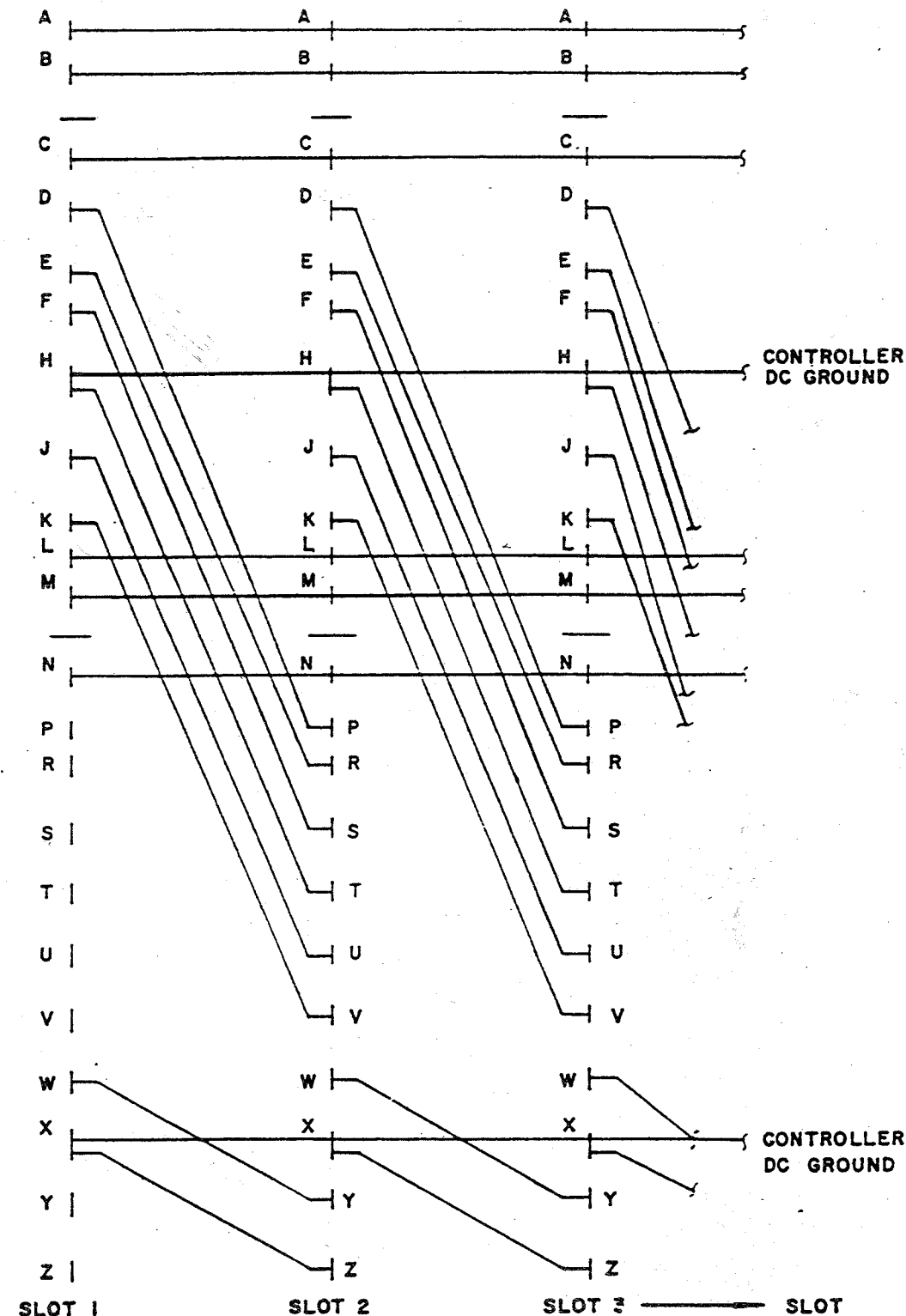
TERMINAL BLOCK & CONNECTOR

PIN ASSIGNMENTS

TERMINAL BLOCK & CONNECTOR PIN ASSIGNMENTS

Drawn By	1-31-84	Title	337 CABINET ASSEMBLY (6/14)
Checked By	JEM 7/18/88	CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION S. E. ROWE, General Manager	
Supervised By	JFF 8/10/88		
Reviewed By	DV 8/11/88		
Revisions		Approved	9-19-88 S. E. Rowe General Manager
			DRAWING NO S-76.0.1

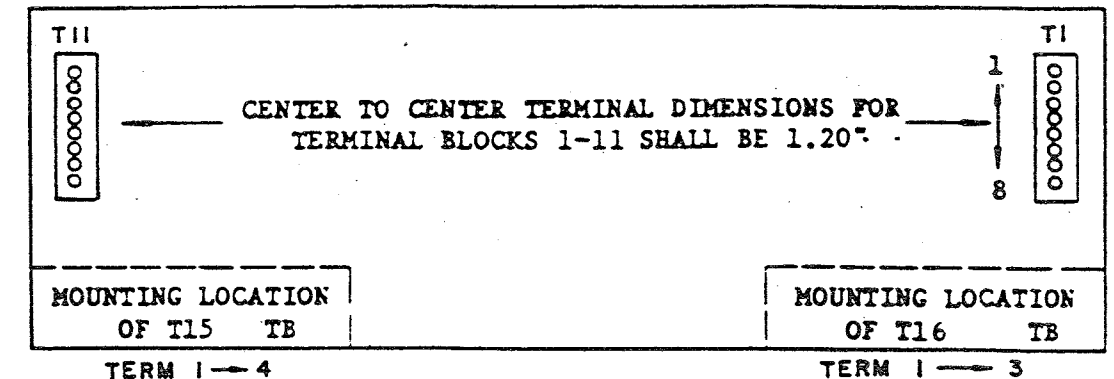
DC GROUND
24 VDC
LOOP KEY
RESET
LOOP NO.1
MAGNETOMETER NO.1
LOOP NO.1
MAGNETOMETER NO.1
LOOP NO.1
MAGNETOMETER NO.1
(COLLECTOR)
LOOP NO.1
MAGNETOMETER NO.1
(EMITTER)
MAGNETOMETER NO.1
LOOP NO.2
MAGNETOMETER NO.1
LOOP NO.2
MAGNETOMETER NO.1
(COLLECTOR)
MAGNETOMETER NO.1
LOOP NO.2
MAGNETOMETER NO.1
(EMITTER)
MAGNETOMETER NO.2
LOOP NO.2
MAGNETOMETER NO.2
(COLLECTOR)
MAGNETOMETER NO.2
LOOP NO.2
MAGNETOMETER NO.2
(EMITTER)
MAGNETOMETER NO.2
LOOP NO.4
MAGNETOMETER NO.2
LOOP NO.4
MAGNETOMETER NO.2
(COLLECTOR)
MAGNETOMETER NO.2
LOOP NO.4
MAGNETOMETER NO.2
(EMITTER)



FRONT VIEW

INPUT FILE WIRING DIAGRAM

CONNECTOR PIN FUNCTIONS ARE THE SAME FOR ALL SLOTS.
CENTER TO CENTER SPACING, BETWEEN SLOTS,
SHALL BE 1.2 INCHES.



T1-11 TERMINAL
ASSIGNMENT

TERM	PIN - FUNCTION
1	SP - SPARE
2	F - CH 1 OUTPUT
3	W - CH 2 OUTPUT
4	D - CH 1 INPUT
5	E - CH 1 INPUT
6	J - CH 2 INPUT
7	K - CH 2 INPUT
8	L - EQ. GND

T15 TERMINAL
ASSIGNMENT

TERM	FUNCTION
1	+24 VDC
2	DC GND
3	DET. RESET
4	CTR DC GND

T16 TERMINAL
ASSIGNMENT

TERM	FUNCTION
1	AC+
2	AC-
3	EQUIP. GND.

INPUT FILE DETAIL

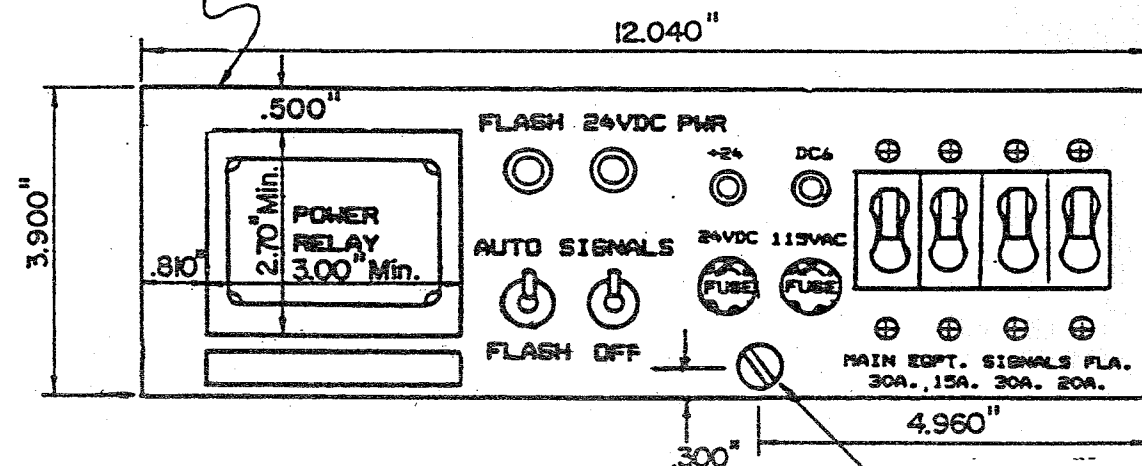
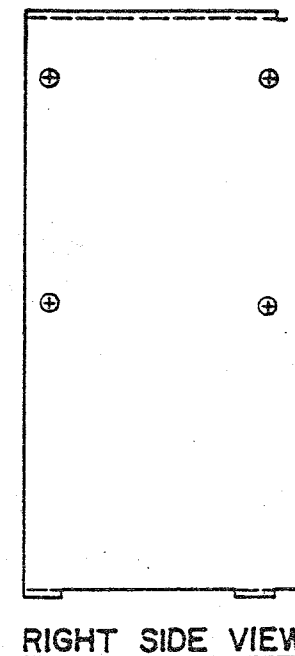
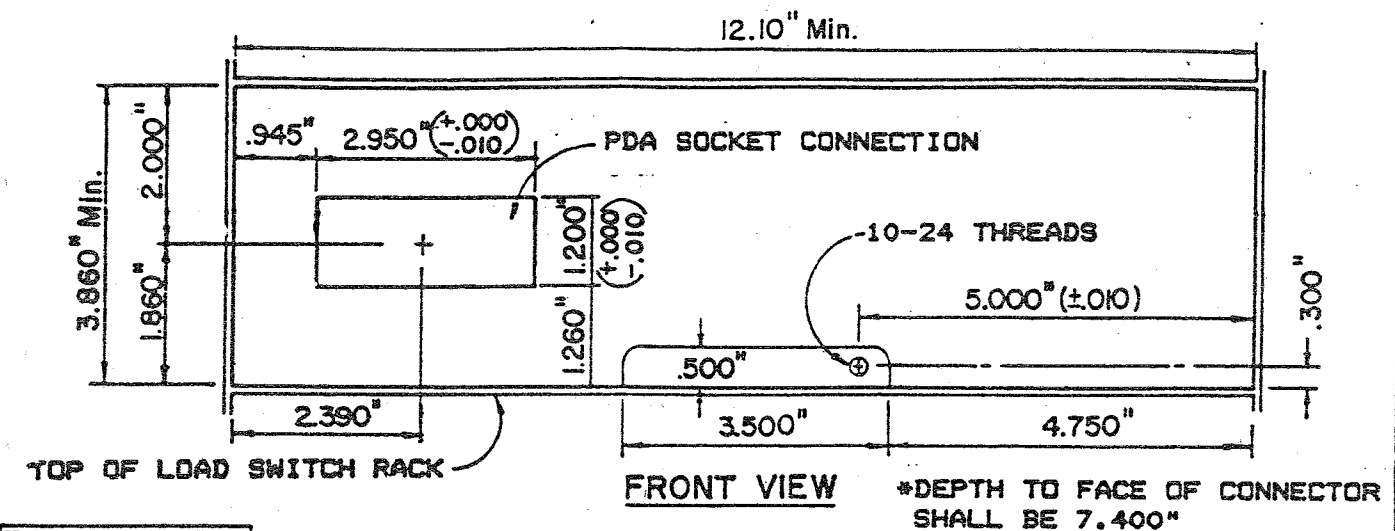
NOTE:

TERMINAL BLOCKS T1-11 SHALL BE THE BARRIER TYPE AND SHALL BE ATTACHED TO THE CHASSIS OF THE FILE WITH 8 8-32 X 5/16 INCH NICKEL PLATED BRASS BINDER SCREWS AND NICKEL PLATED BRASS INSERTS.

INPUT FILE WIRING

Drawn By	J.C. 12-3-84	337 CABINET ASSEMBLY (POST-TOP MOUNTED) 7/14
Checked By	JEM 7/18/88	
Supervised By	JFF 8/14/88	
Reviewed By	DV 12/1/88	
Revisions		CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION S.E. ROWE, General Manager
		APPROVED <u>9-19-88</u> <u>S.E. Rowe</u> General Manager
		DRAWING NO S-76.0.1

PDA RECEPTACLE



FRONT PANEL OF PDA SHALL
OVERHANG & SUPPORT UPPER
OUTPUT FILE CARD GUIDE
BRACKET

2	4	6	8	10	12
			●	(13)	
1	3	5	7	9	11

BEAU SG 5413 ABT
OR EQUIVALENT

PDA CONNECTOR PIN ASSIGNMENTS

<u>POSITION</u>	<u>PLUG</u>	<u>SOCKET</u>
1	{ AC+ MAIN CB (PRI) }	{ AC+ SERVICE (VIA F2) }
2		
3	{ AC+ SIGNALS CB (SEC) }	{ AC+ SWPK BUS }
4	{ VIA PWR. RELAY N.C. }	
5	AC+ EQPT. CB (SEC)	TB01 - 4
6	AC+ MAIN CB (SEC)	TB01 - 3, LR, FR, A/F SW, MU, IF
7	POWER RELAY COIL	LR, FR, MU, A/F SW
8	AC+ FLASHER CB (SEC)	TB01 - 2
9	AC- PWR.SUPP., PR COIL	TB01 - 5
10	+24 VDC PWR.SUPP.OUT	TB02 - 1, LR, FR, IF, MU, SWPK'S
11	DCG	TB02 - 2, MU, IF, C4 CONN.
12	STOP TIME	C4 CONN.
13	EQ. GND	TB01 - 7

POWER DISTRIBUTION ASSEMBLY

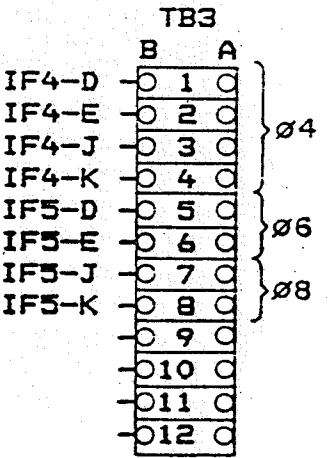
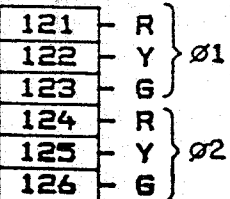
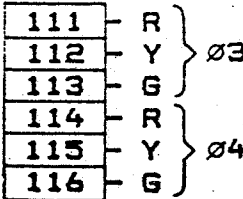
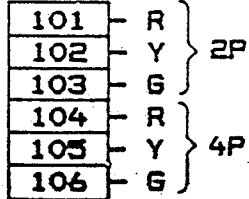
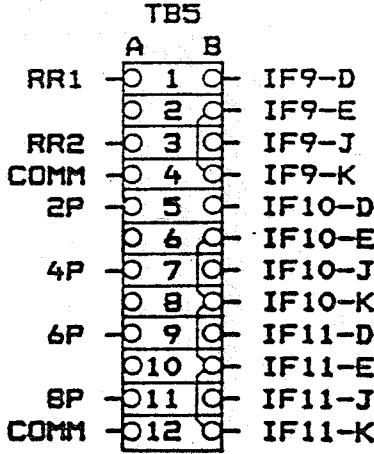
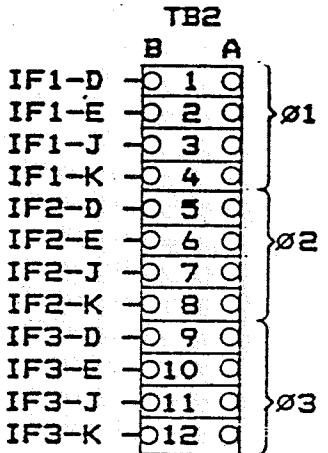
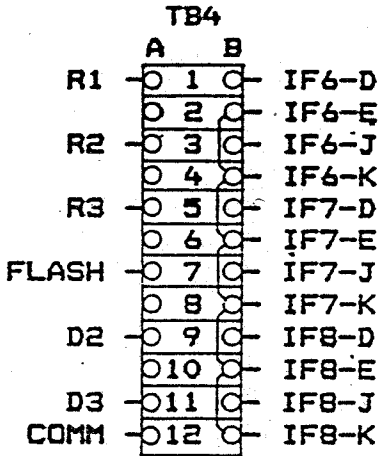
Drawn By	RMO	3-4-87	Title	337 CABINET ASSEMBLY (8/14)
Checked By	JEM	7/12/88		
Supervised By	JFF	8/10/88		
Reviewed By	DV	8/11/88		
Revisions			CITY OF LOS ANGELES	
			DEPARTMENT OF TRANSPORTATION	
			S. E. ROWE, General Manager	
			Approved	9-14-88
			S. E. Rowe	
			General Manager	
			DRAWING NO. S-76.0.1	

DIMENSIONAL TOLERANCE .010

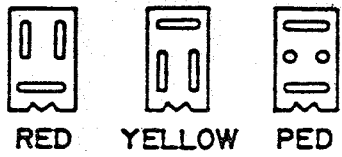
FRONT VIEW OF PDA CASE
(FRONT PANEL DETAIL)

INSTALL SCREW RETAINER
R.A.F. P/N 1003-080-55-0

FIELD TERMINAL ASSIGNMENTS

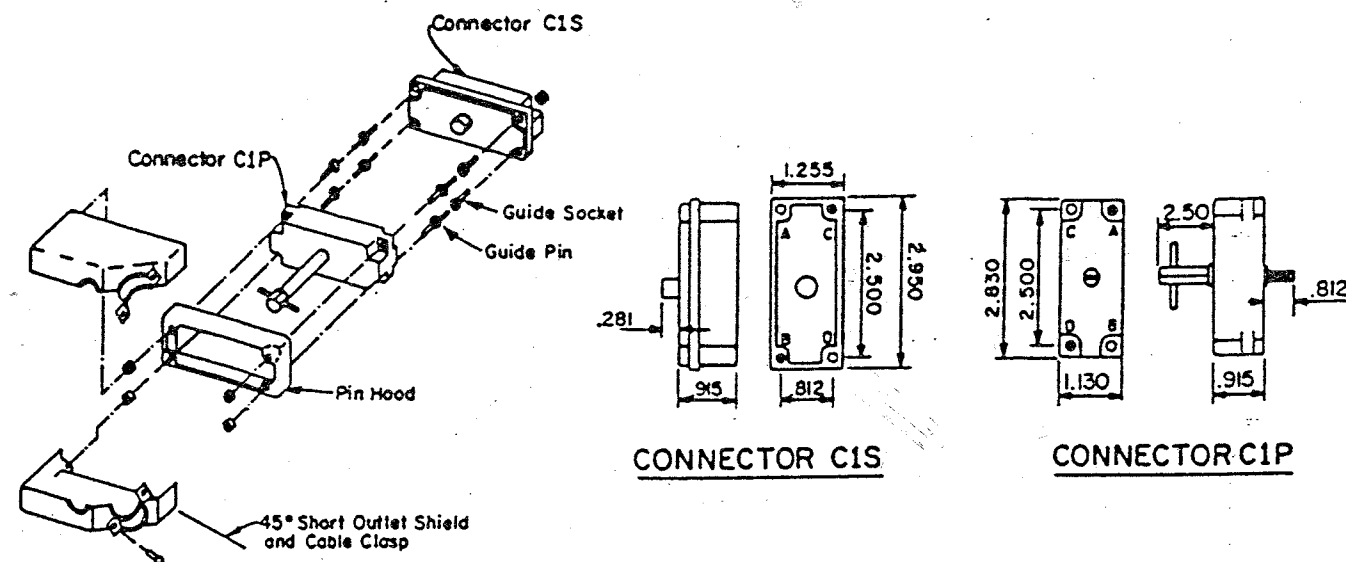


FLASH PROGRAM JUMPERS
(REAR VIEW)

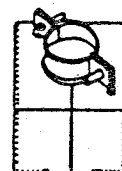
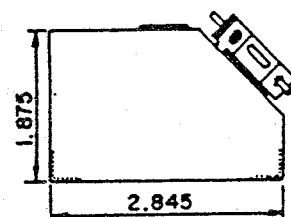


FIELD TERMINAL ASSIGNMENTS

Drawn By	8/10/88	Title	337 CABINET ASSEMBLY (POST-TOP MOUNTED) 9/14
Checked By	JEM 7/18/88		
Supervised By	JFF 8/10/88		
Reviewed By	RV 8/11/88		
Revisions			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION S.E. ROWE, General Manager 9-19-88 S.E. Rowe DRAWING NO S-76.0.1

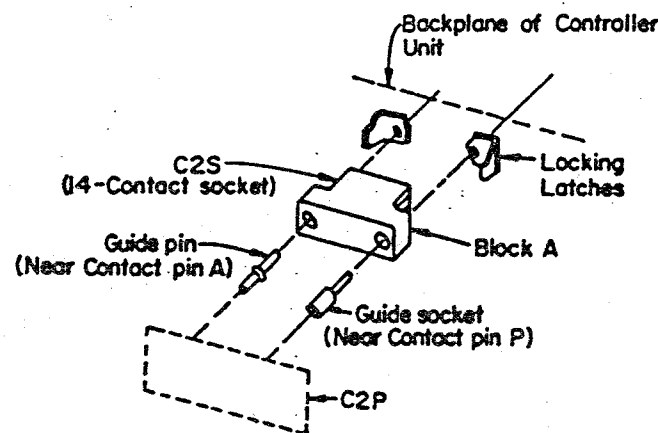


CONNECTOR C1 DETAIL

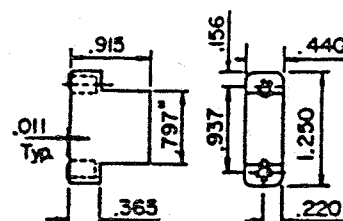


SHIELD FOR C1P

HOOD FOR C1P



CONNECTOR C2 DETAIL



CONNECTOR C2S

OUTPUT PORT ADDRESS ASSIGNMENTS

FOR CONNECTORS C1 AND C3

OUTPUT PORT ADDRESS	BIT	CONNECTOR C1	CONNECTOR C3	OUTPUT PORT ADDRESS	BIT	CONNECTOR C1	CONNECTOR C3
5001	1	2	83	5006	1	83	
5001	2	3	84	5006	2	84	
5001	3	4	85	5006	3	85	
5001	4	5	86	5006	4	86	
5001	5	6	87	5006	5	87	
5001	6	7	88	5006	6	88	
5001	7	8	89	5006	7	89	
5001	8	9	90	5006	8	90	
5002	1	10	91	5007	1	91	
5002	2	11	92	5007	2	92	
5002	3	12	93	5007	3	93	
5002	4	13	94	5007	4	94	
5002	5	14	95	5007	5	95	
5002	6	15	96	5007	6	96	NC
5002	7	16	97	5007	7	97	NC
5002	8	17	98	5007	8	98	NC
5002	9	18	99	5007	9	99	NC
5003	1	19		5008	1		CC-PHASE
5003	2	20		5008	2		CC-INTERVAL
5003	3	21		5008	3		CC-TIMING LS
5003	4	22		5008	4		CC-TIMING NLS
5003	5	23		5008	5		CC-TIMING NMS
5003	6	24		5008	6		CC-TIMING MS
5003	7	25		5008	7		CALL LT 8
5003	8	26		5008	8		CALL LT 9
5004	1	27		5009	1		CH-LS
5004	2	28		5009	2		CH-NLS
5004	3	29		5009	3		CH-NMS
5004	4	30		5009	4		CH-MS
5004	5	31		5009	5		DP
5004	6	32		5009	6		BL-P&I
5004	7	33		5009	7		BL-TIMING
5004	8	34		5009	8		NC
5005	1	35		500A	1		CALL LT 0
5005	2	36		500A	2		CALL LT 1
5005	3	37		500A	3		CALL LT 2
5005	4	38		500A	4		CALL LT 3
5005	5	39		500A	5		CALL LT 4
5005	6	40		500A	6		CALL LT 5
5005	7	41		500A	7		CALL LT 6
5005	8	42		500A	8		CALL LT 7

DEFINITIONS

CC = CHARACTER CONTROL OR STROBE
 CH = CHARACTER
 BL = BLANKING
 NC = TERMINATED AT CONNECTOR FOR FUTURE USE.
 LS = LEAST SIGNIFICANT.
 NLS = NEXT LEAST SIGNIFICANT.
 NMS = NEXT MOST SIGNIFICANT
 MS = MOST SIGNIFICANT.
 DP = DECIMAL POINT.
 P&I = PHASE AND INTERVAL.
 # = ALSO GOES TO THE "PROM" MODULE MATING CONNECTOR PIN # 51.
 "TEST COMPLETE".
 #1 = GOES TO THE OUTPUT OF THE RESTART TIMER.
 #2 = GOES TO THE "PROM" MODULE MATING CONNECTOR PIN # 50, "NEXT TEST".
 #3 = GOES TO THE "PROM" MODULE MATING CONNECTOR PIN # 49, "REPEAT TEST".
 #4 = GOES TO THE "PROM" MODULE MATING CONNECTOR PIN # 52, "SKIP TEST".
 #5 = GOES TO THE "PROM" MODULE MATING CONNECTOR PIN # 53, SPARE.
 #6 = GOES TO THE "PROM" MODULE MATING CONNECTOR PIN # 54, SPARE.

CONNECTOR C2 SOCKET ASSIGNMENT

Socket Contacts	Function	Socket Contacts	Function
A	Audio IN	J	RTS
B	Audio IN	K	Data IN
C	Audio OUT	L	Data Out
D	+5VDC	M	CTS
E	Audio OUT	N	DC GND.
F	-5VDC	P	
H	CD	R	

TERMINAL BLOCK T1 ASSIGNMENT

1. Audio IN	6. CTS
2. Audio IN	7. Data Out
3. CD	8. Audio Out
4. RTS	9. Audio Out
5. Data IN	10. DC GND.

INPUT PORT ADDRESS ASSIGNMENTS

FOR CONNECTORS C1 AND C3

INPUT PORT ADDRESS	BIT	CONNECTOR C1	CONNECTOR C3	INPUT PORT ADDRESS	BIT	CONNECTOR C1	CONNECTOR C3
5001	1	39		5005	1	67	
5001	2	40		5005	2	68	
5001	3	41		5005	3	69	
5001	4	42		5005	4	70	
5001	5	43		5005	5	71	
5001	6	44		5005	6	72	
5001	7	45		5005	7	73	
5001	8	46		5005	8	74	
5002	1	47		5006	1	75	
5002	2	48		5006	2	76	
5002	3	49		5006	3	77	
5002	4	50		5006	4	78	
5002	5	51		5006	5	79	
5002	6	52		5006	6	80	
5002	7	53		5006	7	81	
5002	8	54		5006	8	82	
5003	1	55		5007	1		KEYBOARD CONTROL
5003	2	56		5007	2		KEYBOARD CH LS
5003	3	57		5007	3		KEYBOARD CH NLS
5003	4	58		5007	4		KEYBOARD CH NMS
5003	5	59		5007	5		KEYBOARD CH MS
5003	6	60		5007	6		STOP TIMING
5003	7	61		5007	7		NC
5003	8	62		5007	8		NC
5004	1	#1		5008	1		NC
5004	2	#2		5008	2		NC
5004	3	#3		5008	3		NC
5004	4	#4		5008	4		NC
5004	5	63		5008	5		NC
5004	6	64		5008	6		NC
5004	7	65		5008	7	#5	
5004	8	66		5008	8	#6	

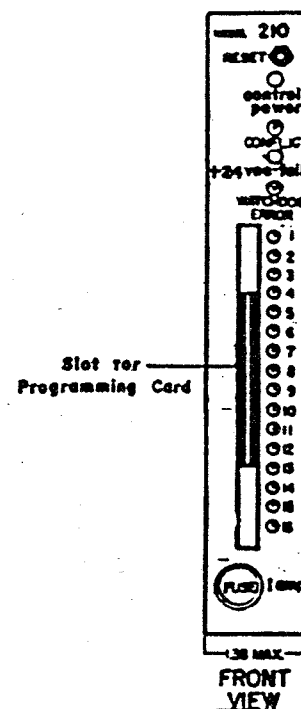
NOTES:

- All dimensions are in inches.
- C1 connector pins 1, 14, 92 and 104 shall be connected to the Controller Unit DC Logic Ground.
- Provide clearance for C1P with hood when mounting connector C1S on the 170 Controller Unit.
- Connector C2P to be furnished only when required by contractor.
- The darker circles in the C1S and C1P connector details denote Guide Pin locations and the open circles denote Guide Socket locations on the mating surfaces of the C1S and C1P. Corner guides for the C1S; Pins A and D, Sockets B and C. Corner guides for the C1P; Pins B and C, Sockets A and D.

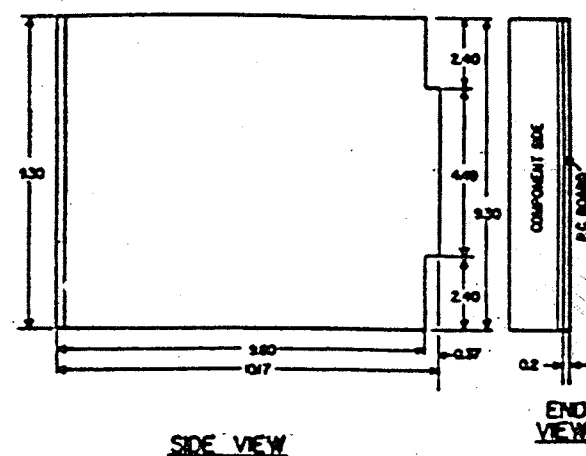
- All functions under Terminal Block T-1 and Connector C2 are referenced to the Modem.

INPUT/OUTPUT PORT ADDRESS

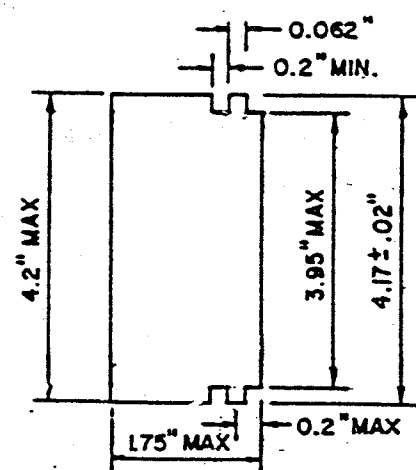
Drawn By	RMO	1-4-87	Title	MODEL 337
Checked By	JAM	7/13/87		CABINET ASSEMBLY
Supervised By	STF	8/16/88		
Reviewed By	DV	8/11/88		
Revisions				
CITY OF LOS ANGELES				
DEPARTMENT OF TRANSPORTATION				
S.E. ROWE, General Manager				
Approved				DRAWING NO
S.E. Rowe				S-76.0.1



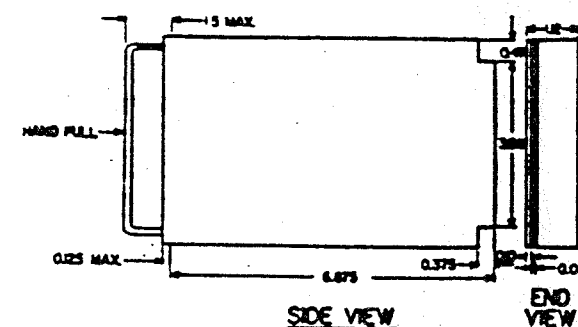
MODEL 210 MONITOR UNIT



MODEL 200 & 204
CROSS SECTION



DETAIL FOR MODELS 222, 224, 227
228, 231, 232, 234, 242, 244, 252 & 255



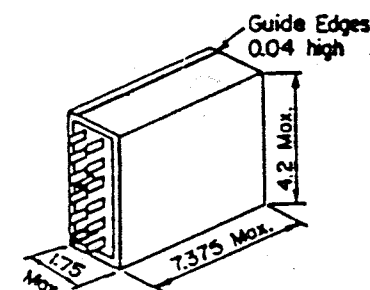
NOTES:

1. ALL DIMENSIONS SHOWN ARE IN INCHES.
2. MODEL 200 SHALL INTERMATE WITH SOCKET BEAU #S-5412-AB OR EQUAL.
3. THE OPENING FOR THE MONITOR UNIT PROGRAM CARD ON MODEL 210 FRONT PANEL SHALL BE 0.4375 INCHES MIN. Laterally & 5.375 INCHES MIN. VERTICALLY. THIS IS TO ENSURE PROGRAM CARD CLEARANCE.
4. THE END VIEW DIMENSION 0.2 INCHES FOR MODEL 210 IS FROM CENTER OF PRINTED CIRCUIT BOARD TO EDGE OF FRONT PANEL.
5. MODEL 210 DIMENSIONS ARE ± 0.02 INCHES EXCEPT AS NOTED.
6. SHOWN ON MODEL 210, CONDUCTORS CONNECTED TO PINS, SHALL BE 2 FEET IN LENGTH WITH RING LUG ON UNCONNECTED END, BUNDLED AND TIED SEPARATELY.
7. A 4-CHANNEL DETECTOR SHALL OCCUPY THE SPACE OF 2-CHANNEL DETECTORS.
8. * KEYED
9. FOUR JUMPERS SHALL BE INSTALLED ON THE CONFLICT MONITOR MOTHER CABINET BOARD BETWEEN PINS 8 TO 13, PINS 11 TO 16, PINS K TO R, AND PINS N TO U.

MODEL 210 MONITOR UNIT PIN ASSIGNMENTS

CONNECTOR PIN NO.	MONITOR FUNCTION	TERMINATION	CONNECTOR PIN NO.	MONITOR FUNCTION	TERMINATION
1	SWPK 2 GRN		A	SWPK 2 YELO	
2	SWPK 2P GRN		B	SWPK 6 GRN	
3	SWPK 6 YELO		C	SWPK 6P GRN	
4	SWPK 4 GRN		D	SWPK 4 YELO	
5	SWPK 4P GRN		E	SWPK 8 GRN	
6	SWPK 8 YELO		F	SWPK 8P GRN	
7	SWPK 5 GRN		H	SWPK 5 YELO	
8	T & B		J	SWPK 1 GRN	
9	SWPK 1 YELO		K	T & B	
10	SWPK 7 GRN		L	SWPK 7 YELO	
11	T & B		M	SWPK 3 GRN	
12	SWPK 3 YELO		N	T & B	
13	SWPK 2P YELO		P	NA	
14	NA		R	SWPK 6P YELO	
15	T & B		S	T & B	
16	SWPK 4P YELO		T	NA	
17	NA		U	SWPK 8P YELO	
18	T & B		V	T & B	
19	NA		W	NA	
20	EQ GND	01-9	X	NA	
21	AC	01-10	Y	DC GROUND	02-2
22	WATCHDOG TIMER	C4-37	Z	EXTERNAL RESET	02-5
23	+24VDC	02-1	AA	T & B	
24	BD OUT CKT	LOGIC RELAY COIL	BB	STOP TIME	02-3
25	BD OUT CKT	DC GROUND	CC	NA	
26	NA		DD	NA	
27	NA		EE	OUTPUT SW-SIDE 2	01-12
28	OUTPUT SW-SIDE 1	AC+	FF	AC+	01-11

MODEL 200 & 204 DETAIL



MODEL 200
CONNECTION ASSIGNMENTS

PIN	FUNCTION
1	AC+
2	Equip. Ground
3	A Output (R,DW)
4	Spore
5	B Output (Y)
6	A Input (R,DW)
7	C Output (G,W)
8	B Input (Y)
9	+24VDC
10	C Input (G,W)
11	Spore
12	Spore

SOCKET
BACK VIEW

PERIPHERAL EQUIPMENT

Drawn By	RM01-4-88	337 CABINET ASSEMBLY (POST-TOP MOUNTED) CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION S. E. ROWE, General Manager DRAWING NO S-76.0.1
Checked By	JEM 7/18/88	
Supervised By	JFF 8/10/88	
Reviewed By	DV 8/11/88	
Revisions		

CTB-2			
POS	A	B	FUNCTION
CTB 2-1	*	Voice jack - T	Voice
2	*	Voice jack - R	Voice
3	*	C2P-A	Audio In
4	*	C2P-B	Audio In
5	*	C2P-C	Audio Out
6	*	C2P-E	Audio Out

2 conductor, twisted, jacketed cable

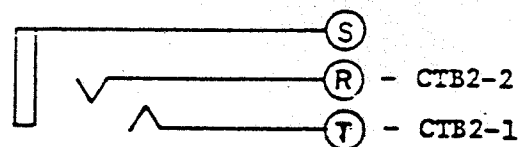
CTB-3			
POS	TO	FUNCTION	
CTB 3-1	C2P-D	+5 VDC	T.P.
2	C2P-F	-5 VDC	T.P.
3	C2P-H	C.D.	T.P.
4	C2P-J	R.T.S.	T.P.
5	C2P-K	Data In	T.P.
6	C2P-L	Data Out	T.P.
7	C2P-M	C.T.S.	T.P.
8	C2P-N	DC Gnd	T.P.

12 conductor jacketed cable

Overvoltage Protection Devices

Unit	Left	Center	Right
1	CTB 2-1B	Gnd lug	CTB 2-2B
2	CTB 2-3B	Gnd lug	CTB 2-4B
3	CTB 2-5B	Gnd lug	CTB 2-6B

Voice Jack



NOTES

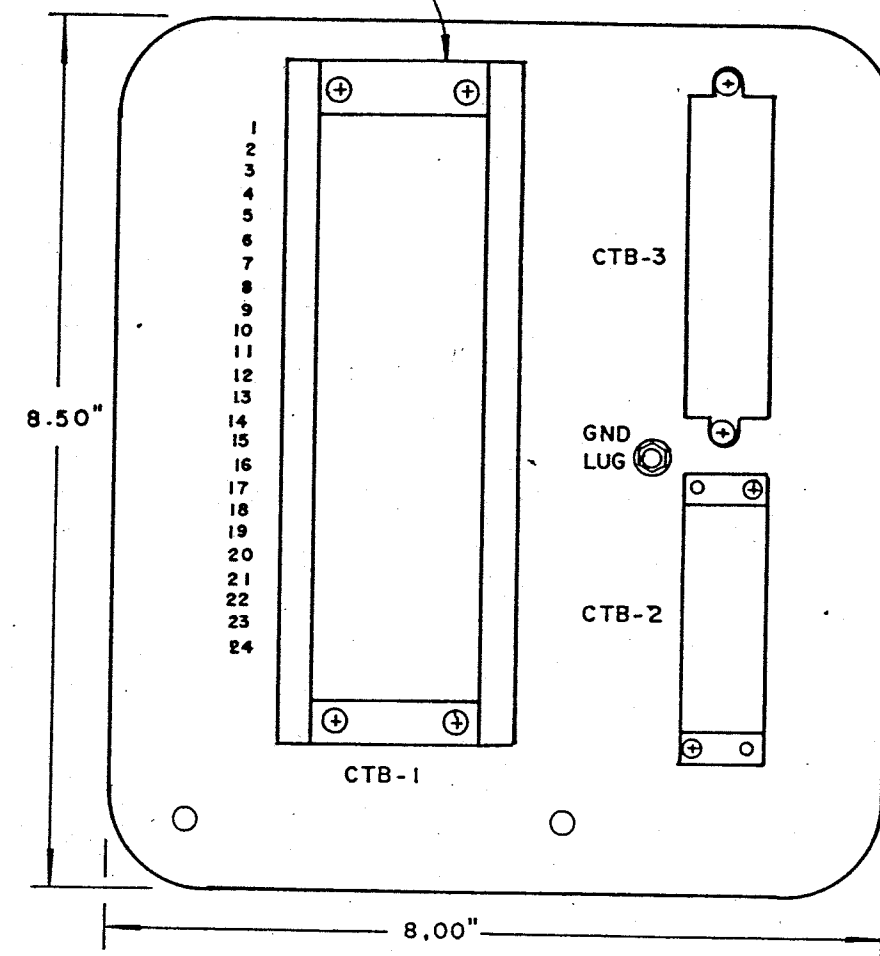
*Indicates block position to be wired, by others, at installation.

Terminal block CTB 1 to be wired by others.

Overvoltage protection devices to be located in spaces between CTB 2 and CTB 3.

Ground conductor between ground lug and cabinet's equipment grounding bus shall be 8 AWG or larger.

SIEMON S66-B824-849
OR EQUIVALENT.



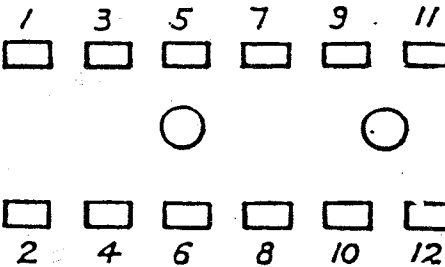
COMMUNICATIONS TERMINAL PANEL WIRING DETAIL

Drawn By	RMO	5-4-88	337 CABINET ASSEMBLY (POST-TOP MOUNTED)
Checked By	JEM	7/18/88	
Supervised By	JFF	8/10/88	
Reviewed By	DV	8/11/88	
Revisions			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION S.E. ROWE, General Manager
Approved: <i>S.E. Rowe</i> S.E. Rowe, General Manager			DRAWING NO S-76.0.1

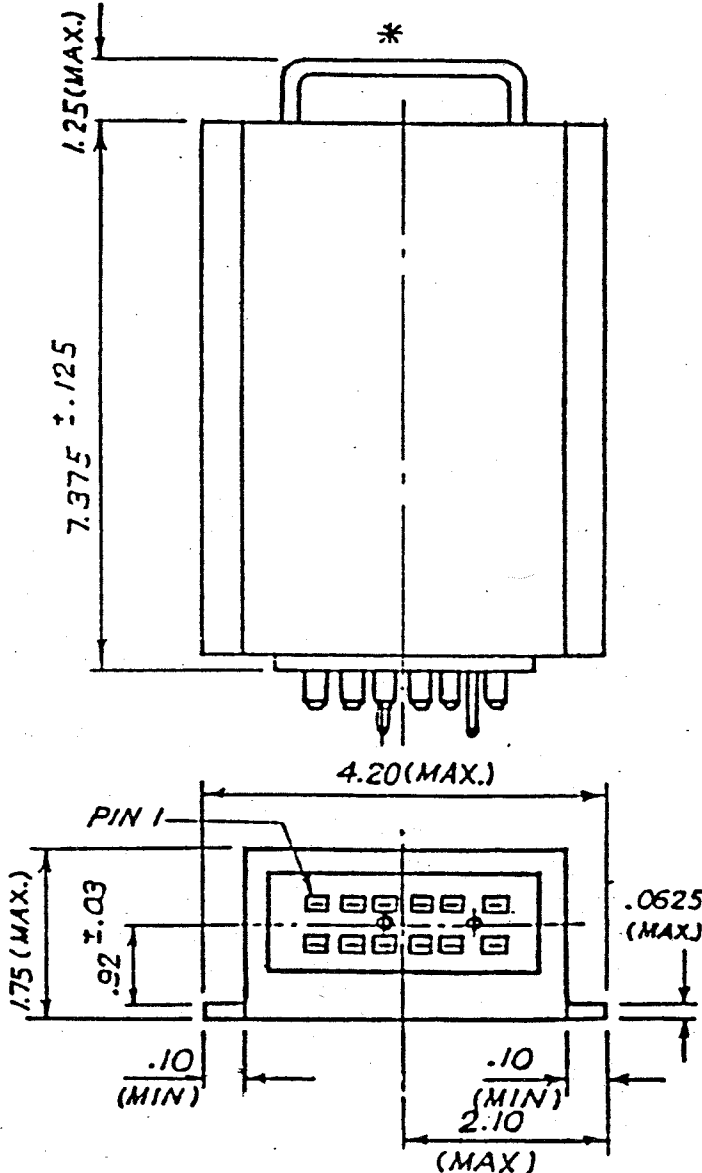
THE SOLID STATE SWITCH PACK, SHALL INTERMATE WITH
A CINCH-JONES SOCKET S-24/2-SB. OR EQUAL CONNECTED
AS FOLLOWS:

PIN NO.	CIRCUIT	PIN NO.	CIRCUIT
1	AC + LIGHT	7	GREEN OR WALK OUTPUT
2	CHASSIS GROUND	8	YELLOW INPUT
3	RED OR DON'T WALK OUTPUT	9	DC+ (15 TO 24 VOLTS)
4	RESERVE FOR DIMMER CIRCUIT	10	GREEN OR WALK INPUT
5	YELLOW OUTPUT	11	AC -
6	RED OR DON'T WALK INPUT	12	NOT USED

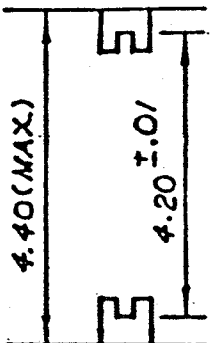
CONNECTOR PINOUT(EXTERNAL VIEW)



*THE SHAPE OF THE HANDLE MAY
BE THE COMPANY'S PREROGATIVE.



File Enclosure

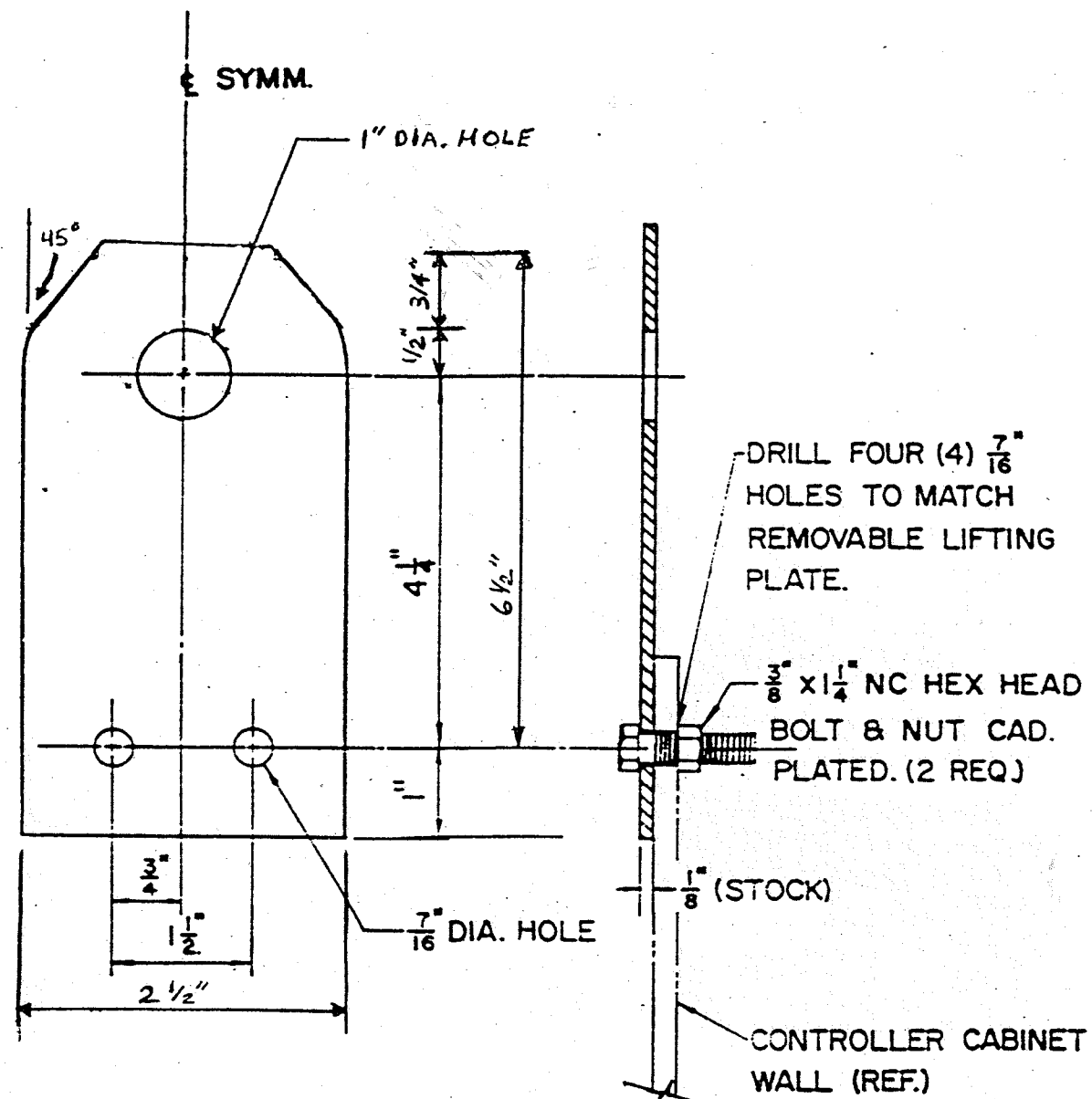


**Enclosure and Edge guide
(170 Cabinets only)**

SOLID STATE SWITCH PACK - SAMPLE DRAWING

Drawn By	J.C.	2-2-83	337 CABINET ASSEMBLY (POST-TOP MOUNTED)
Checked By	JEM	7/11/88	
Supervised By	JFF	8/10/88	
Reviewed By	DV	8/11/88	
Revisions			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION S. E. ROWE, General Manager
			Approved: <u>9-19-88</u> <u>S. E. Rowe</u> General Manager
			DRAWING NO S-76.0.1

NOT TO SCALE



NOTES:

1. MATERIAL: ASTM A36 STEEL PLATE
2. HOT DIP GALVANIZED PLATE PER ASTM SPEC. A-123

LIFTING PLATE 337

Drawn By	BTB	9-27-83	Time
Checked By	S.B.	10-3-83	REMOVABLE LIFTING PLATE FOR CONTROLLER CABINETS
Supervised By	RO	10-3-83	
Reviewed By	MC	10/15/83	CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION S. E. ROWE, General Manager
Revisions	JFF	1/19/96	
			APPROVED OCT 3 1983 Ronald R. Lawrence General Manager
			DRAWING NO S-68.1

MODEL 2070 CONTROLLER

SPECIFICATIONS

Number 54-055-02

March 2009

City of Los Angeles

Department of Transportation

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1	City of Los Angeles Requirements
2	TEES March 12, 2009, Chapter 1, 9, 10
3	TEES 2009 Erratum 1, January 21, 2010
4	TEES 2009 Erratum 2, December 5, 2014

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CITY OF LOS ANGELES REQUIREMENTS

The City of Los Angeles purchase of Model 2070 Controller Units shall comply with the Caltrans Transportation Electrical Equipment Specifications (TEES) dated March, 2009, supplemented by Erratum 1 dated January 21, 2010 and Erratum 2 dated December 5, 2014 and the following City requirements. In case of conflict, the City requirements shall govern the procurement. The Caltrans TEES and supplemental Erratum can be obtained from the web site.

- 1) Procurement is for Model 2070 Controller with a Unit Version of 2070E including these specified modules (no substitutions allowed):

Unit Chassis, 2070-1E, 2070-2A, 2070-3A, 2070-4B, 2070-6A, 2070-7A

- 2) A permanent label, CITY OF LOS ANGELES , shall be stenciled or embossed on the front of Model 2070 Controller Unit, centered directly above the LCD.
- 3) A manufacturer's unit serial number shall be placed on the chassis to right side of the power supply as viewed from the front.
- 4) Page 9-7-13 Additional Note: Termination identification labels for the connection pins of PS1 and PS2 harnesses shall be stenciled at both ends of harnesses on the Power Supply and Motherboard.
- 5) Section 10.1.4 Addition: An on-board DIP switch shall be provided on each modem to enable/disable the anti-streaming function. The anti-streaming function shall limit the modem s transmitter to be on for not more than 7 seconds. However, the 7 second timeout counter shall be reset and the transmitter shall be turned on when either the RTS line is asserted or new transmit data (with RTS is still on) from the CPU are received.
- 6) All bidders shall provide two (2) fully functional units **ON OR BEFORE** bid opening day for the City s compliance testing. Bidders shall send the units to: 555 Ramirez Street, Space 100, Los Angeles, CA, 90012, Attention Mr. Raul De Anda (213) 473-8467. The City will provide a compliance test report within thirty (30) days after the bid opening day. If the test units do not comply with all specification requirements as determined by the City, then the City reserves the rights to reject the bid and select the next available bidder.
- 7) Warranties and Guaranties: It is the responsibility of the contracted vendor to ensure that all equipment provided has been thoroughly tested prior to shipment, and that each shipment conforms to these specifications. The minimum warranty for any equipment and materials shall be for a period of two (2) years from the date of test acceptance by the Department of Transportation, City of Los Angeles. The warranty shall cover all manufacturers defects, parts, labor, and shipping costs. The warranty for each unit of equipment that requires repair shall be extended by the length of time that the unit is out of service for repair.

- 8) Spare Modules: The manufacturer shall provide one complete set of replacement modules for every 100 controller units (or fraction thereof) purchased on the contract at no additional cost to the City. One set of complete replacement modules shall include the following:

2070-1E, 2070-2A, 2070-3A, 2070-4B, 2070-6A, 2070-7A

- 9) Documentation: The manufacturer shall provide ten (10) sets of manuals and schematics for every 100 controller units (or fraction thereof) purchased on the contract. The manuals and schematics shall reflect the latest board revisions and changes. If at any time during the term of the contract the vendor changes any part of the controller design, ten (10) sets of new manuals and new schematics shall be provided to the City prior to delivery of the changed design.
- 10) Test Hardware: The manufacturer shall provide ten (10) sets of wraparound harnesses, special test jigs, and extender boards for performing diagnostics or repairs. These shall be provided with the first shipment of controllers in the contract on a one-time basis.



TRANSPORTATION ELECTRICAL EQUIPMENT SPECIFICATIONS

TEES



March 12, 2009

CHAPTER 1
ELECTRICAL EQUIPMENT
GENERAL SPECIFICATIONS

CHAPTER 1-SECTION 1

ELECTRICAL TERMONOLOGY

1.1.1 Glossary of Terms

A	Amperes
AASHTO	American Association of State Highway and Transportation Officials
AC	Alternating Current
AC+	120 Volts AC, 60 hertz ungrounded power source
AC-	120 Volts AC, 60 hertz grounded return to the power source
AGENCY	Purchasing Government Agency
ANSI	American National Standard Institute
API	Application Program Interface
ASCII	American Standard Code for Information Interchange
Assembly	A complete machine, structure or unit of a machine that was manufactured by fitting together parts and/or modules
ASTM	American Society for Testing and Materials
ATC	Advanced Transportation Controller
AWG	American Wire Gage
bps	bits per second
Big Endian	The sequencing of byte order in memory such that the most significant byte is stored at the lowest memory address, with the next byte in significance stored at the next memory location, and so on.
C	Celsius
C Language	The ANSI C Programming Language
Cabinet	An outdoor enclosure generally housing the controller unit and associated equipment
Certificate of Compliance	A certificate signed by the manufacturer of the material or the manufacturer of assembled materials stating that the materials involved comply in all respects with the requirements of the specifications
Channel	An information path from a discrete input to a discrete output
CIA	CMS Controller Isolation Assembly
CIP	CMS Interface Panel
CMOS	Complementary Metal Oxide Semiconductor
CMS	Changeable Message Sign
CMS SYSTEM	Includes Controller Unit, Model 334C Cabinet, Interconnect Harnesses, CMS and other associated equipment required to operate the system.
Component	Any electrical or electronic device

Contractor	The person or persons, manufacturer, firm, partnership, corporation, vendor or combination thereof, who have entered into a contract with the AGENCY, as party(s) of the second part or legal representative
Controller Unit	That portion of the controller assembly devoted to the operational control of the logic decisions programmed into the assembly
CPDA	CMS Pixel Driver Assembly
CPDM	CMS Pixel Driver Module
CPMM	CMS Pixel Matrix Module
CPU	Central Processing Unit
CR	ACIA Control Register
CRC	Cyclic Redundancy Check
CTS	Clear To Send
DAT Program	The AGENCYs Diagnostic and Acceptance Test Program
Daughter Board	(from TechEncyclopedia) A Printed Circuit Board that plugs into another Printed Circuit Board to augment its capabilities
DB	Decibel
DBa	Decibels above reference noise, adjusted
DC	Direct Current
DCE	Data Communications Equipment
DIN	Deutsche Industrie Norm
DMA	Direct Memory Access
DTA	Down Time Accumulator
DTE	Data Terminal Equipment
DPST	Double Pole Single Throw
EG	Equipment Ground
EIA	Electronic Industries Association
EMI	Electro Magnetic Interference
Engineer	The AGENCY director, acting either directly or through properly authorized agents, such agents acting within the scope of the particular duties delegated to them
EPROM	Ultraviolet Erasable, Programmable, Read Only Memory Device
EEPROM	Electrically Erasable, Programmable, Read Only Memory Device
Equal	Connectors: comply to physical dimensions, contact material, plating and method of connection. Devices: conforming to function, pin out, electrical and operating parameter requirements, access times and interface parameters of the specified device
ETL	Electrical Testing Laboratories, Inc.
FCU	Field I/O Controller Unit.
Firmware	A computer program or software stored permanently in PROM, EPROM, ROM or semi-permanently in EEPROM

FLASH	An IC Memory Device with nonvolatile, electrically erasable, programmable, 100K read/write minimum cycles and fast access time features
FPA	Front Panel Assembly
HDLC	High-Level Data Link Control
HEX	Hexadecimal
Hz	Hertz
IC	Integrated Circuit
I.D.	Identification
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
IPI	Initial Protocol Identifier
ISP	Internet Support Package
ISO	Short for “Isolated” and signifies that two or more power supplies each have different reference grounds.
ISO/IEC	International Standards Organization
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation Systems
Jumper	A means of connecting/disconnecting two or more conductive points by soldering/desoldering a conductive wire.
KB	Kilobytes
Laboratory	The established laboratory of the AGENCY or other laboratories authorized by the AGENCY to test materials involved in the contract
LED	Light Emitting Diode
LOGIC	Negative Logic Convention (Ground True) State
LSB	Least Significant Byte
Lsb	Least Significant Bit
MB	Megabyte
MSB	Most Significant Byte
Msb	Most Significant Bit
m	Milli
MPU	Microprocessor Unit
MIL	Military Specifications
MODEM	Modulation/Demodulation Unit
Module	A functional unit that plugs into an assembly
Motherboard	A printed circuit connector interface board with no active or passive components
MOS	Metal-Oxide Semiconductor
MOV	Metal-Oxide Varistor
MS	Military Standards
M/170	Program Module/Model 170 Controller Unit Connector
TEES	

M/170E	Model 170E Auxiliary Board Connector
N.C.	Normally closed contact
N.O.	Normally open contact
NA	Presently Not Assigned. Cannot be used by the manufacturer for other purposes
NEMA	National Electrical Manufacturer's Association
NETA	National Electrical Testing Association, Inc.
n	nano
NLSB	Next Least Significant Byte
Nlsb	Next Least Significant Bit
NMSB	Next Most Significant Byte
Nmsb	Next Most Significant Bit
NTCIP	National Transportation Communication for ITS Protocol
PCB	Printed Circuit Board
PDA	Power Distribution Assembly
PLA/PAL	Programmable Array Logic Device

PMPP	Point-to-Multi-Point Protocol
ppm	Parts per million
PPP	Point-to-Point Protocol
PWM	Pulse Width Modulation
RAM	Random Access Memory
RDR	ACIA Receiver Data Register
RF	Radio Frequency
RMS	Root-Mean-Square
ROM	Read Only Memory Device
RTC	Model 170E Controller Unit Real Time Clock. This circuitry provides a 170E CPU IRQ Interrupt pulse clocked off of the local power company's line frequency every 16.67 ms.
RTCA	Real Time Clock Adjuster Circuitry
RTS	Request to Send
RXD	Receive Data
R/W	Model 170E Controller Unit Read/Write Control Line
SCI	Serial Communications Interface
SDLC	Synchronous Data Link Control
S	Logic State
TEES	

S	second
SS	Second Source. Produced by more than one manufacturer
Shunt	A means of connecting/disconnecting two conductive points on a solderless PCB post heater.
SR	ACIA Status Register
SRAM	Static Random Access Memory Device
SW	Switch
TB	Terminal Block
TDR	ACIA Transmit Data Register
TIA	Telecommunications Industry Association
TOD	Time Of Day Clock
Triac	Silicon-Controlled Rectifier which controls power bilaterally in an AC switching circuit
TTL	Transistor-Transistor Logic
TSD	Thumb Screw Device. A retractable screw fastener with projecting stainless steel screw, spring and natural aluminum knob finish. (TSD No. 2 shall be flat black.) TSD No.1 - 8-32 SOUTHCO #47-62-301-20 or equal. TSD No.2 - 8-32 SOUTHCO #47-62-301-60 or equal. TSD No.3 - M3 SOUTHCO #47-81-181-10 or equal.
TXC	Transmit Clock
TXCI	Transmit Clock Input
TXCO	Transmit Clock Output
TXD	Transmit Data
μ	Micro
UL	Underwriter's Laboratories, Inc.
VAC	Voltage Alternating Current
VDC	Voltage Direct Current
VMA	Valid Memory Address
VME	Versa Module Eurocard, VMEbus Standard IEEE P1014/D1.2
VMS	Variable Message Sign
X	Number Value
XX	Manufacturer's Option
WDT	Watchdog Timer: A monitoring circuit, external to the device watched, which senses an Output Line from the device and react

CHAPTER 1-SECTION 2

GENERAL

1.2.1 Chapter Conflict

In case of Chapter Conflict, the individual Chapter shall govern over Chapter 1.

1.2.2 Furnished Equipment

All furnished Equipment shall be new and unused. Vacuum or gaseous tubes and electro-mechanical devices (unless specifically called out) shall not be used.

1.2.3 Interchangeability

The following assemblies and their respective associated devices shall electrically and mechanically intermate and be compatible with each other:

<u>ASSEMBLIES</u>	<u>ASSOCIATED DEVICES</u>
Output File #1 & #2	Model 200 Switch Pack Model 210 Monitor Unit Model 430 Heavy Duty Relay
Input File	Models 222 & 224 Detectors Models 242 & 252 Isolators
PDA #2L	Model 204 Flasher Unit Model 206 Power Supply Module
PDA #3L	Model 200 Switch Pack Model 206 Power Supply Module Model 208 Monitor Unit Model 430 Heavy Duty Relay
PDA #4L	Model 206 Power Supply CMS Isolation Module
Model 170E Controller Unit	Cabinet Models 332, 334 & 336 Model 400 MODEM Model 412C Program Module
Model 2070 Controller Unit	Cabinet Models 332, 334, 336 & ITS Model 2070-1 CPU Module Model 2070-2 Field I/O Module Model 2070-3 Front Panel Assembly Model 2070-4 Power Supply Model 2070-5 VME Cage Assembly Model 2070-6 Serial Comm Module Model 2070-7 Serial Comm Module

Model 2070-N1 Controller Unit	Model 2070 Controller Unit Model 2070-8 NEMA Module Model 2070-2B Field I/O Module Model 2070-4N Field I/O Module
Model 2070-N2 Controller Unit	Model 2070 Controller Unit Model 2070-2N Field I/O Module Model 2070-4N Power Supply Module
Pixel Driver Assembly	Pixel Driver Module

1.2.4 Documentation

1.2.4.1 Manual

Two copies of Manual Documentation shall be supplied for each item purchased up to 200 manuals per order. The manual shall be bound in durable covers made of either 65-pound stock paper or clear plastic. The manual shall be printed on 8.5 in by 11 in paper, with the exception that schematics, layouts, parts lists and plan details may be on 11 in by 17 in sheets, with each sheet neatly folded to 8.5 in by 11 in size. Manual text font shall be ARIAL BOLD, size 12. Text characters shall be no more than 10 characters per 1 in and 7 lines per 1 in, with the exception of schematic text, which shall be no more than 18 characters per 1 in and 11 lines per 1 in.

1.2.4.2 Parts Listed

The State of California title, device name, date, serial numbers and revision numbers of equipment covered by the manuals shall be printed on the front cover of the manuals. The manual shall be separated into two volumes; volume one shall be labeled as Operating Manual and volume two shall be label as Electrical/Mechanical Drawings.

Volume one of the Manual shall include a table of contents and items 2 through 9 and Volume two shall include a table of contents and items 10 through 12 in order as listed:

Item #	Section #	Description
1	N/A	Table of Contents
2	1	Glossary
3	2	General Description
4	3	General Characteristics
5	4	Installation
6	5	Adjustments
7	6	Theory of Operation
		a. Systems Description (include block diagram).
		b. Detailed Description of Circuit Operation.

8	7	Maintenance
		a. Preventive Maintenance. b. Trouble Analysis. c. Trouble Shooting Sequence Chart. d. Wave Forms. e. Voltage Measurements. f. Alignment Procedures.
9	8	Parts List (include circuit and board designation, part type and class, power rating, component manufacturer, mechanical part manufacturer, data specification sheets for special design components and original manufacturer's part number).
10	9	Electrical Interconnection Details & Drawings.
11	10	Schematic and Logic Diagram.
12	11	Assembly Drawings and a pictorial diagram showing physical locations and identification of each component or part.

1.2.4.3 Cabinet Manuals

Manuals and Wiring Diagram Sheets for the Cabinet shall be furnished in a weatherproof plastic pouch placed in the cabinet. Cabinet Wiring Diagrams shall be on non-fading, minimum 22-inch x 34-inch sheets.

1.2.4.4 Draft

A preliminary Draft of the Manual shall be submitted to the Engineer for approval prior to final printing.

1.2.5 Packaging

Each item delivered shall be individually packed in its own shipping container. When loose styrofoam is used for packing the item, the item shall be sealed in a plastic bag to prevent direct contact with the styrofoam.

1.2.6 Delivery

Each item delivered for testing shall be complete, including manuals, and ready for testing.

1.2.7 Metal Edges

All sharp edges and corners shall be rounded and free of any burrs.

1.2.7.1 Aluminum

Aluminum sheets shall be Type 3003-H14 or Type 5052-H32 ASTM Designation B209 aluminum alloy. Rod, Bar and Extruded shall be Type 6061-T6, or equal.

1.2.7.2 Stainless Steel

Stainless Steel Sheets shall be annealed or one-quarter-hard complying with the ASTM Designation: A666 for Type 304, Grades A or B, stainless steel sheet.

1.2.7.3 Cold Rolled Steel

Cold Rolled Steel Sheets, Rods, Bars and Extruded shall be Type 1018/1020.

1.2.7.3.1 Plating

All cold roll steel shall be plated. All plating shall be either cadmium plating meeting the requirements of Federal Specification QQ-P-416C, Type 2 Class I or zinc plating meeting the requirements of ASTM B633-85 Type II SC4.

1.2.8 Mechanical Hardware

All Hardware bolts, nuts, washers, screws, hinges and hinge pins shall be stainless steel unless otherwise specified.

1.2.9 Electrical Isolation

Within the circuit of any device, module, or PCB, Electrical Isolation shall be provided between DC logic ground, equipment ground and the AC- (Neutral) conductor. They shall be electrically isolated from each other by 500 MΩ, minimum, when tested at the input terminals with 100 Volts DC.

1.2.10 Daughter Boards

Keyboards and LCD/LED Displays are considered daughter boards. Daughter boards shall be mechanically secured with four spacers / metal screws depending on the area supported. Connectors shall be either Flat Cable or PCB Headers. Components are allowed to be mounted under the daughter board.

CHAPTER 1-SECTION 3

COMPONENTS

1.3.1 General

All components shall be second sourced and shall be of such design, fabrication, nomenclature or other identification as to be purchased from a wholesale distributor or from the component manufacturer, except as follows:

1.3.1.1 Special Design

When a component is of such Special Design that it precludes the purchase of identical components from any wholesale distributor or component manufacturer, one spare duplicate component shall be furnished with each 20, or fraction thereof, components used.

1.3.1.2 Electronic Circuit

The Electronic Circuit design shall be such that all components of the same generic type, regardless of manufacturer, shall function equally in accordance with the specifications.

1.3.2 Electronic Components

1.3.2.1 Socket Mounted

NO device shall be Socket Mounted unless specifically called out or requested and approved at Qualified Product List Submittal.

1.3.2.2 Rated Power

NO component shall be operated above 80% of its maximum Rated Voltage, current or power ratings. Digital components shall not be operated above 3% over their nominal voltage, current or power ratings.

1.3.2.3 Manufactured Date

NO component shall be provided where the Manufactured Date is 3 years older than the contract award date. The design life of all components, operating continuously (24 hours a day, 365 days per year) in their circuit application, shall be 10 years or longer.

1.3.2.4 Encapsulation

Encapsulation of 2 or more discrete components into circuit modules is prohibited except for transient suppression circuits, resistor networks, diode arrays, solid-state switches, optical isolators, transistor arrays and termination networks. Components shall be arranged so they are easily accessible, replaceable and identifiable for testing and maintenance. Where damage by shock or vibration exists, the component shall be supported mechanically by a clamp, fastener, retainer, or hold-down bracket.

1.3.2.5 Contractor

The Contractor shall submit detailed engineering technical data on all components at the request of the Engineer. A letter from the component manufacturer shall be submitted with the detailed engineering data when the proposed application of the component alters the technical data. The letter shall certify that the component application meets specification requirements.

1.3.2.6 Temperature Rating

All components used shall be designed to operate within the full temperature range specified. The component data sheets shall be the only accepted form of validation of the temperature range. Testing and/or screening of commercial grade components is not permitted.

1.3.3 Capacitors

The DC and AC voltage ratings as well as the dissipation factor of a capacitor shall exceed the worst-case design parameters of the circuitry by 150% except for Supercaps which shall be 110%. Supercaps are capacitors rated less than 10 working Volts DC with capacitance values greater than or equal to 1.0F. Capacitor encasements shall be resistant to cracking, peeling and discoloration. With the exemption of Surface Mount Capacitors, all capacitors shall be insulated and shall be marked with their capacitance values and working voltages. Electrolytic capacitors shall not be used for capacitance values of less than 1.0 microfarad and shall be marked with polarity.

1.3.4 Potentiometers

Potentiometers with ratings from 1 to 2 watts shall meet Military Type RV4 requirements. Potentiometers with ratings less than 1 Watt shall be used only for trimmer type function. The potentiometer power rating shall be at least 100% greater than the maximum power requirements of the circuit.

1.3.5 Resistors

Fixed carbon film, deposited carbon, or composition-insulated resistors shall conform to the performance requirements of Military Specifications MIL-PRF-22684F and Amendment 1. All resistors shall be insulated and shall be marked, except for surface mount, with their resistance values. Resistance values shall be indicated by the EIA color codes, or stamped value. The value of the resistors shall not vary by more than 5% between -34.6⁰F and 165.2⁰F.

1.3.5.1 Thermal

Special Ventilation or Heat Sinking shall be provided for all 2-watt or greater resistors. They shall be insulated from the PCB.

1.3.6 Semiconductor-Devices

1.3.6.1 Solid State

All Solid State devices, except LED's, shall be of the silicon type.

1.3.6.2 Transistors / IC / Diodes

All Transistors, Integrated Circuits, and Diodes shall be a standard type listed by EIA. With exemption of Surface Mount Components, Transistors, Integrated Circuits and Diodes shall be clearly identifiable.

1.3.6.3 Metal Oxide Semi-Conductor

All Metal Oxide Semi-Conductor components shall contain circuitry to protect their inputs and outputs against damage due to high static voltages or electrical fields.

1.3.6.4 Device Pin 1

Device Pin "1" locations shall be properly marked on the PCB adjacent to the pin.

1.3.7 Transformers / Inductors

With the exemption of Surface Mount Components, all power transformers and inductors shall have the manufacturer's name or logo and part number clearly and legibly printed on the case or lamination. All transformers and inductors shall have their windings insulated, shall be protected to exclude moisture, and their leads color

coded with an approved EIA color code or identified in a manner to facilitate proper installation.

1.3.8 Triacs

Each triac with a designed circuit load of greater than 0.5 Amperes at 120 VAC shall be mounted to a heat sink with thermal conductive compound or material, in addition to being mechanically secured.

1.3.9 Circuit Breakers

Circuit Breaker shall be UL 489 approved. The trip and frame sizes shall be plainly marked (marked on the breaker by the manufacturer), and the Amperes rating shall be marked and visible from the front of the breaker. Contacts shall be silver alloy and enclosed in an arc-quenching chamber. Overload tripping shall not be influenced by an ambient air temperature range of from 0.4 °F to 122 °F. The minimum Interrupting Capacity shall be 5,000 Amperes, RMS when the breaker is secondary to a UL approved fuse or primary circuit breaker and both breakers in concert provide the rated capacity. For circuit breakers 80 Amperes and above, the minimum interrupting capacity shall be 10,000 Amperes, RMS. Circuit breakers shall be the trip-free type with medium trip delay characteristic (Carling switch Time Delay Curve #24 or equal).

1.3.10 Fuses

All Fuses shall be 3AG Slow Blow type and resident in a holder. Fuse size rating shall be labeled on the chassis, PCB or beside the holder. Fuses shall be easily accessible and removable without use of tools.

1.3.11 Switches

1.3.11.1 Dual-Inline-Package-(DIP)

Dual-inline-package, quick snap switches shall be rated for a minimum of 30,000 operations per position at 50 mA, 30 VDC. The switch contact resistance shall be 100 milliohms maximum at 2 mA, 30 VDC. The contacts shall be gold over brass (or silver). Contact for VAC or 28 VDC and shall be silver over brass (or equal). The DIP shall have recessed switches to prevent accidental switching.

1.3.11.2 5 VDC Logic Switch

5 VDC Logic rating shall be 0.4VA @ 20VAC or DC with contact material of gold over nickel plating or copper alloy. The switch shall be rated for a minimum of 40,000 operations.

1.3.11.3 12 -24 VDC Logic/Control Switches

12-24 VDC control switch contacts shall be rated for a minimum of five-Amperes resistive load at 120 VAC or 28 VDC and shall be gold over brass (or equal). The switch shall be rated for a minimum of 40,000 operations.

1.3.11.4 Power Rating

The switch contacts shall be rated for a minimum of 10 Amperes resistive load at 120 VAC or 28 VDC and shall be silver over brass or equal.

1.3.12 Terminal Blocks

The terminal blocks shall be barrier type, rated at 20 Amperes and 600 VAC RMS minimum. The terminal screws shall be 0.313 in minimum length nickel plated brass binder head type with screw inserts of the same material. Screw size is called out under the associated file, panel or assembly.

1.3.13 Wiring / Cabling / Harnesses

1.3.13.1 Harnesses

Harnesses shall be neat, firm and properly bundled with external protection. They shall be tie-wrapped and routed to minimize cross talk and electrical interference. Each harness shall be of adequate length to allow any conductor to be connected properly to its associated connector or termination point. Conductors within an encased harness have no color requirements. Printed circuit motherboards are to be used where possible to eliminate or reduce cabinet wiring.

1.3.13.2 AC Wiring

Wiring containing AC shall be bundled separately or shielded separately from all DC logic voltage control circuits.

1.3.13.3 Cabling

Cabling shall be routed to prevent conductors from being in contact with metal edges. Cabling shall be arranged so that any removable assembly may be removed without disturbing conductors not associated with that assembly.

1.3.13.4 Labeling

All conductors, except those which can be readily traced, shall be labeled. Labels attached to each end of the conductor shall identify the destination of the other end of the conductor.

1.3.13.5 Conforming

All conductors shall conform to MIL-W-16878G/1 or better and shall have a minimum of 19 strands of copper. The insulation shall be polyvinyl chloride with a minimum thickness of 10 mils or greater. Where insulation thickness is 15 mils or less, the conductor shall conform to MIL-W-16878/17.

1.3.13.6 Conductor Color

Conductor Color identification shall be as follows:

AC - (Neutral) circuits	White.
Equip. Ground	Solid green or continuous green color with 1 or more yellow stripes.
DC logic ground	Solid white or continuous white with a red stripe.
AC + (Line) circuits	Solid black or continuous black with colored stripe.
DC logic ungrounded or signal	Any color not specified.

1.3.14 Indicators / Displays

All indicators and character displays shall be readily visible at a radius of up to 4 ft within the cone of visibility when the indicator is subjected to 97,000 lux (9,000 foot-candles) of white light with the light source at 45 +/-2 degrees to the front panel.

1.3.14.1 Indicators

All indicators and character displays shall have a minimum 90 degrees cone of visibility with its axis perpendicular to the panel on which the indicator is mounted. All indicators shall be self-luminous. All indicators shall have a rated life of 100,000 hours minimum. Each LED indicator shall be white or clear when off and visibly illuminated when on. Indicators supplied on equipment requiring handles shall be mounted such that a horizontal clearance of 15 degrees minimum shall be provided for Models 208, 210, 212, 222, 232, 242 and 252, as well as a clearance of 30 degrees minimum for Models 200, 204 and 206.

1.3.14.2 Character Displays

Liquid Crystal Displays (LCD) shall operate at temperatures of -4 °F to 158 °F.

1.3.15 Connectors

1.3.15.1 Keyed

All connectors shall be keyed to prevent improper insertion of the wrong connector. The mating connectors shall be designated as the connector number and male/female relationship, such as C1P (plug or PCB edge connector) and C1S (socket).

1.3.15.2 Type T

The Type T connector shall be a single row, 10 position, feed through terminal block. The terminal block shall be a barrier type with 6-32, 0.25 in or longer, nickel plated brass binder head screws. Each terminal shall be permanently identified as to its function.

1.3.15.3 Plastic Circular / M Type

Plastic Circular and M Type connectors - Pin and socket contacts for connectors shall be beryllium copper construction sub-plated with 0.00005 in nickel and plated with 0.0000299 in gold. Pin diameter shall be 0.061811 in. All pin and socket connectors shall use the AMP #601105-1 or #91002-1 contact insertion tool and the AMP #305183 contact extraction tool.

1.3.15.4 Edge / PCB

Card Edge and Two-Piece PCB Connectors

1.3.15.4.1 PCB Edge

PCB Edge connectors shall have bifurcated gold-plated contacts. The PCB receptacle connector shall meet or exceed the following:

Operating Voltage:	600 VAC (RMS)
Current Rating:	5.0 Amperes
Insulation Material:	Diallyl Phthalate or Thermoplastic
Insulation Resistance:	5,000 MΩ
Contact Material:	Copper alloy plated with 0.00005 in of nickel and 0.000015 in of gold
Contact Resistance:	0.006 Ohm maximum

1.3.15.4.2 Two Piece PCB

The Two-Piece PCB connector shall meet or exceed the DIN 41612.

1.3.15.4.3 PCB 22/44

The PCB 22/44 Connector shall have 22 independent contacts per side; dual sided with 0.156 in contact centers.

1.3.15.4.4 PCB 28/56

The PCB 28/56 Connector shall have 28 independent contacts per side, dual sided with 0.156 in contact centers.

1.3.15.4.5 PCB 36/72

The PCB 36/72 Connector shall have 36 independent contacts per side, dual sided with 0.100 in contact centers.

1.3.15.4.6 PCB 43/86

The PCB 43/86 Connector shall have 43 independent contacts per side, dual sided with 0.100 in contact centers.

1.3.15.5 Wire Terminal Connectors

Each wire terminal shall be solderless with PVC insulation and a heavy-duty short - locking spade type connector. All terminal connectors shall be crimped using a Controlled-Cycle type crimping tool.

1.3.15.6 Flat Cable Connectors

Each flat cable connector shall be designed for use with 26 AWG cable; shall have dual cantilevered phosphor bronze contacts plated with 0.00015 of gold over 0.00005 inches of nickel; and shall have a current rating of 1 A minimum and an insulation resistance of 5 mega Ohms minimum.

1.3.15.7 PCB Header Post Connectors

Each PCB header post shall be 0.00155 in² by 0.343 in high; shall be mounted on 0.156 in centers; and shall be tempered hard brass plated with 0.000015 in of gold over 0.00005 in of nickel.

1.3.15.8 PCB Header Socket Connectors

Each PCB header socket block shall be nylon or diallyl phthalate. Each PCB header socket contact shall be removable, but crimp-connected to its conductor. The Contractor shall list the part number of the extraction tool recommended by its manufacturer. Each PCB header socket contact shall be brass or phosphor bronze plated with 0.00010 in of gold over 0.00005 in of nickel.

1.3.16 Surge Protection Device

A three-electrode gas tube type that is capable of withstanding 15 pulses of peak current each of which will rise in 8 μ s and fall in 20 μ s to 0.5 of the peak voltage at 3-minute intervals. Peak current rating shall be 20,000 Amperes. It shall have the following ratings:

Impulse Breakdown:	Less than 1,000 Volts in less than 0.1 us at 10 KV/us.
Standby Current:	Less than 1 mA.
Striking Voltage:	Greater than 212 Volts.

CHAPTER 1-SECTION 4

MECHANICAL

1.4.1 Assemblies

All assemblies shall be modular, easily replaceable and incorporate plug-in capability for their associated devices or PCBs. Assemblies shall be provided with 2 guides for each plug-in PCB or associated device (except relays). The guides shall extend to within 0.75 in from the face of either the socket or connector and front edge of the assembly. If Nylon guides are used, the guides shall be securely attached to the file or assembly chassis.

1.4.2 PCB Design

No components, traces, brackets or obstructions shall be within 0.125 in of the board edge (guide edges). The manufacturer's name or logo, model number, serial number, and circuit issue or revision number shall appear and be readily visible on all PCBs. Devices to prevent PC Board from backing out of their assembly connectors shall be provided.

1.4.3 Model Numbers

The manufacturer's model and serial number shall appear on the rear panel of all equipment supplied (where such panel exists). In addition to any assignment of model numbers by the manufacturer, the State model number shall be displayed on the front panel in bold type, at least 0.25 in high.

1.4.4 PCB Connectors

All PCB Connectors mounted on a motherboard shall be mechanically secured to the chassis or frame of the unit or assembly.

1.4.5 Fasteners

All screw type Fasteners shall utilize locking devices or locking compounds except for finger screws, which shall be captive.

1.4.6 Workmanship

Workmanship shall conform to the requirements of this specification and be in accordance with the highest industry standards.

1.4.7 Tolerances

The following tolerances shall apply, except as specifically shown on the plans or in these specifications:

Sheet Metal	+/- 0.0525 in
PCB	+/- 0.010 in
Edge Guides	+/- 0.015 in

CHAPTER 1-SECTION 5

ENGINEERING

1.5.1 Human Engineering

1.5.1.1 Equipment

The Equipment shall be engineered for simplicity, ease of operation and maintenance.

1.5.1.2 Knobs

Knobs shall be a minimum of 0.5 in diameter and a minimum separation of 0.5 in edge to edge.

1.5.1.3 PCB

PCBs shall slide smoothly in their guides while being inserted into or removed from the frame and shall fit snugly into the plug-in PCB connectors. PCBs shall require a force no less than 4.5 lbs or greater than 50 lbs for insertion or removal.

1.5.2 Design Engineering

The design shall be inherently temperature compensated to prevent abnormal operation. The circuit design shall include such compensation as is necessary to overcome adverse effects due to temperature in the specified environmental range. The design shall take into consideration the protection of personnel from all dangerous voltages.

1.5.3 Generated Noise

No item, component or subassembly shall emit a noise level exceeding the peak level of 55 dBa when measured at a distance of one meter away from its surface, except as otherwise noted. No item, component or subassembly shall emit a noise level sufficient to interfere with processing and communication functions of the controller circuits

CHAPTER 1-SECTION 6 PRINTED CIRCUIT BOARDS

1.6.1 Design, Fabrication and Mounting

The Design, Fabrication and Mounting of components and assemblies shall comply with the Association Connecting Electronics Industries Standards (IPC) as specifically listed in this specification. In the event of any conflict between the requirements of this specification and IPC standards, the IPC Standards shall govern.

1.6.1.1 Contacts on PCBs

All contacts on PCBs shall be plated with a minimum thickness of 0.00003 in gold over a minimum thickness of 0.000075 in nickel.

1.6.1.2 PCB Design

PCB design shall be such that when a component is removed and replaced, no damage is done to the board, other components, conductive traces or tracks.

1.6.1.3 Fabrication

Fabrication of PCBs shall be in compliance with IPC-4101B and Amendment 2, except as follows:

1.6.1.3.1 Copper Tracks

NEMA FR-4 glass cloth base epoxy resin copper clad laminates 0.0625 in minimum thickness shall be used. Inter-component wiring shall be by laminated copper clad track having a minimum weight of 1.0 ounces per square foot with adequate cross section for current to be carried. All copper tracks shall be plated or covered by solder mask to provide complete coverage of all exposed copper tracks. Jumper wires to external PCB components shall be from plated-through padded holes and as short as possible.

1.6.1.3.2 Pits, Dents, Bows and Twists

Grade of Pits and Dents shall be of Grade B or better. The permissible bow or twist shall be Class C or better.

1.6.1.4 Mounting

The mounting of parts and assemblies on the PCB shall conform to IPC-2221A, Class 3, except as follows:

1.6.1.4.1 Semiconductor Devices

Semiconductor devices that dissipate more than 250 mW or cause a temperature rise of 50 °F or more shall be mounted with spacers, transipads or heat sinks where applicable to prevent contact with the PCB.

1.6.1.4.2 Residual Flux

When completed, all residual flux shall be removed from the PCB.

1.6.1.4.3 Resistance

Except where Surface Mount Components are used, the resistance between any 2 isolated, independent conductor paths shall be at least 100 MΩ when a 500 VDC potential is applied.

1.6.1.4.4 Coated

All PCBs shall be conformal coated with a UV Tracer. This coating shall conform to the configuration of the object coated, applied on the completed board assembly. The coating shall be resistant to the affect of moisture and solvents.

1.6.1.4.5 Lateral Separation

Where less than 0.125 in lateral separation is provided between the PCB (or the components of a PCB) and any metal surface, a 0.03125 in $\pm$ 0.0156 in thick Mylar (polyester) plastic cover shall be provided on the metal to protect the PCB.

1.6.1.5 Connector Edges

Each PCB connector edge shall be chamfered at 30 degrees from board side planes. The key slots shall also be chamfered so that the connector keys are not extracted upon removal of board or jammed upon insertion. The key slots shall be 0.045 in $\pm$ 0.005 in for 0.1 in spacing and 0.055 in $\pm$ 0.005 in for 0.156 in spacing.

1.6.2 Soldering

1.6.2.1 Hand Soldering

Hand soldering shall comply with IPC-J-STD-00D and Amendments.

1.6.2.2 Automatic Flow Soldering

Automatic flow soldering shall be a constant speed, conveyor system with the conveyor speed set at optimum to minimize solder peaks or points. Temperature shall be controlled to within $\pm$ 46.4 °F of the optimum temperature. The soldering process shall result in the complete coverage of all copper runs, joints and terminals with solder except that which is covered by an electroplating process. Wherever clinching is not used, a method of holding the components in the proper position for the flow process shall be provided.

1.6.2.3 Time-Temperature

If exposure to the temperature bath is of such time-temperature duration, as to come within 80% of any component's maximum specified time-temperature exposure, that component shall be hand soldered to the PCB after the flow process has been completed.

1.6.3 Definitions

Definitions for the purpose of this section on PCBs shall be taken from IPC-613 and Amendment 1.

CHAPTER 1-SECTION 7

QUALITY CONTROL

1.7.1 Components

All components shall be lot sampled to assure a consistent high conformance standard to the design specification of the equipment.

1.7.2 Subassembly, Unit or Module

Complete electrical, environmental and timing compliance testing shall be performed on each module, unit, printed circuit or subassembly. Housing, chassis, and connection terminals shall be inspected for mechanical sturdiness, and harnessing to sockets shall be electrically tested for proper wiring sequence. The equipment shall be visually and physically inspected to assure proper placement, mounting, and compatibility of subassemblies.

1.7.3 Predelivery Repair

1.7.3.1 Defects / Deficiencies

Any defects or deficiencies found by the inspection system involving mechanical structure or wiring shall be returned through the manufacturing process or special repair process for correction.

1.7.3.2 PCB Flow Soldering

PCB flow soldering is allowed a second time if copper runs and joints are not satisfactorily coated on the first run. Under no circumstances shall a PCB be flow soldered more than twice.

1.7.3.3 Hand Soldering

Hand soldering is allowed for printed circuit repair.

CHAPTER 1-SECTION 8

ELECTRICAL, ENVIRONMENTAL AND TESTING REQUIREMENTS

1.8.1 General

The requirements called out in these specifications dealing with equipment evaluation are a minimum guide and shall not limit the testing and inspection to insure compliance.

1.8.2 Certification

These test procedures shall be followed by the Contractor who shall certify that they have conducted inspection and testing in accordance with these specifications.

1.8.3 Inspection

A visual and physical inspection shall include mechanical, dimensional and assembly conformance of all parts of these specifications.

1.8.4 Environmental and Electrical

All components shall properly operate within the following limits unless otherwise noted:

Applied Line Voltage: 90 to 135 VAC, note "Power Failure / Restoration" limits

Frequency: 60 (+/-3.0) Hertz

Humidity: 5% to 95%

Ambient Temperature: -34.6 °F to +165.2 °F

Shock - Test per Specification MIL-STD-810G Method 516.6.

Vibration - per Specification MIL-STD-810G Method 514.6.

1.8.4.1 Commencement Operation

All circuits, unless otherwise noted, shall commence operation at or below 90 VAC as the applied voltage is raised from 50 to 90 VAC at a rate of 2 (+/-0.5) volts / second.

1.8.4.2 Equipment Compliance

All equipment shall be unaffected by transient voltages normally experienced on commercial power lines. Where applicable, equipment purchased separately from the cabinet (which normally is resident) will be tested for compliance in a State accepted cabinet connected to the commercial power lines.

1.8.4.3 Power Line Surge Protection

The power line surge protection shall enable the equipment being tested to withstand (non-destructive) and operate normally following the discharge of a 25 µF capacitor charged to ± 2,000 volts, applied directly across the incoming AC line at a rate of once every 10 seconds for a maximum of 50 occurrences per test. The unit under test will be operated at 68 °F ± 41 °F and at 120 (±12) VAC.

1.8.4.4 Operating

The equipment shall withstand (nondestructive) and operate normally when one discharge pulse of plus or minus 300 volts is synchronously added to its incoming AC power line and moved uniformly over the full wave across 360 degrees or stay at any point of Line Cycle once every second. Peak noise power shall be 5 kilowatts with a pulse rise time of 500 ns. The unit under test will be operated at 68 °F ±41 °F and at 120 (+/-12) VAC.

1.8.4.5 Modules

The controller unit communications modules shall be tested resident in a State-accepted controller unit which in turn is housed in the cabinet.

1.8.4.6 CMS System Equipment

CMS system equipment will be tested for compliance as a complete system with power from commercial power lines applied at the CMS CIP Panel.

1.8.4.7 UL Requirements

Equipment shall comply only with the requirements of UL Bulletin of Research No. 23, "Rain Tests of Electrical Equipment."

1.8.4.8 Normal Operation

All equipment shall continue normal operation when subjected to the following:

1.8.4.8.1 Low Temperature Test

With the item functioning at a line voltage over Electrical Range the Device in its intended operation, the ambient temperature shall be lowered from 68 °F to 34.6 °F at a rate of not more than 64.4 °F per hour. The item shall be cycled at -34.6 °F for a minimum of 5 hours and then returned to 68 °F at the same rate.

1.8.4.8.2 High Temperature Test

With the item functioning at a line voltage over Electrical Range the Device in its intended operation, the ambient temperature shall be raised from 68 °F to 165.2 °F at a rate of not more than 64.4 °F per hour. The item shall be cycled at 165.2 °F for 5 hours and then returned to 68 °F at the same rate. The test shall be repeated with the line voltage at 135 VAC.

1.8.4.8.3 Normal Operation

All equipment shall resume normal operation following a period of at least 5 hours at -34.6 °F and less than 10 percent humidity and at least 5 hours at 165.2 °F and 22% humidity, when 90 VAC is applied to the incoming AC.

1.8.4.9 Humidity and Ambient Temperature

The relative humidity and ambient temperature values in the following table shall not be exceeded.

**AMBIENT TEMPERATURE VERSUS RELATIVE HUMIDITY
AT BAROMETRIC PRESSURES (29.92 In. Hg.)**

Ambient Temperature/ Dry Bulb (in °F)	Relative Humidity (in percent)	Ambient Temperature/ Wet Bulb (in °F)
-34.6 to 33.98	10	1.04 to 108.86
33.98 to 114.8	95	108.86
119.84	70	108.86
129.92	50	108.86
140.0	38	108.86
149.72	28	108.86
160.16	21	108.86
165.2	18	108.86

1.8.4.10 Opening and Closing of Contacts

All equipment shall be capable of normal operation following opening and closing of contacts in series with the applied voltage at a rate of 30 openings and closings per minute for a period of 2 minutes in duration.

1.8.5 Contractor's Testing Certification

1.8.5.1 QC / Final Test

A complete QC / final test report shall be supplied with each item. The test report shall indicate the name of the tester and shall be signed by a responsible manager.

1.8.5.2 Quality Control Procedure & Test Report

The quality control procedure and test report format shall be **supplied** to the Engineer for approval within 15 days following the award of the contract. The quality control procedure shall include the following:

- Acceptance testing of all supplied components.

- Physical and functional testing of all modules and items.

- A minimum 100-hour burn-in of all equipment.

- Physical and functional testing of all items.

CHAPTER 1-SECTION 9 CONNECTOR DETAILS

1.9.1	M104 – Connector	Appendix
1.9.2	M14 – Connector	A1-1
1.9.3	M50 & Circular Plastic Connectors	A1-2
1.9.4	M14S- Serial Connector	A1-3
		A1-4

Section Notes:

M Type connector blocks shall be constructed of phenolic or equal and shall have an insulation resistance of 5000 Mega Ohms. The contacts shall be secured in the blocks with stainless steel springs.

M Type connector corner guides shall be stainless steel. The guide pins shall be 1.097 inches in length and the guide sockets shall be 0.625 inches in length.

Circular plastic connectors shall have quick connect / disconnect capability and thread assist positive detent coupling. The connectors shall be UL listed glass-filled nylon, 94 V-I rated heat stabilized and fire resistant.

CHAPTER 9
MODEL 2070 CONTROLLER
SPECIFICATIONS

CHAPTER 9-SECTION 1 GENERAL

9.1.1 Controller Unit

The Controller Unit shall be composed of the Unit Chassis, modules and assemblies per their version. The following is a list of 2070 Versions, their interface rolls and composition:

UNIT VERSION	DESCRIPTION
2070V UNIT	Provides directly driven VME and mates to 170 & ITS cabinets. It consists of: UNIT CHASSIS, 2070-1A TB, 2070-1A MCB, 2070-2A FI/O, 2070-3A FRONT PANEL, 2070-4 POWER SUPPLY, and 2070-5 VME CAGE ASSEMBLY.
2070L UNIT	LITE Unit mates to the 170 & ITS cabinets. It consists of: UNIT CHASSIS, 2070-1E CPU, 2070-2A (2B if ITS CABINET), FI/O, 2070-3B FRONT PANEL and 2070- 4 POWER SUPPLY
2070LC UNIT	LITE unit mates to ITS cabinets only. It consists of: UNIT CHASSIS, 2070-1E CPU, 2070-2B FI/O, 2070-3C FRONT PANEL and 2070-4 POWER SUPPLY
2070LX UNIT	LX Unit mates to the 170 & ITS cabinets. It consists of: UNIT CHASSIS, 2070-1C CPU, 2070-2A (2B if ITS CABINET), FI/O, 2070-3B FRONT PANEL and 2070- 4 POWER SUPPLY
Note: See Chapter 11 for 2070 NEMA Versions	

9.1.2 Communications and Option Modules

The communications and option modules shall be called out separately from the unit version. The composition weight shall not exceed 25 lbs.

9.1.3 Chassis

The Chassis top and Bottom, Internal Structure Supports, Back Plane Mounting Surface, Module Plates, Power Supply Enclosure, and Front Panel shall be made of minimum aluminum sheet. The Chassis Side panels shall be 0.090 inches minimum sheet

9.1.4 Power Failure Power Restoration Operations

It is noted that the Power Failure Power Restoration operations of this unit are specific to the requirements of the user. All associated modules shall comply to said operations.

9.1.5 2070 Unit Module

2070 UNIT module / assembly power limitations shall be as follows:

Models	+5VDC	+12VDC iso	+12VDC ser	-12 VDC ser
2070-1A MCB	750 mA	-----	-----	-----
2070-1A TB	750 mA	-----	-----	-----
2070-1E CPU	1.0 A	250 mA		
2070-1C, Host Board	2A	250mA		
2070-2A FI/O	250 mA	750 mA	-----	-----
2070-2B FI/O	250 mA	500 mA	-----	-----
2070-3A,B&D FPA	500 mA	-----	50 mA	50 mA
2070-3C FPA	500 mA	-----	50 mA	50 mA
2070-5 VME Cage	5.0 A	-----	200 mA	200 mA
2070-6A & Others	900mA	-----	300 mA	300 mA
2070-7 All Comm	250 mA	-----	50 mA	50 mA
.				

9.1.6 EIA-485 Communications Links

All circuitry associated with the EIA-485 Communications links shall be capable of reliably passing a minimum of 1.0 Mbps. Isolation circuitry shall be by optical isolator technologies.

9.1.7 EIA-485 Line Drivers/Receivers

The EIA-485 Line Drivers/Receivers shall be socket mounted or Surface mounted and shall not draw more than 35 mA in active state and 20 mA in inactive state. A 100-Ohm Termination Resistor shall be provided across each Differential Line Receiver Input. The MOTHERBOARD's control signals (e.g., SP1-RTS) shall be active, or asserted, when the positive terminal (e.g., SP1-RTS+) is a lower voltage than its corresponding negative terminal (e.g., SP1-RTS-). A control signal is inactive when its positive terminal voltage is higher than its negative terminal. Receive and transmit data signals shall be read as a "1" when the positive terminal's (e.g., SP1-TXD+) voltage is higher than its corresponding negative terminal (e.g., SP1-TXD-). A data value is "0" when its positive terminal's (e.g., SP1-TXD+) voltage is lower than its negative terminal (e.g., SP1-TXD-).

9.1.8 Sockets

Sockets for devices (called out to be socket mounted) shall be "xx" pin AUGAT 500/800 series AG10DPC or equal.

9.1.9 Frame Address

SP5 and SP3 SDLC frame address assignments (Command/Response) are as follows:

	SP 5	SP3
CPU 2070-1	"19"	"19"
FI/O 2070-2A	"20"	"NA"
Manufacturer Use	128 -254	128-254
CPU Broadcast to all	"255"	"255"

All other addresses are reserved or assigned by the Agency with the exception of NEMA TS2 Type 1 Requirements (See Chapter 11). The SDLC response shall contain the frame address of the Command sender.

CHAPTER 9-SECTION 2

MODEL 2070-1 CPU MODULE

9.2.1 Model 2070-1A CPU Module

The Model 2070-1A CPU Module shall consist of the Main Controller Board, Transition Board, Board Interface Harness, and CPU Module Software.

9.2.1.1 Main Controller Board (MCB)

The MCB shall be a 3U VME bus compliant board and contain a system controller, an A24-D16 interface, a Master& Slave bus interface, a Multilevel VMEbus Arbiter, a FAIR VMEbus Requester and BTO (64)

9.2.1.2 Controller

The Controller Device shall be a Motorola MC68360 or equal, clocked at 24.576 MHz minimum. The Fast IRQ Service System is reserved for State use only. The Interrupts shall be configured as follows:

Level 7 - VMEbus IRQ7	
Level 6 - VMEbus IRQ6	ACFAIL
Level 5 - VMEbus IRQ5	CPU: Module Counters Timers, LINESYNC (auto vectored), Serial Interface Interrupts
Level 4 - VMEbus IRQ4	
Level 3 - VMEbus IRQ3	
Level 2 - VMEbus IRQ2	
Level 1 - VMEbus IRQ1	

9.2.1.3 Memory Address Organization

8000 0000	80FF FFFF	STANDARD
9000 0000	9000 FFFF	SHORT

9.2.1.4 Transition Board

A Transition Board (TB) shall be provided to transfer serial communication and control signals between the MCB and the Interface Motherboard. Said signal and communication lines shall be driven/received off and on the module compliant to EIA-485. The Transition Board shall provide a 1 K-Ohm pull-up resistor for the A2 & A3 Installed lines. If the DC Ground is not present (slot not occupied) at the CPU EIA-485 line drivers/receivers, the drivers/receivers shall be disabled (inactive).

9.2.1.5 Shielded Interface Harness

A Shielded Interface Harness shall be provided. It shall include MCB and Transition Board connectors with strain relief, lock latch, mating connectors, and harness conductors. A minimum of 25 mm (0.984 in) of slack shall be provided. No power shall be routed through the harness. The harness shall be 100% covered by an aluminum Mylar foil and an extruded black 0.8 mm (0.0315 in) PVC jacket or equal.

9.2.2 Model 2070-1E CPU Module

The **Model 2070-1E** CPU Module shall be a single board module meeting the 2X WIDE Board requirements. The module shall be furnished normally resident in the Motherboard Slot A5. The module shall meet all the requirements listed under this section and Chapter Details Section 7. **The Model 2070-1E Module shall have a Motorola MC68EN360 CPU or equal, clocked at 24.576 MHz minimum.**

9.2.2.1 Dual SCC Device

A Dual SCC Device (asynch / synch) and associated circuitry shall be furnished to provide two additional system serial ports. The Dual SCC1 shall be assigned to the System Serial Port SP1 meeting all requirements called out for SP1 except where noted. The Dual SCC2 shall be assigned as System Serial Port SP8. The SP8 and associated circuitry shall interface with the MC68EN360 address and data structure and serially be connected to the external world via the DB 25 Pin C13S Connector located on the module front panel. **The SP8 shall meet all SP2 Port requirements except where noted, including EIA 485 drivers / receivers and synchronous data rate of 614.4 Kbps.**

9.2.2.2 68EN360 SCC1

The 68EN360 SCC1 shall be reassigned to Ethernet (ENET) Network meeting Ethernet **10 Mbps IEEE 802.3 (TP) 10 BASE T Standard Requirements, both hardware and software.** **The CPU network lines shall be connected to a port on the Network Switch. Four LEDs labeled "10/100 and Link/Act" shall be mounted on the front panel signifying Ethernet operational conditions between the CPU and the Network Switch.**

9.2.2.3 Module 2070 -1E Power Requirements.

The 2070-1E CPU Module shall not draw more than 1.00 A of +5VDC & **250 mA** of ISO+12 VDC.

9.2.2.4 The C13S Connector

The C13S Connector shall be a DB25S connector and shall be located on the Module 2070 -1X CPU front panel and shall contain signals for SP8, LINESYNC, NRESET, POWERDOWN, and an isolated BIAS +5VDC as specified in the following subsections and as listed in A9-7. **TX and RX LEDs shall be provided as show in A9-7.**

9.2.2.4.1 Serial Port SP8

System Serial Port 8 (SP8) shall be isolated, converted to EIA-485, and then routed to Connector C13S. SP8 shall meet all SP2 Port requirements except where noted.

9.2.2.4.2 LINESYNC and POWERDOWN

LINESYNC and POWERDOWN lines shall each be isolated, converted to EIA-485, and then routed to connector C13S for external module use.

9.2.2.4.3 NRESET

CPU_Reset and POWER UP lines shall be isolated, then OR'd to form NRESET. NRESET shall then be converted to EIA-485 and routed to connector C13S for external module use.

9.2.3 Model 2070-1C CPU Module

The TYPE 2070-1C CPU Module shall be a single board module meeting the 2X WIDE board requirements. The module shall be furnished normally resident in MOTHERBOARD Slot A5. The module shall meet the requirements as listed in Section 9.2.2.4 of these specifications.

9.2.3.1 Engine Board

The TYPE 2070-1C CPU shall use an Engine Board compliant to the AASHTO/ITE/NEMA Next Generation ATC Standard with the exceptions as defined in Sections 9.2.5 and 9.2.8. The Engine Board shall be used for execution of the application software. No other microprocessor or memory of the 2070-1C CPU shall be used for execution of the application software.

9.2.3.2 Ethernet Ports

The ETHERNET ports of the Engine Board shall be brought out on RJ 45 Connectors mounted on the 2070-1C front panel. The front panel LED indicators for the two CPU Ethernet ports shall be provided as indicated in drawing A9-15.

9.2.3.3 Network Switches, Module 2070-1C

The Model 2070-1C CPU Module shall be provided with two integrated Store-and-Forward Network Switches per the IEEE 802.3, 802.3u and 802.3 x specifications. One switch shall be configured with port 1 and 2 connected to the front panel RJ-45 connectors and port 3 shall be connected to the CPU ENET 1 port. The second switch shall be configured with port 1 connected to the front panel RJ-45, port 2 shall be connected to the CPU ENET 2 port. Port 3 shall be used to route Ethernet across the Motherboard to the "A" Connectors. DC Grounding plane around the network connectors and lines shall be provided. Port 3 Network Lines shall be assigned to: NetP5 TX+, TX-, RX+ and RX- respectively.

9.2.3.4 Universal Serial Bus (USB)

The TYPE 2070-1C CPU Module shall include a USB port compliant to the AASHTO/ITE Next Generation ATC Standard with the exceptions that USB shall conform to the appropriate sections of the USB v2.0 specification for both hardware and software operations. USB shall be brought out from the Engine Board to a USB Connector mounted on the 2070-1C front panel.

9.2.3.5 Host Module

The 2070-1C CPU Module shall use a Host Module that provides the mechanical and electrical interfaces to the Engine Board and Motherboard.

The TYPE 2070-1C CPU Module shall implement the host module identification using the Engine Board SPI serial port, compliant to the AASHTO/ITE Next Generation ATC Standard.

9.2.4 Model 2070-1A and 2070-1E CPU Module

9.2.4.1 Contiguous Addresses

16 megabytes of contiguous address space for each specified memory (DRAM, SRAM and FLASH) shall be allocated on an even boundary. The SRAM and FLASH memories shall be accessed through the OS-9 Operating System's Supplied File Manager.

9.2.4.2 Incoming +5 VDC

When the incoming +5 VDC falls below its operating level, the SRAM shall drop to its standby state and the SRAM and TOD Clock shall shift to the +5 VDC Standby Power. A on-board circuit shall sense the +5 VDC Standby Power and shift to a On-board CPU Power Source. When the incoming +5 VDC rises to within its operating level, the appropriate MCB Circuitry shall shift from standby power to incoming +5 VDC.

9.2.4.3 Ram Memory

A minimum of 8 MB of DRAM memory, organized in 32-bit words, shall be provided. A minimum of 512 KB of SRAM will be available for agency use, organized in 16 or 32-bit words shall be provided. The time from the presentation of valid RAM address, select lines, and data lines to the RAM device to the acceptance of data by the RAM device shall not exceed 80 ns and shall be less as required to fulfill zero wait state RAM device write access under all operational conditions.

9.2.4.4 Flash Memory

A minimum of 8 MB of FLASH memory, organized in 16- or 32- bit words, shall be provided. The MCB shall be equipped with all necessary circuitry for writing to the FLASH memory under program control. No more than 2 MB of FLASH Memory shall be used for the Boot Image and a minimum of 6 MB shall be available for Agency use. A maximum of 2 MB of Flash Memory shall be reserved the Boot Image only. Flash memory shall have a minimum rated capacity of 100,000 read/write cycles and be industrial grade or better.”

9.2.4.5 Time-of-day Clock

A software settable hardware Time-of-Day (TOD) clock shall be provided. It shall, under on-board standby power maintain an accuracy of ± 1 minute per 30 days at 25°C. The clock shall provide a minimum fractional second resolution of 10 ms and shall track seconds, minutes, and hours, day of month, month, and year.

9.2.4.6 CPU_Reset

A software-driven CPU_Reset signal (Active LOW) shall be provided to reset other controller systems. The signal output shall be a driver capable of sinking 30 mA at 30 VDC. Execution of the program module “cpureset” in the boot image shall assert the CPU_Reset signal once. CPU_Reset shall be executed when the controller starts up or is rebooted using the OS-9 break command.

9.2.4.7 CPU_ACTIVE LED Indicator

An open-collector output, capable of sinking 30 mA at 30 VDC, shall be provided to drive the Front Panel Assembly CPU_ACTIVE LED Indicator. The LED shall default to ON when the controller starts up.

9.2.4.8 Tick Timer

The OS-9 Operating System Tick Timer interrupt shall be derived from the each transition of LINESYNC signal, with a tick rate of 120 ticks per second.

9.2.4.9 SRAM and TOD Clock

The SRAM and TOD Clock Circuitry under Standby mode shall draw no more than 8uA at 2.5 VDC and 35 degrees C. An On board Capacitor supply shall hold up SRAM and TOD for a minimum of 7 days.

9.2.4.10 Network Switch, Model 2070 -1E

The Model 2070-1E CPU Module shall be provided with an integrated Store-and-Forward Network Switch per the IEEE 802.3, 802.3u and 802.3 x specifications. The switch shall be configured with two ports connected to the front panel RJ-45 connectors (C14S) and a third port shall be connected to the CPU. A forth Port on the Network Switch shall be used to route Ethernet across the Motherboard to the “A” Connector’s Network Lines. DC Grounding around the network connectors and lines shall be provided. The Network Lines shall be assigned as: NetP5 TX+, TX-, RX+ and RX- respectively.

9.2.5 Model 2070-1C CPU Engine Board

9.2.5.1 Model 2070-1C CPU Module Processor

The Model 2070-1C CPU Module Processor shall utilize a Freescale series MPC 82xx / 83xx with a minimum MIPS of 400 calculated using the Dhrystone v2.1 benchmark at 25°C.

9.2.5.2 Ram Memory (DRAM)

The Model 2070-1C CPU Module shall contain a minimum of 64Mbytes of DRAM or equivalent volatile memory for application and OS program execution.

9.2.5.3 Flash Memory

The Model 2070-1C CPU Module shall contain a minimum of 32Mbytes of FLASH for storage of OS Software and user application.

9.2.5.4 Static Memory (SRAM)

The Model 2070-1C CPU Module shall contain a minimum of 1MB minimum of SRAM memory for non-volatile parameter storage.

9.2.5.5 Standby Power

The Model 2070-1C CPU Module Engine Board shall provide the Standby Power required for supporting the SRAM and RTC.

9.2.5.6 Real-Time Clock (RTC)

The Model 2070 -1C Module shall be provided with a software settable, hardware RTC that meets the requirements of the ASHTO/ITE/NEMA ATC Standard except that in the absence of VPRIMARY, the RTC shall operate from VSTANDBY as listed

in A9-16 of these specifications. Also Operating System Time shall be maintained by utilizing the RTC and LINESYNC as defined in Section 9.5.5.3.

9.2.5.7 CPU_Reset

A software-driven CPU_Reset Signal (Active Low) shall be provided to reset other system devices and shall be accessible by application programs as well as by the command line as “cpureset”. CPU_Reset shall be executed when the Controller starts up or is rebooted using the reboot command.

9.2.5.8 CPU_ACTIVE

An Active Low signal shall be provided to drive the Front Panel Assembly CPU_ACTIVE LED indicator. This signal shall cause the LED to default to ON when the controller starts up.

9.2.5.9 Application Program Interface (API)

The Model 2070-1C Module shall be fully compliant and shall be provided, upon request, with an installed copy of the Application Program Interface (API) compliant to the latest ASHTO/ITE ATC API Standard.

9.2.5.10 Integrated Security

The Model 2070-1C Module shall be implemented with integrated security support for DES, 3DES, MD-5, SHA-1, AES and ARC-4 encryption algorithms as well as a public key accelerator and an on-chip random number generator.

9.2.5.11 SD Card Support

The Model 2070-1C Module shall support SD Card Memory and shall be provided with an industry standard SD Card socket.

9.2.6 Data Key

A Datakey Keyceptacle™ (KC4210, KC4210PCB or equal) shall be mounted on the CPU module front panel (or the Transition Board of MODEL 1A). Power shall not be applied to the receptacle if the key is not present.

The contractor shall supply a 8Mb Memory Size Datakey (SFK8Mb or equal) with each MODEL 1A TB (Transition Board) or 1E and 1C CPU module unless specified otherwise. The Datakey shall be temperature rated for –40 °C to +85 °C (–40°F to 185 °F) operation, shall be blue in color, and shall be initialized to the format and default values defined below. External capability to program the CPU Datakey shall be provided by the contractor.

When programmed, the memory on the key of header shall be organized as follows:

Bytes	Description	Default Values
1-2	16 bit Frame Check Sequence (FCS) calculated as defined in clause 4.6.2 of ISO/IEC 3309. This FCS is calculated across bytes 3-64	
3	Key Type	See table below
4	Header Version	2

5-8	Latitude	0.0
9-12	Longitude	0.0
13-14	Controller ID	0xFFFF
15-16	Communication drop number	0xFFFF
17-20	IP Address	10.20.70.51
21-24	Subnet Mask	255.255.255.0
25-28	Default Gateway	10.20.70.254
29	Startup Override	0xFF
30-64	Reserved for Agency use	All bytes set to 0xFF
65 to End	User Data	All bytes set to 0xFF

When programmed, Byte 3 of the header shall contain the Key Type value as defined in the following table:

Key Type	Model No.	Memory Size	Sector Size	Part Number
1.	DK1000	1Kb	2 Byte	611-0006-002A
2.	LCK16000	16Kb	2 Byte	611-0070-008A
3.	SFK2Mb	2Mb	64KBytes	611-0089-004A
4.	SFK4Mb	4Mb	64KBytes	611-0104-002A
5.	SFK8Mb	8Mb	64KBytes	611-0132-006A
6.	SFK32Mb	32Mb	64KBytes	611-0164-005A

The data format in the CPU Datakey header for the Latitude and Longitude fields shall comply with IEEE/ANSI 754-1985 STD. All the other fields shall follow a Big Endian Format as implemented by Motorola CPUs.

The Startup Override byte, not the Key Type, may be used to override the default controller startup procedure, as described in section 9.2.7.3.3.

9.2.7 Model –1A and 2070-1E CPU Module Software

The following shall be supplied:

1. Operating System
2. Drivers and Descriptors
3. Application Kernel
4. Deliverables
5. Error Handler

9.2.7.1 Operating System

The CPU Module shall be supplied with Microware Embedded OS-9 Release 1.3 or later with kernel edition #376 or later. The following modules shall be included:

- 1 Embedded OS-9 Real Time Kernel
- 2 Sequential Character File Manager (SCF)
- 3 Stacked Protocol File Manager (SPF)
- 4 Pipe File Manager (PIPEMAN)
- 5 Random Block File Manager (RBF)
- 6 C Shared Library (CSL)

Boot Image shall include the following utility modules:

Dir	Tmode	Edt	List	Load	Deldir
Dump	Del	Ident	Iniz	Irqs	Events
Echo	Format	Dcheck	Login	Link	Kermit
Tsmon	Mdir	Mfree	Pd	Makdir	Save
Attr	Rename	Procs	Unlink	Sleep	Xmode
Shell	Build	Setime	Merge	Grep	
Tee	Printenv				

The Boot Image with the above utilities and including the network driver and descriptor shall be loaded into RAM as part of OS-9 initialization as defined in Section 9.2.7.3.2.

9.2.7.2 Drivers and Descriptors

9.2.7.2.1 Supplied Modules

Supplied modules shall be re-entrant, address independent, and shall not contain self-modifying code.

Device drivers which require extensions to the standard Microware libraries shall use the `_os_getstat()` and `_os_setstat()` functions.

A custom setstat code and parameter structure are defined as follows:

```
#define SS_2070    0x2070

error_code _os_getstat(path_id path, SS_2070, PB2070 *pb);
error_code _os_setstat(path_id path, SS_2070, PB2070 *pb);

typedef struct
{
    u_int32 code;
    u_int32 param1;

    union
    {
        u_int32 param;
        void *pointer;
    } param2;
} PB2070, *pb;
```

The following subcodes for use with PB2070.code are also defined:

```
#define GS2070_Status    0x1C
#define SS2070_SSig      0x1A
#define SS2070_IFC       0x22
#define SS2070_OFC       0x23
#define SS2070_Timer_Null 0x0000    (Default State)
#define SS2070_Timer_Sig  0x1000
#define SS2070_Timer_Cyc  0x1001
#define SS2070_Timer_Start 0x1002
#define SS2070_Timer_Stop  0x1003
#define SS2070_Timer_Reset 0x1004
```

Note: When PB2070.param2.pointer is used, PB2070.param1 should be loaded with the size of what PB2070.param2.pointer is referencing. When calling _os_getstat() or _os_setstat(), all reserved or unused parameters and fields in PB2070 should be loaded with 0 (zero).

9.2.7.2.2 Memory Drivers

Drivers shall be provided to access the FLASH, SRAM, and DRAM memories. The following descriptors shall apply:

/f0	FLASH drive	non-volatile, writeable
/dd	FLASH drive	OS-9 default device for /f0
/f0wp	FLASH Drive	as /f0 except write protected
/f0fmt	FLASH Drive	as /f0 except format enabled
/r0	SRAM Drive	non-volatile ramdisk
/r0fmt	SRAM Drive	as /r0 except format enabled
/r2	DRAM Drive	volatile 2 MB ramdisk, not automatically initialized

9.2.7.2.3 MC68360 Internal Timers

A driver to handle each of the four internal timers under the OS-9 Kernel shall be provided. Timer resolution shall be one count equals 100 μ S and all timer periods shall be specified in units of hundreds of microseconds (μ S), i.e. a timer period of 7 = 700 μ S. The minimum allowed timer period shall be 500 μ S. The Maximum Timer Period for timers 1-4 shall be 6.5535 seconds (0xFFFF). The Maximum Timer Period for timer12 and timer34 shall be 429496.7295 seconds (0xFFFFFFFF). The driver shall return error E\$Param from os_setstat() if the requested timer period is outside the allowable range.

A signal of "0" shall be an invalid signal and the driver shall return an E\$PARAM error if received.

Access to the MC68360 internal timers shall be through the following descriptors:

The timers should be set to SS2070_Timer_Null Mode upon initialization.

9.2.7.2.3.1 Descriptor

Descriptor names for each timer:

timer1	= access to MC68360's internal timer #1
timer2	= access to MC68360's internal timer #2
timer3	= access to MC68360's internal timer #3
timer4	= access to MC68360's internal timer #4
timer12	= access to MC68360's internal timer #1 & #2 [cascaded]
timer34	= access to MC68360's internal timer #3 & #4 [cascaded]

9.2.7.2.3.2 Timer Standard

Timer Standard OS-9 Function Calls:

error_code _os_open (char *timer_desc_name, path_id *path);

error_code _os_read (path_id path, void *timer_value, u_int32 *size);

Note: Prior to calling _os_read(), size must be loaded with the value 4 and timer value must be pointed to a u_int32. _os_read() shall read the current timer value and load it into timer_value as μ S x 100.

error_code _os_close (path_id path);

9.2.7.2.3.3 Time Extension

Timer Extension to Standard OS-9 Function Calls:

The timer drivers shall support the following modes using the following function with the SS_2070 option code and a custom parameter block structure:

```
error_code _os_setstat(path_id path, SS_2070, PB2070 *pb);
```

- a. Send signal after specified time interval. Sets timer to zero and schedules individual one-shot signal. After one-shot signal is sent, timer shall stop (SS2070_Timer_Stop).

```
pb→ code = SS2070_Timer_Sig;          /* request for one-shot signal */
pb→ param1 = signal;
pb→ param2.param = period;
```

- b. Send recurring periodic signal. Sets timer to zero and schedules repeating periodic signal.

```
pb→ code = SS2070_Timer_Cyc (0x1001); /* request for periodic signal */
pb→ param1 = signal;
pb→ param2.param = period;
```

- c. Start timer. Starts the timer if stopped or null. Timer will free run in a periodic mode, starting at the current timer value as its initial value and timer's maximum allowable time as its timer period. Timer will not send a signal and any pending signals will be cancelled.

```
pb→ code = SS2070_Timer_Start;          /* start timer if stopped */
```

- d. Stop timer. Leaves current value in timer. Cancels any pending signals.

```
pb→ code = SS2070_Timer_Stop;          /* stop timer if running */
```

- e. Reset timer. Stops timer if running, resets timer value to zero, and cancels any pending signals.

```
pb→ code = SS2070_Timer_Reset;          /* reset timer (stop and zero) */
```

9.2.7.2.3.4 Timer Extension

Timer Extension to Standard OS-9 Function Calls:

The timer driver shall support the following function with the SS_2070 option code and custom parameter block structure:

```
error_code _os_getstat(path_id path, SS_2070, PB2070 *pb);
```

- a. Retrieve current timer configuration.

```

typedef struct
{
    u_int32 value;
    u_int32 mode;
    u_int32 signal;
    u_int32 period;
} Timer_status;

pb→ code = GS2070_Status (0x1C)    /* Request timer status data */
pb→ param1 = sizeof(Timer_status)
pb→ param2.pointer = &Timer_status *

```

Status data shall be returned in the structure pointed to by pb→param2.pointer as follows:

```

pb→ param2.pointer→value    /* current timer value in μS x 100 */
pb→ param2.pointer→mode    /* SS2070_Timer_Sig if one-shot signal pending,
                             SS2070_Timer_Cyc if periodic signal pending,
                             SS2070_Timer_Start if free running,
                             SS2070_Timer_Stop if not active
                             SS2070_Timer_Reset if timer is reset
                             SS2070_Timer_Null when timer is first
                             initialized */

pb→ param2.pointer→signal    /* signal code pending if
                             SS2070_Timer_Sig or
                             SS2070_Timer_Cyc, 0 otherwise */

pb→ param2.pointer→period    /* timer period in μS x 100 if
                             SS2070_Timer_Sig or
                             SS2070_Timer_Cyc and
                             Maximum Timer Period if
                             SS2070_Timer_Start
                             , 0 otherwise */

```

The following values shall be returned when the timer is in the SS2070_Timer_Null (Timer initialized) Mode:

```

Timer Mode =    SS2070_Timer_Null
Timer Value =    0
Timer Period =    0
Timer Signal =    0

```

The following values shall be returned when the timer is in the SS2070_Timer_Start Mode:

```

Timer Mode =    SS2070_Timer_Start
Timer Value =    Running Timer Value
Timer Period =    Maximum Timer Period
Timer Signal =    0

```


The following values shall be returned when the timer is in the SS2070_Timer_Stop Mode:

Timer Mode = SS2070_Timer_Stop
Timer Value = Current Timer Value
Timer Period = 0
Timer Signal = 0

The following values shall be returned when the timer is in the SS2070_Timer_Reset Mode:

Timer Mode = SS2070_Timer_Reset
Timer Value = 0
Timer Period = 0
Timer Signal = 0

9.2.7.2.3.5 Timer Period

All timer periods are specified in units of hundreds of microseconds (μ S), i.e. a timer period of 7 = 700 μ S. The minimum allowed timer period shall be 500 μ S. The maximum timer period for timers 1-4 shall be 6.5535 seconds (0xFFFF). The maximum timer period for timer12 and timer34 shall be 429496.7295 seconds (0xFFFFFFFF). The driver shall return error E\$Param from _os_setstat() if the requested timer period is outside the allowable range.

9.2.7.2.4 CPU Datakey

Access and control to the CPU Datakey shall be provided through the following descriptor name and OS-9 functions:

Descriptor name:

datakey = access to the CPU Datakey

Function Calls:

```
error_code = _os_open (char *datakey_desc_name, path_id *path);
```

```
error_code = _os_close (path_id path);
```

```
error_code = _os_read (path_id path, void *data_buffer, u_int32 *data_size);
```

```
error_code = _os_write (path_id path, void *control, u_int32 *data_size);
```

```
error_code = _os_seek(path_id path, u_int32 *position); sets read / write offset
```

```
error_code = _os_ss_erase(path_id path, u_int32 num_sec_erase); erases sector(s)  
if pointer is on a block boundary, returns E$PARAM error if not on a boundary */
```

```
error_code = _os_gs_pos(path_id path, u_int32 *position); /* gets current file  
pointer position */
```

```
error_code = _os_gs_size(path_id path, u_int32 *size); /* gets current datakey size  
*/
```

Error codes returned by Function calls:

E\$NotRdy if datakey is not inserted

E\$Seek if Offset plus *data_size is beyond end of CPU Datakey.

E\$EOF if upon read or write, the last byte of CPU Datakey has previously been processed.

Note: Use of SCF to implement the datakey driver is not allowed.

9.2.7.2.5 Flow Control Modes

The asynchronous serial communications device drivers shall support the six flow control modes (FCM#) described below:

FCM#	Description
1.	No Flow Control Mode: The driver transmits data regardless of the state of CTS. Upon a write command, the driver asserts RTS, and de-asserts RTS when data transmission is completed. This is the default mode. When user programs issue the first RTS related command, the driver switches to Manual Flow Control Mode (FCM# 1).
2.	Manual Flow Control Mode: The driver transmits data regardless of the state of CTS. The user program has absolute control of the RTS state. The driver doesn't automatically assert or de-assert RTS.
3.	Auto-CTS Flow Control Mode: The driver transmits data only when CTS is externally asserted. The user program has absolute control of the RTS state. The driver doesn't automatically assert or de-assert RTS.
4.	Auto-RTS Flow Control Mode: The driver transmits data regardless of the state of CTS. Upon a write command, the driver asserts RTS, and de-asserts RTS when data transmission is completed and any configured RTS extension is elapsed. If the user program asserts RTS, then RTS remains on until the user program de-asserts RTS. If the user program de-asserts RTS before the transmission buffer is empty, the driver holds RTS on until the transmission buffer is empty and any configured RTS extension is elapsed.
5.	Fully Automatic Flow Control Mode: The driver transmits data only when CTS is externally asserted. Upon a write command, the driver asserts RTS and waits for CTS, starts data transmission when CTS is asserted, and de-asserts RTS when data transmission is completed and any configured RTS extension is elapsed. If user program asserts RTS, then RTS remains on until the user program de-asserts RTS. If the user program de-asserts RTS before the transmission buffer is empty, the driver holds RTS on until the transmission buffer is empty and any configured RTS extension is elapsed.
6.	Dynamic Flow Control Mode: The driver transmits data only when CTS is externally asserted. The driver controls RTS based on the status of its receiving buffer. The driver asserts RTS continuously as long as its receiving buffer has sufficient capacity to store incoming data. If the receiving buffer approaches full, the driver de-asserts RTS until enough data has been read from the buffer to create sufficient receive capacity.

9.2.7.2.5.1 Serial Device Driver

The serial device driver shall be able to set user options via `_os_setstat()` and return status via `_os_getstat()`. To support legacy application programs, the device driver shall also be able to set user options via `_os_ss_size()` and to return status via `_os_gs_size()`:

```
error_code _os_setstat(path_id path, SS_2070, void *pb);
error_code _os_getstat(path_id path, SS_2070, void *pb);
error_code _os_ss_size(path_id path, u_int32 size);
error_code _os_gs_size(path_id path, u_int32 *size);
```

Note: The preferred method of accessing serial device drivers is through `_os_setstat()` and `_os_getstat()`. The `_os_ss_size()` and `_os_gs_size()` interface may not be required by future versions of this specification and is therefore not recommended for new development.

The option subcodes to be passed in `pb→code` and the data to be contained in `pb→param1` are defined as follows. `pb→param2` is unused here and should be set to 0 (zero). For `_os_ss_size()` and `_os_gs_size()`, the size argument is the same format as `pb→param1`.

9.2.7.2.5.2 Supported Setstat

The supported `_os_setstat()` / `_os_ss_size()` options shall be as follows.

- a. **Subcode passed in `pb→code` is SS2070_OFC (0x23).**

Data passed in `pb→param1` is defined as follows:

Bits	Description
31-24	Auto RTS turn-off extension in number of characters (range:0-255, 0=default).
23-14	Reserved for future use.
13	Inhibit return of error E\$Write from <code>_os_write()</code> when transmit buffer full in FCM# 2, 4, 5 (default=0, 0=error, 1=block)
12	Inhibit variable SCC MRBLR (default =0; 0=NO; 1=inhibit).
11	Inhibit SCC TODR (default=0; 0=NO; 1=inhibit).
10-8	Flow Control Mode Number (FCM#) (range:0-5).
7-0	Subcode SS2070_OFC (0x23).

Variable MRBLR (68360 SCC)

To reduce the IRQ handler overhead, the 68360 SCC driver shall use variable MRBLR as follows. If SS2070_OFC bit 12 is set to 1, the MRBLR shall be fixed at 16 for all baud rates. Variable MRBLR is not required for SP1 or SP8 on the 2070-1B CPU Module.

Baud Rate	MRBLR Setting
1200	1
2400	2
4800	4
9600	8
19200 & Higher	16

TODR (68360 SCC)

TODR requests processing a new TX buffer immediately. To reduce impact on other serial channel operations, SS2070_OFC bit 11 may be set to 1 to prevent assertion of TODR. TODR is not required for SP1 or SP8 on the 2070-1B CPU Module.

- b. Subcode passed in `pb→code` is SS2070_IFC (0x22).
Data passed in `pb→param1` is defined as follows:

Bits	Description
31-11	Reserved for Future Use.
10	DCD must be asserted to receive data (default=0; 0=NO; 1=YES).
9-8	Reserved for Future Use.
7-0	Subcode = SS2070_IFC (0x22).

c. **Subcode passed in pb→code is SS2070_SSig (0x1A).**

1. If CTS is currently negated and bits 16-31 are not all 0:
Setting the SS2070_SSig parameter block bit 11 (send when CTS is asserted) will cause the controller to send a one-shot signal as soon as CTS is asserted.
Setting the SS2070_SSig parameter block bit 12 (send when CTS is negated) will cause the controller to send a one-shot signal immediately.
2. If CTS is currently asserted and bits 16-31 are not all 0:
Setting the SS2070_SSig parameter block bit 11 (send when CTS is asserted) will cause the controller to send a one-shot signal immediately.
Setting the SS2070_SSig parameter block bit 12 (send when CTS is negated) will cause the controller to send a one-shot as soon as CTS is negated.
3. If both bits 11 and 12 of the SS2070_SSig parameter block are set, and bits 16-31 are not all 0:
The controller will send a one-shot signal upon the next change of CTS state

Data passed in pb→param1 is defined as follows:

Bits	Description
31-16	A signal number to be sent to calling process when the state of an input changes.
15-13	Reserved for Future Use.
12	Send signal when CTS is de-asserted.
11	Send signal when CTS is asserted.
10-8	Reserved for Future Use.
7-0	Subcode = SS2070_SSig (0x1A).

9.2.7.2.5.3 Supported Getstat

The supported _os_getstat() / _os_gs_size() options shall be as follows.

- a. **Subcode passed in pb→code is GS2070_Status (0x1C).**
Data returned in pb→param1 is defined as follows:

Bits	Description
31-16	Current unfilled transmit buffer character count of the serial device driver.
15-11	Reserved for Future Use.
10-8	Current Flow Control Mode Number (FCM#).

7	Reserved for Future Use.
6	Overrun error –0=no error; 1=error has occur since last GS2070_Status call.
5	Frame error –0=no error; 1=error has occur since last GS2070_Status call.
4	Parity error –0=no error; 1=error has occur since last GS2070_Status call.
3-2	Reserved for Future Use.
1	DCD state –0=de-asserted; 1=asserted.
0	CTS state –0=de-asserted; 1=asserted.

9.2.7.2.6 Device Drivers Compliant

Device drivers compliant with the OS-9 SCFMAN shall be provided for CPU Activity LED Indicator and Day Light Savings time correction features. The descriptor names shall be as follows:

led = access to CPU Activity LED Indicator

dstclock = access to Daylight Savings Time Clock correction

The standard OS-9 SCFMAN library calls and their functions are as follows:

error_code _os_open (char *desc_name, path_id *path); //open descriptor for command

error_code _os_close (path_id path); //close descriptor

error_code _os_write (path_id path, void *value, u_int32 *data_size); //set value of function

*value = 1, turn on LED or enable DST correction (default)

*value = 0, turn off LED or disable DST correction set u_int32*data_size to 1

error_code _os_read (path_id path, void *value, u_int32 *data_size); //get current state set u_int32*data_size to 1

9.2.7.2.7 Manufacturer Support

The manufacturer shall provide the following features to support the TOD operation and synchronization.

9.2.7.2.7.1 Leap Year and Daylight Savings Time

Leap Year and Daylight Savings Time (DST) Adjustments - The OS-9 System clock / calendar shall automatically be adjusted to account for DST and leap years.

9.2.7.2.7.2 Setting Hardware Clock

Setting Hardware Clock from OS-9 System Clock - A device driver compatible with the OS-9 SCFMAN shall be provided to allow the hardware TOD clock/calendar to be updated from the OS-9 system clock under application control. The descriptor name shall be "ClockUpdate." Opening the descriptor shall cause the driver to synchronize the clock to a minimum of 10 ms resolution. The driver shall compensate for any time elapsed during the process of updating the hardware clock.

9.2.7.2.7.3 Setting OS-9 System Clock

Setting OS-9 System Clock from Hardware Clock - At system power up, the OS-9 system TOD clock/calendar shall automatically be updated from the hardware TOD clock. The clocks shall be synchronized to a minimum of 10 ms resolution.

9.2.7.2.8 Flash Ram Drive

The FLASH drive shall be protected from corruption. It shall be protected using the Write Protect (WP) bit of the Base Register. When writing to the FLASH drive the

current sector of FLASH being written shall first be backed up in SRAM. The backup sector copy shall be invalidated when FLASH write operation is completed. In case of power failure, the FLASH driver shall detect the presence of the valid backup sector copy in SRAM and shall read sector data from the valid backup sector copy.

A user write operation shall restore the valid backup sector copy first. Execution of the program module, “FLRESTORE,” in the Boot Image shall also restore the valid backup sector copy to FLASH drive after a specified delay. “FLRESTORE” shall accept a delay parameter in seconds ranging from 0 to 600 seconds. The default delay factor is 30 seconds.

9.2.7.3 OS-9 Application Kernel

9.2.7.3.1 Boot Sysreset

The provided software shall boot OS-9 from SYSRESET. The entire program shall be resident in FLASH Memory. The serial port descriptors shall be configured with the default parameters as listed in A9-16.

9.2.7.3.2 Hardware Initialization

Hardware initialization, preliminary self-test, OS-9 initialization (except Extended Memory Test), and forking OPEXEC shall be completed in less than 4 seconds. This startup time shall be measured from the release of SYSRESET to the turn on of the CPU_ACTIVE LED using a user level program named ONLED. The ONLED program shall be the last module loaded into RAM and executed using opexec or a startup file.

9.2.7.3.3 Startup Procedure

The boot image init module shall be configured with the default directory name as /f0wp and sysgo as the first executable module.

Sysgo shall operate as follows:

1. Sysgo shall set the execution directory to /f0wp/CMD5
2. Sysgo shall check if the backspace key (0x08) is being received on /sp4 (c50j). If received, Sysgo shall:
 - a. Fork a shell with no arguments on /sp4 using the current directory.
 - b. Remain an active process and monitor the shell for termination. If the shell does terminate, Sysgo shall fork another shell with no arguments on /sp4. Unless Sysgo dies, a shell shall always be provided on /sp4.
3. If the backspace key was not received, Sysgo shall check for the presence of a Datakey. If present and valid (Datakey Header Version 2 or greater), Sysgo shall check the Startup Override Byte in the Datakey header.

If Startup Override is 0x01, Sysgo shall:

- a. Fork a shell that executes a shell script stored on the Datakey in the following format. Immediately following the key header shall be a 2-byte value indicating the length of the script. The script shall immediately follow the length value, and shall be stored as ASCII text.
 - b. If there is any error reading or starting the script or if the shell terminates with an error, Sysgo shall display an error message on /sp4 and fork another shell as described in step 2. If there are no errors executing the script, Sysgo shall exit without forking another shell.

If Startup Override is 0x02, Sysgo shall:

 - a. Fork an executable module stored on the Datakey immediately following the header.
 - b. If there is any error loading or forking the module, Sysgo shall display an error message on /sp4 and fork a shell as described in step 2. If there are no errors forking the module, Sysgo shall then exit without forking a shell.
4. If the backspace key was not received and Startup Override Byte is 0xFF:
 - a. Sysgo shall fork the module named /f0wp/OPEXEC if present at /f0wp.
 - b. If there is any error loading or forking OPEXEC, Sysgo shall display an error message on /sp4 and fork a shell as described in step 2. If there are no errors forking OPEXEC, Sysgo shall then exit without forking a shell.
5. If the backspace key was not received, Startup Override Byte is 0xFF, and there is no OPEXEC file:
 - a. Sysgo shall fork a shell that executes a shell script named /f0wp/startup if present at /f0wp.
 - b. If there is any error reading or starting the script or if the shell terminates with an error, Sysgo shall display an error message on /sp4 and fork another shell as described in step 2. If there are no errors executing the script, Sysgo shall exit without forking another shell.
6. If the backspace key was not received, Startup Override Byte is 0xFF, and there is no OPEXEC and no startup file:
 - a. Sysgo shall fork a shell as described in step 2.

9.2.7.3.4 Short Out

A Short Out is defined as the period of time between ACFAIL/POWER DOWN transition to LOW and back to HIGH without a SYSRESET transition to LOW. ACFAIL/POWER DOWN transitions shall generate an interrupt. The interrupt shall update an OS-9 event named "ACFAIL". The "ACFAIL" event shall set a value 1 indicating an ACFAIL condition occurred for the DOWN transition and set 0

indicating non-ACFAIL condition for the HIGH transition. The IRQ7 and auto-vector 31(7) shall not be used to update the "ACFAIL" event.

In addition, the ACFAIL condition shall generate the OS-9 auto-vector 30(6) interrupt service. Each interrupt service installed shall exit with the "Carry Bit" set allow OS9 to propagate the ACFAIL interrupt. The Contractor shall supply an interrupt handler at priority 255 that acknowledges and clears the interrupt.

Priority 1 shall be reserved for the OS-9 system.

9.2.7.3.5 Long Out

A Long Out is defined as ACFAIL transition to LOW follow by a SYSRESET going LOW. The SYSRESET going HIGH shall be followed by an operating system reboot.

9.2.7.4 Error Handler

9.2.7.4.1 Initialization and Power-Up Test

A manufacturer may include an error handling routine to save troubleshooting data regarding initialization, power-up test abnormalities and other error conditions. If used, the error report shall be stored in the file /r0/ErrorMessage and shall not exceed 11kb in size.

9.2.7.5 Network Requirements

On the MODEL 2070-1E CPU module, an OS-9 SPF Ethernet hardware driver and descriptor for the 68360 (SCC1) shall be provided in the operating system Boot Image. The descriptor shall be named spqe0.

9.2.7.5.1 BOOTOBS

The following OS-9 modules should be included in the /f0/CMDS/BOOTOBS flash disk directory to allow for standard TCP/IP network communications using Ethernet Protocol over Ethernet hardware and/or Serial Line Internet Protocol (SLIP) or Point-to-Point Protocol over serial links:

1. Drivers and Descriptors for PPP.
2. Drivers and Descriptors for SLIP.
3. LAN Comm Pak modules: spenet, enet, spip, ip0, sptcp, tcp0, spudp, udp0, spraw, raw0, sproute, route0, spicp, ipcp0, splcp, lcp0, sphdlc, hdlc0, spslip, spsl0
4. Network modules pkman, pkdvr, pk, pks
5. Network Trap Handler: netdb_local, netdb_dns
6. NFS Modules: nfs, nfsnul and nfs_devices.

The PPP and SLIP descriptors shall have baud rates and ports set as follows and be stored in the /f0/CMDS/BOOTOBS directory,

hdlc0 and spsl0 configured to use /sp1 and 38400 bps

hdlc1 and spsl1 configured to use /sp2 and 115200 bps

hdlc2 and spsl2 configured to use /sp3 and 115200 bps

hdlc3 and spsl3 configured to use /sp4 and 38400 bps

9.2.7.5.2 CMDS

The following Network utilities shall be included and shall reside in the /f0/CMDS directory as identified in this specification.

arp, dhcpc, tftp, tftpd, ftp, ftpd, ftpdc, idbdump, idbgen, rpcdbgen, ifconfig, inetd, ipstart, ndbmod, netstat, ping, route, routed, telnet, telnetdc, hostname, nfsc, mount, rpcdump, nfsstat, exportfs, portmap, pppd, chat, pppauth, nfsd, mountd, and showmount.

9.2.7.5.3 Multi-user functionality

The boot image init module shall be configured with a “default directory name” as /f0wp. This will allow login and tsmon to provide the user with login prompt from the terminal port or from the network via a telnet session.

The following OS-9 modules should be included in the operating system boot image for the implementation of multi-user mode.

login, tsmon

9.2.7.5.4 Network Configuration

The modules inetdb, inetdb2 and rpcdb shall be generated by the make utility via the use of a makefile and the network configuration files residing the /f0/ETC directory. The generated inetdb, inetdb2 and rpcdb modules should be re-located to the /f0/CMDS/BOOTOBJS directory where they will be pick-up by the network configuration shell scripts located at /f0/SYS. The modules shall be configured with the network default values as defined in Section 9.2.6 (Data Key) via the interfaces.conf shell script.

9.2.7.5.5 Netcfg

A Utility Program named netcfg shall be provided that reads the CPU Datakey for an IP Address, Subnet Mask and Default Gateway. If the Datakey is present and valid (**Datakey Header Version 2 or greater**), netcfg shall set the IP Address, Subnet Mask and Default Gateway of the Model 2070 Controller when executed by a user at the command line. The netcfg utility shall create a new inetdb, inetdb2 and rpcdb database module based on the Datakey network parameters or network parameters from the command line. The new inetdb, inetdb2 and rpcdb modules should be re-located to the /f0/CMDS/BOOTOBJS directory where they will be pick-up by the network configuration shell scripts located at /f0/SYS. The netcfg shall also allow the user to read, write and display network parameters to and from the Datakey via the command line prompt. If the Datakey is not present or invalid and the flag option is not “n” netcfg shall display an error and exit without altering the network configuration. The netcfg utility shall reside in /f0/CMDS.

Netcfg options:

a= Write IP Address in Datakey
m= Write Netmask Address in Datakey
g= Write Gateway Address in Datakey

If the checksum is incorrect when executing the -a, -m or -g option the following will occur:

1. The default Datakey data will be loaded.
2. The networking changes will be made to the default networking parameters.
3. The CRC will be recalculated.
4. The networking parameters will be written to the Datakey.

This option loads default networking parameters into the Datakey.

-d= Write Default Networking Parameters in the Datakey

This option will display the networking information contained in the Datakey.

-i= Reads Networking Parameters from the Datakey

This option will set the networking parameters permanently on the controller using values from the Datakey

-c= Changes interfaces.conf and builds inetdb, inetdb2 and rpcdb.

Normal operation of this option will be:

1. Read the Datakey networking parameters
2. Delete interfaces.conf and routes.conf from /f0/etc
3. Write new interfaces.conf and routes.conf in /f0/etc.
4. Execute idbggen to create new inetdb and inetdb2
5. Executes rpcdbgen to create a new rpcdb
6. Delete inetdb, inetdb2 and rpcdb in /f0/cmds/bootobjs.
7. Relocate inetdb, inetdb2 and rpcdb in /f0/cmds/bootobjs.

This option will display the current Controller Network Parameters such as the IP Address, Netmask , Gateway and MAC Address. This requires the network Stack to be initialized.

-r= Reads current Networking Configuration.

This option will set the networking parameters dynamically on the controller using values from the Datakey

-s= Sets Network Configuration Dynamically from the Datakey.

This option will set the networking parameters permanently on the controller using values from the command line. The option will do the same functions as option “c” with network parameters from the command line.

n= Set Controller Network Parameters without the Datakey

The netcfg -n -a [opts] -m [opts] -g [opts] shall allow the user to permanently set the IP Address, Subnet Mask and Gateway of the Model 2070 Controller when executed by the user at the command line using parameters provided by the user at the command line.

Where opts may be IP Address in the format xxx.xxx.xxx.xxx, netmask in the format xxx.xxx.xxx.xxx and gateway as xxx.xxx.xxx.xxx.

Example, the following sets the IP Address, Netmask and Gateway permanently in the Model 2070 Controller to 10.20.70.51, 255.255.255.0 and 10.20.70.254:

```
netcfg -n -a 10.20.70.51 -m 255.255.255.0 -g 10.20.70.254
```

These options will display the help menu on how to use the netcfg utility.

h, ?, blank = displays the help menu

The help menu shall consist of the following:

Netcfg Usage:

```
netcfg [- a ] [-m ] [-g ] [-n ] [-d ] [- i ] [-r ] [-s ]
```

-a	follows Ip Address	; Write IP Address in Datakey
-m	follows Netmask	; Write Netmask Address in Datakey
-g	follows Gateway	; Write Gateway Address in Datakey

-d		;Write Default Networking Parameters in the Datakey

- i ;Reads Networking Parameters from the Datakey
- c ;Changes interfaces.conf and builds inetdb, inetdb2 and rpcdb.
- r ;Reads current Controller Networking Configuration.
- s ;Sets Network Configuration Dynamically from the Datakey.
- n <network parameters> ;Set Controller Network Parameters without Datakey

Example of option -n:

```
netcfg -n -a 10.20.70.51 -m 255.255.255.0 -g 10.20.70.254
```

See Section 9.2.6 for additional information.

9.2.7.5.6 ETC

A set of example configuration files consistent with the above networking modules shall be provided in the /f0/ETC directory. This directory shall contain the following text files.

hosts, hosts.equiv, networks, protocols, services, inetd.conf, resolv.conf, hosts.conf, rpc, interfaces.conf, routes.conf. makefile, nfs.map, nfsd.map

9.2.7.6 Standard Microware File System Configuration

9.2.7.6.1 Directories

The 2070 shall follow Standard Microware File System Configuration. A /f0/CMDS, /f0/CMDS/BOOTOBJS, /f0/ETC and /f0/SYS directories shall be implemented. Execute permission shall be included in the attributes of files in the /f0/CMDS directory. Sysgo should set its execution directory to /f0wp/CMDS prior to spawning opexec or other processes. The /f0/CMDS/BOOTOBJS shall contain the modules as identified above and other customizable descriptors and modules. The /f0/SYS shall also contain the following four standard OS-9 network configuration shell script files: startspf, startnfs, loadspf and loadnfs.

9.2.7.6.2 Password

The /f0/SYS shall contain a "password" file. The password file should follow Microware's password file format for the addition and configuration of multiuser functionality and password protection.

A Termcap text file shall be include in the /f0/SYS directory. This Termcap file shall contain description fields defining the capability names and values of the front panel DISPLAY.

9.2.7.6.3 utilities

The utilities tar, make, fixmod , mshell and vi shall be included in the /f0/CMDS directory.

9.2.7.6.4 Ver

A Ver utility shall be provided as part of the OS-9 Image and shall allow access to Controller's Manufacturer Name, Image Build Number, TEES Version, Image Build Date and CPU Module Type. Ver should display the contents of a data module named "bootid" which contains in it's data area the following structure:

```
/* bootid_body*/
Struct bootid_body {

char *mfgname;           /* Manufacturer Name */
char *cpumoduletype;     /* CPU Module Type */
char *teesrelease;       /* TEES Release */
char *imagebulddate;     /* Image Build Date */
u_int 16 majv;           /* Major Version*/
u_int 16 minv;           /* Minor Version */
u_int 16 sv1;            /* Sub-Version 1 */
u_int 16 sv2;            /* Sub-Version 2 */
u_int 16 sv3             /* Sub-Version 3 */
u_int 16 dv;             /* Development Version */
};
```

When run via the command line the Ver utility shall display the following:

Ver options:

- a Shows all information
- b CPU Module Type
- d Image Build Date
- m Controller's Manufacturer Name
- t TEES Version
- v Image Build Version Number
- ? Display Help

CPU Type shall display 2070-1A, 2070-1E or 2070-1C.

Image Build Date shall be in the form of mm/dd/yyyy

Manufacturer's name shall be shown as one word only.

TEES Version shall be "TEES XXXX EY" where XXXX is the is the year of the TEES and Y is any Errata if applicable.

Ver without an option shall be the same as Ver -a.

Ver -a shall display all information as shown by the following example:

```
2070 -1E
03/06/2008
Vendor Name
TEES 2008 E5      ; E5 Would be blank if there are no Erratas.
Build 2.7.3.0.0.0
```

The help menu shall consist of the following:

Ver Usage:

```
Ver [- a ] [-b ] [-d ] [-m ] [-t ] [- v ] [-? ]
```

```
-a      Shows all information
-b      CPU Module Type
-d      Image Build Date
-m      Controller's Manufacturer Name
-t      TEES Release
-v      Image Build Version Number
-?      Display Help
```

9.2.8 Model 2070-1C CPU Software

9.2.8.1 Operating System

The model 2070-1C CPU Module shall be supplied with Linux 2.6.18 kernel or later. Platform specific options shall be selected by the manufacturer based on the requirements of the MPC 82xx/ 83xx and the Model 2070-1C CPU options selected by the agency.

The items marked with an asterisk (*) shall be the minimum Linux kernel configuration features that shall be included in the kernel build; others shall be included when possible:

```
#
# Automatically generated make menuconfig
# Linux kernel version: 2.6.18
# Tue Nov 7 11:57:18 2006
#
#
# Code maturity level options
#
CONFIG_BROKEN_ON_SMP=y
CONFIG_LOCK_KERNEL=y
CONFIG_INIT_ENV_ARG_LIMIT=32

#
# General setup
```

```

#
CONFIG_LOCALVERSION=""
CONFIG_SWAP=y
CONFIG_SYSVIPC=y *
CONFIG_IKCONFIG=y *
CONFIG_IKCONFIG_PROC=y *
CONFIG_INITRAMFS_SOURCE=""
CONFIG_EMBEDDED=y *
CONFIG_SYSCTL=y *
CONFIG_HOTPLUG=y *
CONFIG_PRINTK=y
CONFIG_BUG=y
CONFIG_ELF_CORE=y *
CONFIG_BASE_FULL=y
CONFIG_FUTEX=y
CONFIG_EPOLL=y
CONFIG_SHMEM=y
CONFIG_VM_EVENT_COUNTERS=y
CONFIG_RT_MUTEXES=y
CONFIG_BASE_SMALL=0
CONFIG_SLOB=y

#
# Loadable module support
#
CONFIG_MODULES=y *
CONFIG_MODULE_UNLOAD=y *
CONFIG_MODVERSIONS=y
CONFIG_MODULE_SRCVERSION_ALL=y
CONFIG_KMOD=y *

#
# Processor type and features
#

CONFIG_PREEMPT=y *
CONFIG_PREEMPT_BKL=y

#
# Bus options (PCI, PCMCIA, EISA, MCA, ISA)
#
CONFIG_PCI=y
CONFIG_PCI_GOANY=y
CONFIG_PCI_BIOS=y
CONFIG_PCI_DIRECT=y

#
# Executable file formats
#
CONFIG_BINFMT_ELF=y *
CONFIG_BINFMT_AOUT=m *

#
# Networking
#
CONFIG_NET=y

```



```

#
# Networking options
#
CONFIG_PACKET=y *
CONFIG_PACKET_MMAP=y *
CONFIG_UNIX=y *
CONFIG_INET=y *
CONFIG_IP_MULTICAST=y *
CONFIG_IP_FIB_HASH=y
CONFIG_IP_PNP=y *
CONFIG_IP_PNP_DHCP=y *
CONFIG_IP_PNP_BOOTP=y *
CONFIG_IP_PNP_RARP=y
CONFIG_SYN_COOKIES=y *
CONFIG_TCP_CONG_BIC=y

#
# IP: Virtual Server Configuration
#
CONFIG_IPV6=y
CONFIG_NETFILTER=y *

#
# Device Drivers
#

#
# Generic Driver Options
#
CONFIG_STANDALONE=y
CONFIG_PREVENT_FIRMWARE_BUILD=y
CONFIG_FW_LOADER=m

#
# Block devices
#
CONFIG_BLK_DEV_FD=y
CONFIG_BLK_DEV_LOOP=y *
CONFIG_BLK_DEV_NBD=m
CONFIG_BLK_DEV_RAM=y *
CONFIG_BLK_DEV_RAM_COUNT=16
CONFIG_BLK_DEV_RAM_SIZE=4096
CONFIG_BLK_DEV_RAM_BLOCKSIZE=1024
CONFIG_BLK_DEV_INITRD=y *

#
# SCSI device support
#
CONFIG_SCSI=y *
CONFIG_SCSI_PROC_FS=y *

#
# SCSI support type (disk, tape, CD-ROM)
#

```

```

CONFIG_BLK_DEV_SD=y *
#

#
# Network device support
#
CONFIG_NETDEVICES=y
CONFIG_DUMMY=y
#
# Ethernet (10 or 100Mbit)
#
CONFIG_NET_ETHERNET=y *
CONFIG_MII=y
#
# Wan interfaces
#
CONFIG_WAN=y
CONFIG_PPP=y
CONFIG_PPP_FILTER=y
CONFIG_PPP_ASYNC=y
CONFIG_PPP_SYNC_TTY=y
CONFIG_PPP_DEFLATE=y
CONFIG_PPP_BSDCOMP=y
CONFIG_SLIP=y
CONFIG_SLIP_COMPRESSED=y
CONFIG_SLIP_MODE_SLIP6=y
#
# Input device support
#
CONFIG_INPUT=y
#
# Serial drivers
#
#
# Non-8250 serial port support
#
CONFIG_UNIX98_PTYS=y *
CONFIG_LEGACY_PTYS=y *
CONFIG_LEGACY_PTY_COUNT=256 *

#
#
#
CONFIG_RTC=y
#
#
# I2C support
#
CONFIG_I2C=y
#
# I2C Algorithms
#
CONFIG_I2C_ALGOBIT=m
CONFIG_I2C_ALGOPCF=m
#
# SPI support
#
CONFIG_SPI=y

```

```

CONFIG_SPI_MASTER=y
#
# USB support
#
CONFIG_USB_ARCH_HAS_HCD=y
CONFIG_USB_ARCH_HAS_OHCI=y
CONFIG_USB_ARCH_HAS_EHCI=y
CONFIG_USB=y *
#
# Miscellaneous USB options
#
CONFIG_USB_DEVICEFS=y *

#
# NOTE: USB_STORAGE enables SCSI, and 'SCSI disk support'
#
# may also be needed; see USB_STORAGE Help for more information
#
CONFIG_USB_STORAGE=y *
CONFIG_USB_STORAGE_FREECOM=y *
CONFIG_USB_STORAGE_ISD200=y *
CONFIG_USB_STORAGE_DPCM=y *

#
# USB Input Devices
#
CONFIG_USB_HID=y
CONFIG_USB_HIDINPUT=y

#
#

#
# File systems
#
CONFIG_EXT2_FS=y *
CONFIG_EXT3_FS=y
CONFIG_JBD=y
CONFIG_INOTIFY=y
CONFIG_INOTIFY_USER=y
CONFIG_DNOTIFY=y

#
# DOS/FAT/NT Filesystems
#
CONFIG_FAT_FS=y *
CONFIG_MSDOS_FS=y *
CONFIG_VFAT_FS=y *
CONFIG_FAT_DEFAULT_CODEPAGE=437 *
CONFIG_FAT_DEFAULT_IOCHARSET="iso8859-1" *
CONFIG_NTFS_FS=m
CONFIG_NTFS_RW=y

#
# Pseudo filesystems
#
CONFIG_PROC_FS=y *
# CONFIG_PROC_KCORE is not set

```

```

CONFIG_SYSFS=y *
CONFIG_TMPFS=y *
CONFIG_RAMFS=y *

#
# Miscellaneous filesystems
#

#
# Network File Systems
#
CONFIG_NFS_FS=y *
CONFIG_NFS_V3=y *
CONFIG_NFSD=y *
CONFIG_NFSD_V3=y *
CONFIG_NFSD_TCP=y *
CONFIG_ROOT_NFS=y *
CONFIG_LOCKD=y *
CONFIG_LOCKD_V4=y *
CONFIG_EXPORTFS=y *
CONFIG_NFS_COMMON=y *
CONFIG_SUNRPC=y *

#
# Native Language Support
#
CONFIG_NLS=y
CONFIG_NLS_DEFAULT="iso8859-1" *

#
# Kernel hacking
#
CONFIG_TRACE_IRQFLAGS_SUPPORT=y
# CONFIG_PRINTK_TIME is not set
# CONFIG_MAGIC_SYSRQ is not set
# CONFIG_UNUSED_SYMBOLS is not set
# CONFIG_DEBUG_KERNEL is not set
CONFIG_LOG_BUF_SHIFT=14
# CONFIG_DEBUG_BUGVERBOSE is not set
# CONFIG_DEBUG_FS is not set
# CONFIG_UNWIND_INFO is not set
CONFIG_EARLY_PRINTK=y
# CONFIG_DOUBLEFAULT is not set

#
# Security options
#
# CONFIG_KEYS is not set
# CONFIG_SECURITY is not set

#
# Cryptographic options
#
CONFIG_CRYPT=y *
CONFIG_CRYPT_HMAC=y *
CONFIG_CRYPT_MD4=y
CONFIG_CRYPT_MD5=y *

```

```

CONFIG_CRYPT_SHA1=y
CONFIG_CRYPT_DES=y
CONFIG_CRYPT_AES=y
CONFIG_CRYPT_ARC4=y

#
# Library routines
#
CONFIG_CRC_CCITT=y
CONFIG_CRC32=y *
CONFIG_ZLIB_INFLATE=y *
CONFIG_ZLIB_DEFLATE=y *

```

9.2.8.2 Linux Drivers

All Linux Drivers provided in the Model 2070-1C CPU shall be compliant to AASHTO, ITE and NEMA ATC Standard V. 5.2.b Annex B and as defined in these specifications. In case of conflict these specifications shall govern over ATC Standard V.5.2b.

9.2.8.2.1 GPIO

The GPIO driver allows the user to control the CPU active LED, determine if the Datakey is present, reset peripheral devices, and power down peripheral devices.

open ()

The following dev entries shall exist:

```

/dev/datakeypresent
/dev/cpuactive
/dev/powerdown
/dev/cpureset

```

read ()

```
int read(int filp, void *buf, int count);
```

This allows for reading the state of the power down pin and for reading the state of the whether the Datakey is inserted. The value passed in the count parameter must be 1 or no bytes will be read.

write ()

```
int write(int filp, void *buf, int count);
```

Allows changing the state of the CPU Active LED and the CPU reset signal. Writing a single nonzero character to the /dev/cpuactive device shall turn on the CPU active LED and writing zero will turn off the LED.

close ()

Closes the file descriptor.

9.2.8.2.2 Timers

This driver provides an abstraction for controlling up to 16 timers with 100µs resolution simultaneously. A timer can be used to send a one-shot or periodic signal to a process. A timer can be used in a free running mode where the timer is either restarted (stopped and cleared), started (running), or stopped. When the timer device node is opened, a timer is assigned automatically to the caller if one is available, thus eliminating the need for user applications to know which timers the other applications are using to avoid collisions.

Supported Device File Operations:

```
open();  
close();  
read();  
ioctl();
```

open()

The dev entry for the timer driver shall be /dev/timers. When the device is opened, a timer is automatically assigned to the caller if there is one available; otherwise an error is returned to the caller.

close()

Closes the file descriptor and reinitializes the timer, making it available to be reused.

read()

A call to read with a count of at least 4 bytes will read a binary 32-bit unsigned integer containing the current value of the open timer.

ioctl()

```
ioctl(int fd, unsigned int cmd, unsigned long params);
```

This ioctl passes a parameter structure for the parameters. The structure used is defined as follows:

```
typedef struct {  
    u32 code;  
    u32 param1;  
    union {  
        u32 param;  
        void *pointer;  
    } param2;  
} timing_params_t;
```

The ioctl supports getting and setting a timer status structure defined as follows:

```
typedef struct {  
    u32 value;  
    u32 mode;  
    u32 signal;  
    u32 period;
```

```
} Timer_status;
```

Command Definitions:

ATC_TIMER_GET_PARAMS

ATC_TIMER_SET_PARAMS

ATC_TIMER_GET_PARAMS

When this command is issued, a `timing_params_t` shall be passed as the parameter. The `params.code` value shall be set to `ATC_TIMER_GET_STATUS`, `params.param2.pointer` shall point to a `Timer_status` structure, and `params.param1` shall be the number of bytes allocated for the `Timer_status` structure. The current timer status shall be copied into the location at `params.param2.pointer` or an error will be returned if an invalid length or invalid pointer was passed to the `ioctl`.

```
timing_params_t params;
```

Parameter Code Definitions:

`ATC_TIMER_GET_STATUS`

Example for retrieving timer configuration:

```
params.code = ATC_TIMER_GET_STATUS;  
params.param1 = sizeof(Timer_status);  
params.param2.pointer = &Timer_status;
```

```
ioctl(fd, ATC_TIMER_GET_PARAMS, &params);
```

Status data should be returned in the structure pointed to by `params.param2.pointer` as follows:

<code>params.param2.pointer→value</code>	// current timer value in $\mu\text{S} \times 100$
<code>params.param2.pointer→mode</code>	// <code>ATC__TIMER_SIG</code> if one-shot signal pending, // <code>ATC_TIMER_CYC</code> if periodic signal pending, // <code>ATC_TIMER_START</code> if free running, // <code>ATC_TIMER_STOP</code> if not active // <code>ATC_TIMER_RESET</code> if timer is reset // <code>ATC_TIMER_NULL</code> when timer is first // initialized
<code>params.param2.pointer→signal</code>	// signal code pending if // <code>ATC_TIMER_SIG</code> or // <code>ATC_TIMER_CYC</code> , 0 otherwise
<code>params.param2.pointer→period</code>	// timer period in $\mu\text{S} \times 100$ if // <code>ATC_TIMER_SIG</code> or // <code>ATC_TIMER_CYC</code> and // Maximum Timer Period if // <code>ATC_TIMER_START</code>

, 0 otherwise

The following values shall be returned when the timer is in the ATC_TIMER_NULL (Timer initialized) Mode:

Timer Mode = ATC_TIMER_NULL
Timer Value = 0
Timer Period = 0
Timer Signal = 0

The following values shall be returned when the timer is in the ATC_TIMER_START Mode:

Timer Mode = ATC_TIMER_START
Timer Value = Running Timer Value
Timer Period = Maximum Timer Period
Timer Signal = 0

The following values shall be returned when the timer is in the ATC_TIMER_STOP Mode:

Timer Mode = ATC_TIMER_STOP
Timer Value = Current Timer Value
Timer Period = 0
Timer Signal = 0

The following values shall be returned when the timer is in the ATC_TIMER_RESET Mode:

Timer Mode = ATC_TIMER_RESET
Timer Value = 0
Timer Period = 0
Timer Signal = 0

ATC_TIMER_SET_PARAMS

This function sets the mode of the timer based on the parameter code value in the structure of type `timing_params_t` that is passed as the parameter. As an example in the explanation of the parameter code definitions, the following variable will be used:

```
timing_params_t params;
```

Parameter Code Definitions:

```
ATC_TIMER_SIG  
ATC_TIMER_CYC  
ATC_TIMER_START  
ATC_TIMER_STOP  
ATC_TIMER_RESET  
ATC_TIMER_NULL
```

ATC_TIMER_SIG

This command sends a one-time signal to the caller process after a specified time.

Example to set up a one-time signal to be sent after 1/10 of a second:

```
params.code = ATC_TIMER_SIG;
params.param1 = SIGALRM;          // signal code
params.param2 = 1000;             // 1/10 of a second period
ioctl(fd, ATC_TIMER_SET_PARAMS, &params);
```

ATC_TIMER_CYC

This command sets up a one-shot signal to be sent to the caller process after a specified time. While in this mode, the current timer value can be read at any time by calling the read() function.

Example to set up cyclical signal to occur every 1/10 of a second:

```
params.code = ATC_TIMER_CYC;
params.param1 = SIGALRM;          // signal code
params.param2 = 1000;             // 1/10 of a second period
ioctl(fd, ATC_TIMER_SET_PARAMS, &params);
```

ATC_TIMER_START

This command starts the timer without clearing its value. The timer value will be incremented every 100us. The current value can be read by calling read() or by calling the ioctl with command ATC_TIMER_GET_PARAMS, and read the period member of the Timer_status structure.

Example:

```
params.code = ATC_TIMER_START;
ioctl(fd, ATC_TIMER_SET_PARAMS, &params);
```

ATC_TIMER_STOP

This command stops the timer without clearing its value. The current value can still be read while the timer is stopped.

Example:

```
params.code = ATC_TIMER_STOP;
ioctl(fd, ATC_TIMER_SET_PARAMS, &params);
```

ATC_TIMER_RESET

This command stops the timer and resets the timer value. The timer value will read as 0 when in reset state.

Example:

```
params.code = ATC_TIMER_RESET;
ioctl(fd, ATC_TIMER_SET_PARAMS, &params);
```

9.2.8.2.1 Time of Day

The Time of Day driver overrides the operating system internal time of day to utilize AC line sync pulses or square wave pulses from the RTC. The time source can be changed via an ioctl command.

Supported Device File Operations:

```
open();  
close();  
read();  
write();  
ioctl();
```

`open()`

The dev entry for the timer driver shall be /dev/tod. The device can be opened for read, write, or read/write.

`close()`

Closes the file descriptor.

`read()` / `write()`

```
int read(int filp, void *buf, int count);  
int write(int filp, void *buf, int count);
```

Reads / Writes the current time of day value in the following format:

YYYYMMDDHHMMSSFFF

Y = year M = month D = day H = hour M = minute S = second F = fraction

The fractional field shall be a value from 0 to 127 in RTC Square Wave Mode and a value from 0 to 2 * AC Line Sync Frequency - 1 in AC Line Sync Mode.

If the *count* passed to the read() function is greater than 18, only 18 bytes will be read. A read always starts with the 4 byte year in ASCII decimal. If the count is less than 18, then read shall modify *count* bytes in *buf*.

If the *count* passed to write() is less than 17 or the data in *buf* is not in the proper format, then write shall return an error of EINVAL.

```
ioctl()
ioctl(int fd, unsigned int cmd, unsigned long param);
```

The `ioctl` function supports multiple different commands, each described separately.

Command Definitions:

```
    ATC_TOD_SET
    ATC_TOD_GET
    ATC_TOD_SET_TIMESRC
ATC_TOD_GET_TIMESRC
ATC_TOD_GET_INPUT_FREQ
ATC_TOD_REQUEST_TICK_SIG
ATC_TOD_CANCEL_TICK_SIG
ATC_TOD_REQUEST_ONCHANGE_SIG
ATC_TOD_CANCEL_ONCHANGE_SIG
ATC_DST_ENABLE
ATC_DST_DISABLE
    ATC_DST_SET_INFO
ATC_DST_GET_INFO
```

ATC_SET and ATC_GET

These commands get and set the time and time zone atomically. The parameter to both functions is the same and defined below:

Parameter Data:

```
typedef struct {
    struct timeval *tv;
    int *tzsec_offset;
    int *dst_offset;
} atc_time_tz_t
```

The `ATC_SET` command is only concerned with the `tv` and `tzsec_offset` parameters. If the `tv` member is non-zero and the command is `ATC_SET`, then the time is set according to the `tv_sec` and `tv_usec` members of the struct `timeval *tv`. Additionally if the `tzsec_offset` parameter is non-zero the time zone offset is also set. The `ATC_GET` command sets the data pointed to by the `tv`, `tzsec_offset`, and `dst_offset` for each of those members that are non-zero.

ATC_SET_TIMESRC and ATC_GET_TIMESRC

Parameter Definitions:

```
ATC_TIMESRC_LINESYNC
    ATC_TIMESRC_RTCQWR
    ATC_TIMESRC_CRYSTAL
    ATC_TIMESRC_EXTERNAL1
    ATC_TIMESRC_EXTERNAL2
```

These commands get and set the time source. The time source may use AC line sync pulses or the RTC square wave output.

ATC_TOD_GET_INPUT_FREQ

This command gets the current frequency that is driving the time of day clock.

ATC_TOD_REQUEST_TICK_SIG

This command requests a signal to be sent at each tick of the time of day clock as long as the file device remains opened. The *param* value passed to ioctl is the signal number that should be sent to the calling process at each time of day clock tick.

ATC_TOD_CANCEL_TICK_SIG

This releases the signal from being sent when the time of day clock ticks. If the file device is closed, the signal is automatically released.

ATC_TOD_REQUEST_ONCHANGE_SIG

This command requests a signal to be sent each time the time of day clock is changed by more than one tick. The *param* value passed to ioctl is the signal number that should be sent to the calling process.

ATC_TOD_CANCEL_ONCHANGE_SIG

This releases the signal from being sent when the time of day is changed by more than one tick. If the file device is closed, the signal is automatically released.

ATC_SET_DST_INFO and ATC_GET_DST_INFO

These commands allow setting the daylight savings time information, which shall be used when daylight savings time is enabled.

Parameter Data:

```
typedef struct dst_info {
    char type;
    union dst_types_u {
        struct dst_absolute_struct {
            int secs_from_epoch_to_transition;
            int seconds_to_adjust;
        } absolute;
        struct dst_generic_struct {
            char month;
            char dom_type;
            union dst_gen_dom_union {
                char dom;
                // ex: second Saturday of month
                // ex: first Sunday on or after oct. 9
                struct dst_gen1_struct {
                    char dow; // day of week (sun-sat)
                    char occur; // number of occurrences
                    char on_after_dom; // day of month
                } week_and_day;
                // ex: second to last Thursday of month
                // ex: first Sunday on or before oct. 9
                struct dst_gen2_struct {
                    char dow; // day of week (sun-sat)
                    char occur; // number of occurrences
                    char on_before_dom // day of month
                } reverse_occurrences_of_day;
            } gendom;
            int seconds_to_adjust;
        } generic;
    } begin, end;
    unsigned char begin_has_occurred_flag;
    unsigned char end_has_occurred_flag
} dst_info_t;
```

The daylight saving time information contains two identical unions named begin and end. The begin union contains the information necessary to determine when daylight saving should begin going into effect by adjusting the time, and end union contains the information necessary to determine when daylight saving should end by re-adjusting the time. The unions contain two structures named absolute and generic. The type member of the struct dst_info shall be 0 for absolute or 1 for generic. The absolute structure contains the exact date and time the beginning/ending adjustment should be made, and by how many seconds the time should be adjusted. The generic structure contains information that can be valid for a number of years, by containing the month in which the beginning/ending adjustment should be made and a union named gendom (short for generic day of month), that contains the information to determine the day of the month on which the beginning/ending adjustment will take place for any particular year. The information in the generic day of month

union determines a particular day of the month by finding the specific day of the week that occurs a specific number of times before or after a specific day of the month. The `dom_type` member of the union `dst_gen_dom_union` shall be a 0, 1, or 2 determining whether the `dom` member, `dst_gen1_struct` member or `dst_gen2_struct` union member respectively is used. The `dom`, `on_after_dom`, and `on_before_dom` members specify a day of the month from 1 to 31 inclusive. The `occur` member of these structures shall be 1 or greater, determining the number of times the particular day of the week, in the `dow` member (0 – 6, 0 being Sunday) shall occur to determine the day of the month when the daylight saving adjustment shall take place.

ATC_DST_ENABLE and ATC_DST_DISABLE

These commands enable and disable daylight saving time to be in effect.

9.2.8.2.2 EEPROM

The EEPROM driver provides full capability for reading and writing to EEPROM.

Supported Device File Operations:

```
open();
close();
read();
write();
lseek();
ioctl();
```

open()

The dev entry for the host EEPROM shall be `/dev/eeprom`. The EEPROM can be opened for Read, Write, or Read/Write.

Examples:

```
fd = open("/dev/eeprom", O_RDONLY);
fd = open("/dev/eeprom", O_WRONLY);
fd = open("/dev/eeprom", O_RDWR);
```

close()

Closes the file descriptor.

read()

```
int read(int fd, void *buf, int count);
```

Reads up to *count* bytes into *buf* and returns the number of bytes read. The read occurs at the current position within the device.

Note: The current position can be determined using the `ioctl`. The current position can be changed using the `lseek()` function.

Possible Errors:

EIO if end of file condition has already been reached

```
write()  
int write(int filp, void *buf, int count);
```

Writes *count* bytes to the device at the current file position within the device. If all of the bytes specified by *count* cannot be written before the end of the device no bytes shall be written and an error shall be returned. The number of bytes written shall be returned. If the value returned is less than *count*, then the returned value of bytes were written correctly, but the remaining bytes contain errors. In this case it is necessary to try the write again for the remaining bytes or repeat the same write again until the number of bytes returned matches the *count*.

Possible Errors:

EIO if end of file condition would occur writing the number of bytes specified.

```
lseek()  
lseek(int fd, int pos, int type);
```

Seeks to a specified position in the device. Both absolute and relative types of seeking are supported. If relative seeking is specified the *pos* value may be positive or negative. If absolute seeking is specified the file position is assigned to the *pos* value. If seeking outside the device size is attempted an error is returned and no change to the file position takes place.

Type Definitions:
ATC_EEPROM_SEEK_ABS
ATC_EEPROM_SEEK_REL

```
ioctl()  
ioctl(int fd, unsigned int cmd, unsigned long param);
```

The ioctl function supports multiple different commands, each described separately.

Command Definitions:
ATC_EEPROM_GET_FILE_POS
ATC_EEPROM_GET_DEVICE_SIZE

ATC_EEPROM_GET_FILE_POS

Returns the current file position. The *param* value is ignored.

ATC_EEPROM_GET_DEVICE_SIZE

Returns the size of the EEPROM device in bytes. The *param* value is ignored.

9.2.8.2.3 Datakey

This driver provides full capability for manipulating Datakey devices. Datakeys of sizes as listed in Section 9.2.6 of these specifications shall be supported.

Supported Device File Operations:

```
open();  
close();  
read();  
write();  
lseek();  
ioctl();
```

open()

The dev entry for the Datakey shall be /dev/datakey. The Datakey can be opened for Read, Write, or Read/Write.

Examples:

```
fd = open("/dev/datakey", O_RDONLY);  
fd = open("/dev/datakey", O_WRONLY);  
fd = open("/dev/datakey", O_RDWR);
```

read()

```
int read(int filp, void *buf, int count);
```

Reads up to *count* bytes into *buf* and returns the number of bytes read. The read occurs at the current position within the device.

Note: The current position can be determined using the ioctl. The current position can be changed using the lseek() function.

Possible Errors:

ENXIO if Datakey is not present

EBUSY if the signature changes

EIO if end of file condition has already been reached

write()

```
int write(int filp, void *buf, int count);
```

Writes *count* bytes to the device at the current file position within the device. If all of the bytes specified by *count* cannot be written before the end of the device no bytes shall be written and an error shall be returned. The number of bytes written shall be returned. If the value returned is less than *count*, then the returned value of bytes were written correctly, but the remaining bytes contain errors. In this case it is necessary to try the write again for the remaining bytes or repeat the same write again until the number of bytes returned matches the *count*.

Possible Errors:

ENXIO if Datakey is not present

EBUSY if the device signature changes (ie. Someone switched devices really fast)

EIO if end of file condition would occur writing the number of bytes specified.

close()

Closes the file descriptor.

lseek()

`lseek(int fd, int pos, int type);`

Seeks to a specified position in the device. Both absolute and relative types of seeking are supported. If relative seeking is specified the *pos* value may be positive or negative. If absolute seeking is specified the file position is assigned to the *pos* value. If seeking outside the device size is attempted an error is returned and no change to the file position takes place.

Type Definitions:

ATC_DATAKEY_SEEK_ABS

ATC_DATAKEY_SEEK_REL

ioctl()

`ioctl(int fd, unsigned int cmd, unsigned long param);`

The `ioctl` function supports multiple different commands, each described separately. If the Datakey is not inserted ENXIO is returned as the error code.

Command Definitions:

ATC_DATAKEY_GET_FILE_POS

ATC_DATAKEY_ERASE_ALL

ATC_DATAKEY_ERASE_SECTOR

ATC_DATAKEY_READ_PROTECT_BITS

ATC_DATAKEY_WRITE_PROTECT_BITS

ATC_DATAKEY_GET_DEVICE_SIZE

ATC_DATAKEY_GET_SECTOR_SIZE

ATC_DATAKEY_GET_FILE_POS

Returns the current file position. The *param* value is ignored.

ATC_DATAKEY_ERASE_ALL

Erases all data on the Datakey. The *param* value is ignored. The CPU active light blinks with high frequency during erasure. Always returns 0.

Note: When data is erased, all values are read as 0xFF.

ATC_DATAKEY_ERASE_SECTOR

Erases all data in the sector containing the address specified by *param*. The CPU active light blinks at high frequency during erasure. Returns 0 on success or EINVAL on invalid address. The sector size can be determined using the appropriate `ioctl()` in order to know what address ranges will be erased by this command.

ATC_DATAKEY_READ_PROTECT_BITS

Returns the value of the protect bits directly read from the Datakey. The data format will be in accordance with the datasheet for the Datakey being used (not the same for different device sizes). This function is provided so the user can ensure that the device is not protected. The *param* value is ignored.

ATC_DATAKEY_WRITE_PROTECT_BITS

Writes the value specified in *param* directly to the Datakey protection byte. The data format varies in accordance with the datasheet for the Datakey being used. This function is provided primarily so that the user can remove protection if writing is being prevented.

ATC_DATAKEY_GET_DEVICE_SIZE

Returns the size of the Datakey device in bytes. The *param* value is ignored.

ATC_DATAKEY_GET_SECTOR_SIZE

Returns the sector size of the Datakey in bytes. The *param* value is ignored.

9.2.8.2.4 Constants Defined by this specification

The content of *atc_spxs.h* is displayed on this page.

```
#ifndef __ATC_SPXS_H
#define __ATC_SPXS_H

#define ATC_SPXS_WRITE_CONFIG    0
#define ATC_SPXS_READ_CONFIG    1

#define ATC_SDLC                  0
#define ATC_SYNC                  1
#define ATC_HDLC                  2

#define ATC_B1200                  0
#define ATC_B2400                  1
#define ATC_B4800                  2
#define ATC_B9600                  3
#define ATC_B19200                 4
#define ATC_B38400                 5
#define ATC_B57600                 6
#define ATC_B76800                 7
#define ATC_B115200                8
#define ATC_B153600                9
#define ATC_B614400               10
const int ATC_B[] = { 1200, 2400, 4800, 9600, 19200, 38400,
                    57600, 76800, 115200, 153600, 614400 };

#define ATC_CLK_INTERNAL          0
#define ATC_CLK_EXTERNAL         1
```

```
#define ATC_GATED                0
#define ATC_CONTINUOUS           1

typedef struct atc_spcx_config_t {
    unsigned char protocol;
    unsigned char baud;
    unsigned char transmit_clock_source;
    unsigned char transmit_clock_mode;
} atc_spxs_config;

#endif
```

The content of atc.h is displayed on the following two pages.

```
#ifndef __ATC_H
#define __ATC_H

// Device File Names
#define ATC_HOST_EEPROM_DEV "/dev/eeprom"
#define ATC_ENGINE_EEPROM_DEV "/dev/engine_eeprom"
#define ATC_DATAKEY_DEV "/dev/datakey"
#define ATC_GPIO_POWERDOWN_DEV "/dev/powerdown"
#define ATC_GPIO_DATAKEY_DEV "/dev/datakeypresent"
#define ATC_GPIO_CPUACTIVE_DEV "/dev/cpuactive"
#define ATC_GPIO_CPURESET_DEV "/dev/cpureset"
#define ATC_TIMING_TOD_DEV "/dev/tod"
#define ATC_TIMING_TIMERS_DEV "/dev/timers"

#define ATC_SP1 "/dev/sp1"
#define ATC_SP2 "/dev/sp2"
#define ATC_SP3 "/dev/sp3"
#define ATC_SP4 "/dev/sp4"
#define ATC_SP5 "/dev/sp5"
#define ATC_SP6 "/dev/sp6"
#define ATC_SP8 "/dev/sp8"

#define ATC_SP1S "/dev/sp1s"
#define ATC_SP2S "/dev/sp2s"
#define ATC_SP3S "/dev/sp3s"
#define ATC_SP4S "/dev/sp4s"
#define ATC_SP5S "/dev/sp5s"
#define ATC_SP6S "/dev/sp6s"
#define ATC_SP8S "/dev/sp8s"

// DATAKEY IOCTL CONSTANTS
#define ATC_DATAKEY_GET_FILE_POS 3
#define ATC_DATAKEY_ERASE_ALL 6
#define ATC_DATAKEY_ERASE_SECTOR 7
#define ATC_DATAKEY_READ_PROTECT_BITS 8
#define ATC_DATAKEY_WRITE_PROTECT_BITS 9
#define ATC_DATAKEY_GET_DEVICE_SIZE 10
#define ATC_DATAKEY_GET_SECTOR_SIZE 11

// DATAKEY LSEEK CONSTANTS
#define ATC_DATAKEY_SEEK_REL 0
#define ATC_DATAKEY_SEEK_ABS 1

// EEPROM IOCTL CONSTANTS
#define ATC_EEPROM_GET_FILE_POS 3
#define ATC_EEPROM_GET_DEVICE_SIZE 10

// EEPROM LSEEK CONSTANTS
#define ATC_EEPROM_SEEK_REL 0
#define ATC_EEPROM_SEEK_ABS 1

// Time of Day driver Definitions
#define ATC_TOD_SET_TIMESRC 1
```

```

#define ATC_TOD_GET_TIMESRC 2
#define ATC_TOD_GET_INPUT_FREQ 3
#define ATC_TOD_REQUEST_TICK_SIGNAL 5
#define ATC_TOD_CANCEL_TICK_SIGNAL 6
#define ATC_TOD_DST_ENABLE 10
#define ATC_TOD_DST_DISABLE 11
#define ATC_TOD_DST_SETINFO 12
#define ATC_TOD_DST_GETINFO 13

// TIMING Driver Definitions
#define ATC_TIMER_GET_STATUS      0x1C
#define ATC_TIMER_NULL           0x0000 // When timer is initialized
#define ATC_TIMER_SIG            0x1000 // If one-shot signal is
pending */
#define ATC_TIMER_CYC            0x1001 // If periodic signal is
pending */
#define ATC_TIMER_START          0x1002 // If free running
#define ATC_TIMER_STOP           0x1003 // If not active
#define ATC_TIMER_RESET          0x1004 // If timer is reset

typedef struct
{
    unsigned int value;
    unsigned int mode;
    unsigned int signal;
    unsigned int period;
} Timer_status;

typedef struct
{
    unsigned int code;
    unsigned int param1;

    union
    {
        unsigned int param;
        void __user *pointer;
    } param2;
} timing_params;

#define ATC_TIMER_SET_PARAMS      0
#define ATC_TIMER_GET_PARAMS      1

#define ATC_SET_TIMESRC 1
#define ATC_TIMESRC_LINESYNC 0
#define ATC_TIMESRC_RTCSQWR 1

typedef struct atc_datakey_t {
    unsigned int16 fcs;
    unsigned int8 type;
    unsigned int8 version;
    unsigned int32 latitude;

```

```
        unsigned int32 longitude;  
        unsigned int16 id;  
        unsigned int16 drop;  
        unsigned int32 ipaddress;  
        unsigned int32 subnet;  
        unsigned int32 gataway;  
    } atc_datakey;  
  
#endif
```

9.2.8.3 Linux Application Kernel

9.2.8.3.1 Boot Sysreset

The provided software shall boot Linux from SYSRESET. The entire program shall be resident in FLASH Memory. The serial port descriptors shall be configured with the defaults parameters as listed in A9-16.

9.2.8.3.2 Hardware Initialization

The Engine Board low-level hardware and O/S software initialization shall be completed within a maximum of 4.5 seconds from the release of STARTUP/SYSRESET as shown in A9-17. This startup time shall be measured from the release of STARTUP/SYSRESET to the turn on of the ACTIVE LED using a user level program named ONLED.

9.2.8.3.3 Startup Procedure

The Linux boot image shall startup as described in the AASHTO, ITE and NEMA ATC Standard V. 5.2.b Section 5.3.5.1. The boot up process shall be completed within the time period specified in Section 9.2.8.3.2 of these specifications.

Linux startup shall be configured to auto run scripts or execute Linux binaries residing in the USB Memory upon power up with USB Memory inserted. If there is no USB Memory inserted in the Model 2070-1C Module, Linux shall boot normally as defined above.

9.2.8.4 Linux Utilities

The following Linux utilities shall be provided resident in the Model 2070-1C CPU Module:

Ver , fl, onled

A Ver utility shall be provide in the /bin directory and shall meet the requirement as defined in Section 9.2.7.6.4 of this specification and as applicable for the Linux OS.

Re-Flash (fl) utility shall be provided in the /bin directory and shall meet the requirements as defined in Section 9.2.9 of this specification and as applicable for the Linux OS.

ONLED (onled) program shall be provided in the /bin directory. The onled program shall be a Linux binary and shall toggle the ACTIVE LED when executed.

9.2.8.5 Linux Network Requirements

The following Network utilities not listed under FHS-2.3 shall be provided resident in the Model 2070-1C CPU Module:

vi, arp, telnet, ftp, ifconfig, netstat, ping, showmount, ntpdate, ntpq, ntp-time, and rpcinfo

The Model 2070 -1C CPU shall have full support for NFS and shall have the following daemons resident:

rpc.mountd, and rpc.nfsd

The Model 2070 -1C CPU shall have full support for FTP and shall have the following daemons resident:

vsftpd

The Model 2070 -1C CPU shall have full support for NTP and shall have the following daemons resident:

ntpd and ntpdc

9.2.8.6 Linux File System Configuration

The Model 2070-1C CPU Module Linux File System Configuration shall meet the requirements and guidelines for files, directories and utility commands as per the Filesystem Hierarchy Standard (FHS-2.3) dated January 28, 2004.

9.2.9 Re-Flash Utility

A Utility Program shall be provided that would allow the user to upgrade (re-flash) the Boot Image for the Model 2070-1A and E CPU as defined in section 9.2.7 and the Linux Kernel as defined in Section 9.2.8 for the Model 2070-1C CPU. This utility shall provide the capabilities for upgrading the Operating System and drivers when available by the manufacturer. The Utility Program shall provide the capability for the user to dynamically upgrade the Boot Image via the command prompt. The contractor shall also provide a copy in CD-ROM Memory of all files originally stored in the flash drive /f0 so that they can be reloaded as needed.

9.2.10 Communications Loading Test

The Model 2070 Controller using the Model 2070-1A and 1E CPU shall pass a Communications Loading Test consisting of Serial and Network Communications. The test shall run Sp1, Sp2, Sp3, and Sp8 at 9600 bytes per second in a continuous full duplex asynchronous/synchronous communications loop with the network stack initialized and a telnet session established for each port with standard out, in and standard error directed to the telnet session port. The test shall not exceed a maximum CPU load of 30% during test duration of 96 hours for Model 2070 -1E Module. The controller using Model -1C Module shall have a maximum CPU load of 10% for the above test and shall meet all test requirements as defined in Section 9.1.1 of the ATC v.5.2.b.

9.2.11 Diagnostic Acceptance Test (DAT)

The standard Caltrans DAT Program shall be provided resident in the 2070 Unit as the application program.

9.2.12 QPL or Purchasing Agency

Source and object Software shall be provided to the QPL or Purchasing Agency on both document listing and CD-ROM Memory. It shall provide user descriptions of test logic and reports. The Agency shall possess non-exclusive rights to this program suite.

9.2.13 Deliverables

9.2.12.1 Copies Delivery

Two copies of the following items will be provided to the purchasing AGENCY on a CD disk readable by a PC compatible computer.

1. Specific hardware memory addresses, including FLASH, SRAM, and DRAM starting addresses, shall be specified and provided. Written documentation of addresses shall be in PDF form and will have the file name of "Memory Map.pdf"
2. Copies of the vendor kernel, platform drivers and OS-9 utility executable modules.
3. Copy of all provided written manuals in PDF form.
4. RE-FLASH Utility and the procedures for its use in PDF form. The PDF documentation of the procedures shall have the file name of "Reflash Utility Procedures.pdf".

9.2.12.2 Software Delivery

All Linux Software, **except for loadable modules**, shall be compliant to the GPL license as published by the Free Software Foundation.

CHAPTER 9-SECTION 3

MODEL 2070-2 FIELD I/O MODULE (FI/O)

9.3.1 Model 2070-2A Module

The Model 2070-2A Model shall consist of the Field Controller Unit; Parallel Input/Output Ports; other Module Circuit Functions (includes muzzle jumper); Serial Communication Circuitry; Module Connectors C1S, C11S, and C12S mounted on the module front plate; VDC Power Supply (+12VDC to +5VDC); and required software.

9.3.2 Model 2070-2B Module

The Model **2070-2B** Model shall consist of the Serial Communication Circuitry, DC Power Supply, and Module Connector C12S mounted on the module front plate only.

9.3.3 Field I/O Controller Unit (FCU)

The FCU shall include a programmable microprocessor/controller unit together with all required clocking and support circuitry. **The FCU shall be provided with in-circuit re-programmability via a JTAG or BDM port.**

9.3.4 Parallel Input Ports

The Parallel Input Ports shall provide 64 bits of input using ground-true logic. Each input shall be read logic "1" when the input voltage at its field connector input is less than 3.5 VDC, and shall be read logic "0" when either the input current is less than 100 μ A or the input voltage exceeds 8.5 VDC. Each input shall have an internal pull-up to the isolated +12 VDC and shall not deliver greater than 20 mA to a short circuit to ground. **The pull-up resistance shall not be less than 10K or more than 50K Ohms.**

9.3.4.1 Parallel Output Ports

The **Parallel Output Ports** shall provide 64 bits of output. Each output written as a logic "1" shall have a voltage at its field connector output of less than 4.0 VDC. Each output written as a logic "0" shall provide an open circuit (1 Mega Ohm or more) at its field connector output. Each output shall consist of an open-collector capable of driving 40 VDC minimum and sinking 100 mA minimum. Each output circuit shall be capable of switching from logic "1" to logic "0" within 100 μ s when connected to a load of 100 K-Ohms minimum. Each output circuit shall be protected from transients of 10 $\pm$ 2 μ s duration, $\pm$ 300 VDC from a 1 K-Ohm source, with a maximum rate of 1 pulse per second.

9.3.4.2 Output Operation

Each output shall latch the data written and remain stable until either new data is written or the active-low reset signal. Upon an active-low reset signal, each output shall latch a **LOGIC** "0" and retain that state until a new writing. The state of all output circuits at the time of **POWER UP** or in Power Down state shall be open. It shall be possible to simultaneously assert all outputs within 100 μ s of each other. An output circuit state not changed during a new writing shall not glitch when other output circuits are updated.

9.3.5 Other Module Circuit Functions

9.3.5.1 Maximum Capacitive Load

A maximum capacitive load of 100 pF shall be presented to the LINESYNC input signal. The EIA-485 compliant differential LINESYNC signals shall be derived from the LINESYNC signal.

9.3.5.2 External WDT “Enable” Shunt/Toggle Switch

An External WDT “Enable” Shunt/Toggle Switch shall be provided on the board. With the jumper IN and NRESET transitions HIGH (FCU active), the FCU shall output a state change on Output 39 (Monitor Watchdog Timer Input) every 100 ms for 10 seconds or due to Set Output Command. When the shunt is missing, the feature shall not apply. This feature is required to operate with the Model 210 Monitor Unit only.

9.3.5.3 Watchdog Circuit

An FCU Watchdog Circuit shall be provided. It shall be enabled by the Filed I/O firmware at Power Up with a value of 100 ms. Its enabled state shall be machine readable and reported in the FI/O status byte. Once enabled, the watchdog timer shall not be disabled without resetting the FI/O. Failure of the FI/O to reset the watchdog timer within the prescribed timeout shall result in a hardware reset.

9.3.5.4 One KHz Reference

A synchronizable 1 KHz time reference shall be provided. It shall maintain a frequency accuracy of $\pm 0.01\%$ (± 0.1 counts per second).

9.3.5.5 32 Bit Millisecond Counter

A 32-bit Millisecond Counter (MC) shall be provided for “time stamping.” Each 1 KHz reference interrupt shall increment the MC.

9.3.5.6 Power Up

At Power Up, the FCU loss of communications timer shall indicate loss of communications until the user program sends the Request Module Status message to reset the “E” Bit.

9.3.5.7 Logic Switch

A LOGIC Switch shall be provided resident on the module board. The switch shall function to disconnect Serial Port 3 (SP3) from the external world, Connector C12S. Its purpose is to prevent multiple use of SP3. An LED shall be provided on the module front panel labeled “SP3 ON”. If LED light is ON, SP3 is active and available at C12S.

9.3.6 Serial Communications/Logic Circuitry

9.3.6.1 System Serial Port 5 (SP5) EIA 485 Signal

System Serial Port 5 (SP5) EIA 485 signal Lines shall enter the Field I/O Module and be split into two multi-drop isolated ports. One shall be routed to the FCU and the other converted to EIA 485, then routed to Connector C12S.

9.3.6.2 System Serial Port 3 (SP3) EIA 485 Signal

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System Serial Port 3 (SP3) EIA 485 signal lines shall enter the **Field I/O Module** and be isolated, converted back to EIA 485 and then routed to Connector C12S.

9.3.6.3 Linesync and Power Down Lines

Linesync and Power Down Lines shall be split and isolated, one routed to FCU for shut down functions and the other changed to EIA 485; then routed to connector 12S for external module use.

9.3.6.4 CPU_Reset and Power Up

CPU_Reset and Power Up (SysReset) Lines shall be isolated and “OR’d” to form NReset. NReset shall be used to reset the FCU and other module devices. NReset shall also, be converted to EIA 485, and then routed to Connector C12S.

9.3.6.5 Module 2070-2B

If the module is 2070-2B, routing to FCU doesn’t apply.

9.3.6.6 Internal Isolation

Isolation between internal +5DC / DCG#1 and +12 DC ISO/DCG#2 and +12 DC ISO shall be used for board power and external logic.

9.3.7 Buffers

A Transition Buffer shall be provided capable of holding a minimum of 1024 recorded entries. The Transition Buffer shall default to empty. There shall be two entry types: Transition and Rollover. The inputs shall be monitored for state transition. At each transition (If the input has been configured to report transition), a transition entry shall be added to the Transition Buffer. The MC shall be monitored for rollover. At each rollover transition (\$xxxx FFFF - \$xxxx 0000), a rollover entry shall be added to the Transition Buffer. For rollover entries, all bits of byte 1 are set to indicate that this is a rollover entry. Transition Buffer blocks are sent to the **CPU Module** upon command. Upon confirmation of their reception, the blocks shall be removed from the Transition Buffer.

9.3.8 I/O Functions

9.3.8.1 Inputs

Input scanning shall begin at I0 (bit 0) and **proceed to the highest input I63**, ascending from **lsb to msb in increasing input number**. Each complete input scan shall finish within 100 μ s. Once sampled, the Logic State of input shall be held until the next input scan. Each input shall be sampled 1,000 times per second. The time interval between samples shall be 1 ms $\pm$ 100 μ s. If configured to report, each input that has transitioned since its last sampling shall be identified by input number, transition state, and timestamp (at the time the input scan began) and shall be added as an entry to the Transition Buffer. If multiple inputs change state during one input sample, these transitions shall be entered into the Input Transition Buffer by increasing number. The MC shall be sampled within 10 μ s of the completion of the input scan.

9.3.8.2 Data Filtering

If configured, the inputs shall be filtered by the FCU to remove signal bounce. The filtered input signals shall then be monitored for changes as noted. The filtering

parameters for each input shall consist of Ignore Input Flag and the On and Off filter samples. If the Ignore Input flag is set, no input transitions shall be recorded. The On and Off filter samples shall determine the number of consecutive samples an input must be on and off, respectively, before a change of state is recognized. If the change of state is shorter than the specified value, the change of state shall be ignored. The On and Off filter values shall be in the range of 0 to 255. A filter value of 0, for either or both values, shall result in no filtering for this input. The default values for input signals after reset shall be as follows:

Filtering	Enabled
On and off filter values shall be set to	5
Transition monitoring	Disabled (Timestamps are not logged)

9.3.8.3 Outputs

Simultaneous assertion of all outputs shall occur within 100 μ s. Each output shall be capable of being individually configured in state to ON, OFF, or a state synchronized with either phase of LINESYNC. The condition of the outputs shall only be "ON" if the FI/O continues to receive active communications from the CPU Module. If there is no valid communications with the CPU Module for 2.0 seconds, all outputs shall revert to the OFF condition, and the [Module Status Byte](#) shall be updated to reflect the loss of communication from the CPU Module.

9.3.8.4 Standard Function

Each output shall be controlled by the data and control bits in the CPU Module Field I/O frame protocol as follows:

Output Bit Translation

Case	Output Data Bit	Output Control Bit	Function
A	0	0	Output in the OFF state
B	1	1	Output is a square wave, synchronized to the LINESYNC signal. When LINESYNC is ON (1), the output is OFF, and when LINESYNC is OFF (0), the output is ON.
C	0	1	Output is a square wave, synchronized to the LINESYNC signal. When LINESYNC is ON (1), the output is ON, and when LINESYNC is OFF (0), the output is OFF
D	1	0	Output is in the ON state.

9.3.8.4.1 Case A

In Case A above, the corresponding output shall be turned OFF if previously ON and if previously OFF remain OFF until otherwise configured. For half-cycle switching (cases B and C), all outputs to be changed shall be changed within 50 μ s after the corresponding LINESYNC transition and shall remain in the same state during the entire half cycle. In Case D above, the corresponding output shall be turned ON if

previously OFF and if previously ON remain ON until otherwise configured. All outputs shall neither glitch nor change state unless configured to do so.

9.3.8.5 Interrupts

All interrupts shall be capable of asynchronous operation with respect to all processing and all other interrupts. MILLISECOND Interrupt shall be activated by the 1 KHz reference once per ms. A timestamp rollover flag set by MC rollover shall be cleared only on command. **LINESYNC Interrupt - both the 0-1 and 1-0 transitions of the LINESYNC signal shall generate this interrupt.** The LINESYNC interrupt shall monitor the MC interrupt and set the MC error flag if there has not been an interrupt from the 1 KHz source for 0.5 seconds (≥ 60 consecutive LINESYNC interrupts). The LINESYNC interrupt shall synchronize the 1 KHz time reference with the 0-1 transition of the LINESYNC signal once a second. A LINESYNC error flag shall be set if the LINESYNC interrupt has not successfully executed for 0.5 seconds or longer (≥ 500 consecutive millisecond interrupts).

9.3.8.6 Communication Service Routine

A low-level communication service routine shall be provided to handle reception, transmission, and EIA-485 communication faults. The communication server shall automatically:

For Transmission:

- Generate the opening and closing flags
- Generate the CRC value
- Generate the abort sequence (minimum of 8 consecutive '1' bits) when commanded by the FCU
- Provide zero bit insertion

For Receiving:

- Detect the opening and closing flags
- Provide address comparison, generating an interrupt for messages addressed to the **Field** I/O Module, and ignoring messages not addressed to the **Field** I/O Module
- Strip out inserted zeros
- Calculate the CRC value, compare it to the received value, and generate an interrupt on an error
- Generate an interrupt if an abort sequence is received

9.3.8.7 Communication Processing

This task shall be to process the command messages received from the CPU Module, prepare, and start **the** response transmission. The response message transmission shall begin within 4 ms of the receipt of the received message. Message type processing time constraints shall not exceed 70 ms per message.

9.3.8.8 Input Processing

This task shall process the raw input data scanned in by the 1 ms interrupt routine, perform all filtering, and maintain the transition queue entries.

9.3.9 Data Communication Protocols

9.3.9.1 Communications Protocol

Protocol - All communications between the CPU Module and the Field I/O shall be SDLC-compatible command-response, support 0 bit stuffing, and operate at a data rate of 614.4 Kbps. The CPU Module shall always initiate the communications and if the command frame is incomplete or there is an error, no Field FI/O response shall be transmitted. The number of bytes of a command or response is dependent upon the Field I/O Module identification.

9.3.9.1.1 Frame Types

The frame type shall be determined by the value of the first byte of the message. The command frames type values 112 – 127 (\$70 - \$7F) and associated response frame type values 240 – 255 (\$F0 - \$FF) are allocated for **Manufacturer diagnostics**. All other frame types not called out are reserved. The command-response Frame Type values and message times shall be as follows:

Frame Types

Module Command	I/O Module Response	Description	Minimum Message Time	Maximum Message Time
0-43	128-171	Reserved for NEMA TS-2		
44-48	172-176	Reserved		
49	177	Request Module Status	250 μ s	275 μ s
50	178	MC Management	222.5 μ s	237.5 μ s
51	179	Configure Inputs	344.5 μ s	6.8750 ms
52	180	Poll Raw Input Data	317.5 μ s	320 μ s
53	181	Poll Filtered Input Data	317.5 μ s	320 μ s
54	182	Poll Input Transition Buffer	300 μ s	10.25 ms
55	183	Set Outputs	405 μ s	410 μ s
56	184	Configure Input Tracking	340 μ s	10.25 ms
57	185	Configure Complex Outputs	340 μ s	6.875 ms
58	186	Reserved / Optional (Configure Watchdog)	222.5 μ s	222.5 μ s
59	187	Controller Identification	222.5 μ s	222.5 μ s
60	188	I/O Module Identification	222.5 μ s	222.5 μ s
61-62	189-190	Reserved (see Section 9.3.9.1.2)	---	---
63	191	Poll variable length raw input (see Section 9.3.9.1.2)	317.5 μ s	320 μ s
64	192	Variable length command outputs	405 μ s	410 μ s
65	193	Reserved (see Section 9.3.9.1.2)	---	---
67	195	Reserved (see Section 9.3.9.1.2)	---	---
68-111	196-239	Reserved	---	---
112-127	240-255	Manufacturer Diagnostics	---	---

9.3.9.1.2 ITS Cabinet Monitor

Messages 61/189, and 62/190, and 65/193 are for ITS Cabinet Monitor Unit. See ITS Cabinet Monitor System Serial Bus #1 for Command and Response Frames (See Chapter 3). [Message 63 /191](#) shall be the same as Message 52/180 except Byte 2 of [Message 63](#) response shall denote the following number of input data bytes:

Message 64/192 shall be the same as Message 55/183 except Byte 2 of the Message 64 Command shall denote the number of output data bytes plus the following output control bytes:

9.3.9.2 Request Module Status

The Command shall be used to request [FI/O Module](#) status information response.

Command/response frames are as follows:

Request Module Status Command

Description	Msb								Lsb	Byte Number
(Type Number = 49)	0	0	1	1	0	0	0	1		Byte 1
Reset Status Bits	P	E	K	R	T	M	L	W		Byte 2

Request Module Status Response

Description	Msb								Lsb	Byte Number
(Type Number = 177)	1	0	1	1	0	0	0	1		Byte 1
System Status	P	E	K	R	T	M	L	W		Byte 2
SCC Receive Error Count	Receive Error Count									Byte 3
SCC Transmit Error Count	Transmit Error Count									Byte 4
Timestamp MSB	Timestamp MSB									Byte 5
Timestamp NMSB	Timestamp NMSB									Byte 6
Timestamp NLSB	Timestamp NLSB									Byte 7
Timestamp LSB	Timestamp LSB									Byte 8

9.3.9.2.1 Status Bits

The response Status Bits are defined as follows:

- P - Indicates FI/O hardware reset
- E - Indicates a communications loss of greater than 2 seconds
- M - Indicates an error with the MC interrupt
- L - Indicates an error in the LINESYNC
- W - Indicates that the FI/O has been reset by the Watchdog
- R - Indicates that the [SCC Receive Error](#) count byte has rolled over
- T - Indicates that the [SCC Transmit Error](#) count byte has rolled over
- K - Indicates the Datakey has failed or is not present

9.3.9.2.2 Request Module Status

Each of these bits shall be individually reset by a '1' in the corresponding bit of any subsequent Request Module Status frame, and the response frame shall report the current status bits. The SCC error count bytes shall not be reset. When an SCC error count rolls over (255 - 0), its corresponding roll-over flag shall be set.

9.3.9.3 MC Management

MC Management frame shall be used to set the value of the MC. The 'S' bit shall return status '0' on completion or '1' on error. The 32-bit value shall be loaded into the MC at the next 0-1 transition of the LINESYNC signal. The frames are as follows:

MC Management Command

Description	msb								Lsb	Byte Number
(Type Number = 50)	0	0	1	1	0	0	1	0		Byte 1
New Timestamp MSB	x	x	x	x	x	x	x	x		Byte 2
New Timestamp NMSB	x	x	x	x	x	x	x	x		Byte 3
New Timestamp NLSB	x	x	x	x	x	x	x	x		Byte 4
New Timestamp LSB	x	x	x	x	x	x	x	x		Byte 5

MC Management Response

Description	msb								Lsb	Byte Number
(Type Number = 178)	1	0	1	1	0	0	1	0		Byte 1
Status	0	0	0	0	0	0	0	0	S	Byte 2

9.3.9.4 Configure Inputs Command

The Configure Inputs command frame shall be used to change input configurations. The command-response frames are as follows:

Configure Inputs Command

Description	msb								Lsb	Byte Number
(Type Number = 51)	0	0	1	1	0	0	1	1		Byte 1
Number of Items (n)	n	n	n	n	n	n	n	n		Byte 2
Item # - Byte 1	E	Input Number								Byte 3(I-1)+3
Item # - Byte 2	Leading edge filter (e)									Byte 3(I-1)+4
Item # - Byte 3	Trailing edge filter (r)									Byte 3(I-1)+5

Configure Inputs Response

Description	msb								Lsb	Byte Number
(Type Number = 179)	1	0	1	1	0	0	1	1		Byte 1
Status	0	0	0	0	0	0	0	0	S	Byte 2

Block field definitions shall be as follows:

- E - Ignore Input Flag. "1" = do not report transitions for this input, "0" = report transitions for this input
- e - A one-byte leading edge filter specifying the number of consecutive input samples which must be "0" before the input is considered to have entered to "0" state from "1" state (range 1 to 255, 0 = disabled)
- r - A one-byte trailing edge filter specifying the number of consecutive input samples which must be "1" before the input is considered to have entered to "1" state from "0" state (range 1 to 255, 0 = disabled)
- S - return status S = '0' on completion or '1' on error

9.3.9.5 Poll Raw Input Data

The Poll Raw Input Data frame shall be used to poll the FI/O for the current unfiltered status of all inputs. The response frame shall contain 8 bytes (2A) or 15 bytes of information indicating the current input status. The frames are as follows:

Poll Raw Input Data Command

Description	Msb								lsb	Byte Number
(Type Number = 52)	0	0	1	1	0	1	0	0		Byte 1

Poll Raw Input Data Response (2070-2A)

Description	msb								lsb	Byte Number
(Type Number = 180)	1	0	1	1	0	1	0	0		Byte 1
Inputs I0 (lsb) to I7 (msb)	x	x	x	x	x	x	x	x	x	Byte 2
Inputs I8 to I63	x	x	x	x	x	x	x	x	x	Bytes 3 to 9
Timestamp MSB	x	x	x	x	x	x	x	x	x	Byte 10
Timestamp NMSB	x	x	x	x	x	x	x	x	x	Byte 11
Timestamp NLSB	x	x	x	x	x	x	x	x	x	Byte 12
Timestamp LSB	x	x	x	x	x	x	x	x	x	Byte 13

Poll Raw Input Data Response (2070-8 via 2070-2B)

Description	msb								lsb	Byte Number
(Type Number = 180)	1	0	1	1	0	1	0	0		Byte 1
Inputs I0 (lsb) to I7 (msb)	x	x	x	x	x	x	x	x	x	Byte 2
Inputs I8 to I119	x	x	x	x	x	x	x	x	x	Bytes 3 to 16
Timestamp MSB	x	x	x	x	x	x	x	x	x	Byte 17
Timestamp NMSB	x	x	x	x	x	x	x	x	x	Byte 18
Timestamp NLSB	x	x	x	x	x	x	x	x	x	Byte 19
Timestamp LSB	x	x	x	x	x	x	x	x	x	Byte 20

9.3.9.6 Poll Filtered Input Data

The Poll Filtered Input Data frame shall be used to poll the FI/O for the current filtered status of all inputs. The response frame shall contain 8 bytes (2A) or 15 bytes of information indicating the current filtered status of the inputs. Raw input data shall be provided in the response for inputs that are not configured for filtering. The frames are as follows:

Poll Filter Input Data Command

Description	Msb								lsb	Byte Number
(Type Number = 53)	0	0	1	1	0	1	0	1		Byte 1

Poll Filter Input Data Response (2070-2A)

Description	msb								lsb	Byte Number
(Type Number = 181)	1	0	1	1	0	1	0	1		Byte 1
Inputs I0 (lsb) to I7 (msb)	x	x	x	x	x	x	x	x	x	Byte 2
Inputs I8 to I63	x	x	x	x	x	x	x	x	x	Bytes 3 to 9
Timestamp MSB	x	x	x	x	x	x	x	x	x	Byte 10

Timestamp NMSB	x	x	x	x	x	x	x	x	Byte 11
Timestamp NLSB	x	x	x	x	x	x	x	x	Byte 12
Timestamp LSB	x	x	x	x	x	x	x	x	Byte 13

Poll Filter Input Data Response (2070-8 via 2070-2B)

Description	msb								lsb	Byte Number
(Type Number = 181)	1	0	1	1	0	1	0	1		Byte 1
Inputs I0 (lsb) to I7 (msb)	x	x	x	x	x	x	x	x	x	Byte 2
Inputs I8 to I119	x	x	x	x	x	x	x	x	x	Bytes 3 to 16
Timestamp MSB	x	x	x	x	x	x	x	x	x	Byte 17
Timestamp NMSB	x	x	x	x	x	x	x	x	x	Byte 18
Timestamp NLSB	x	x	x	x	x	x	x	x	x	Byte 19
Timestamp LSB	x	x	x	x	x	x	x	x	x	Byte 20

9.3.9.7 Poll Input Transition Buffer

The Poll Input Transition Buffer frame shall poll the FI/O for the contents of the input transition buffer. The response frame shall include a three-byte information field for each of the input changes that have occurred since the last interrogation. The frames are as follows:

Poll Input Transition Buffer Command

Description	msb								lsb	Byte Number
(Type Number = 54)	0	0	1	1	0	1	1	0		Byte 1
Block Number	x	x	x	x	x	x	x	x	x	Byte 2

Input Transition Buffer Response

Description	msb								lsb	Byte Number
(Type Number = 182)	1	0	1	1	0	1	1	0		Byte 1
Block Number	x	x	x	x	x	x	x	x	x	Byte 2
Number of Entries (n)	x	x	x	x	x	x	x	x	x	Byte 3
Item #	S	Input Number								Byte 3(I-1)+4
Item # Timestamp NLSB	x	x	x	x	x	x	x	x	x	Byte 3(I-1)+5
Item # Timestamp LSB	x	x	x	x	x	x	x	x	x	Byte 3(I-1)+6
Status	0	0	0	0	C	F	E	G		Byte 3(n-1)+7
Timestamp MSB	x	x	x	x	x	x	x	x	x	Byte 3(n-1)+8
Timestamp NMSB	x	x	x	x	x	x	x	x	x	Byte 3(n-1)+9
Timestamp NLSB	x	x	x	x	x	x	x	x	x	Byte 3(n-1)+10
Timestamp LSB	x	x	x	x	x	x	x	x	x	Byte 3(n-1)+11

The entry types are depicted as follows:

Input Transition Entry

Description	msblsb								Byte Number
Transition Entry Identifier	S	Input Number							1
Timestamp NLSB	x	x	x	x	x	x	x	x	2
Timestamp LSB	x	x	x	x	x	x	x	x	3

MC Rollover Entry

Description	msblsb								Byte Number
Rollover Entry Identifier	1	1	1	1	1	1	1	1	1
Timestamp MSB	x	x	x	x	x	x	x	x	2
Timestamp NMSB	x	x	x	x	x	x	x	x	3

9.3.9.7.1 Active Input

Each detected state transition for each active input (see configuration data) is placed in the queue as it occurs. Bit definitions are as follows:

- S Indicates the state of the input after the transition
- C Indicates the 255 entry buffer limit has been exceeded
- F Indicates the transition buffer limit has been exceeded
- G Indicates the requested block number is out of monotonic increment sequence
- E Same block number requested, E is set in response

9.3.9.7.2 Block Number Byte

The Block Number byte is a monotonically increasing number incremented after each command issued by the CPU Module. When the FI/O Module receives this command, it shall compare the associated Block Number with the Block Number of the previously received command. If it is the same, the previous buffer shall be re-sent to the CPU Module and the 'E' flag set in the status response frame. If it is not equal to the previous Block Number, the old buffer shall be purged and the next block of data sent. If the block number is not incremented by one, the status G bit shall be set. The block number received becomes the current number (even if out of sequence). The Block Number byte sent in the response block shall be the same as that received in the command block. Counter rollover shall be considered as a normal increment.

9.3.9.8 Set Outputs

The Set Outputs frame shall be used to command the FI/O to set the Outputs according to the data in the frame. If there is any error configuring the outputs, the 'E' flag in the

response frame shall be set to “1”. If the LINESYNC reference has been lost, the 'L' bit in the response frame shall be set to “1”. Loss of LINESYNC reference shall also be indicated in [Module Status Response Frame](#). The output bytes depend upon field I/O module. These command and response frames are as follows:

Set Outputs Command (2070-2A)

Description	Msb							lsb	Byte Number
(Type Number = 55)	0	0	1	1	0	1	1	1	Byte 1
Outputs O0 (lsb) to O7 (msb) Data	x	x	x	x	x	x	x	x	Byte 2
Outputs O8 to O63 Data	x	x	x	x	x	x	x	x	Bytes 3 to 9
Outputs O0 (lsb) to O7 (msb) Control	x	x	x	x	x	x	x	x	Byte 10
Outputs O8 to O63 Control	x	x	x	x	x	x	x	x	Bytes 11 to 17

Set Outputs Command (2070-8 via 2070-2B)

Description	Msb							lsb	Byte Number
(Type Number = 55)	0	0	1	1	0	1	1	1	Byte 1
Outputs O0 (lsb) to O7 (msb) Data	x	x	x	x	x	x	x	x	Byte 2
Outputs O8 to O103 Data	x	x	x	x	x	x	x	x	Bytes 3 to 14
Outputs O0 (lsb) to O7 (msb) Control	x	x	x	x	x	x	x	x	Byte 15
Outputs O8 to O103 Control	x	x	x	x	x	x	x	x	Bytes 16 to 27

Set Outputs Response

Description	Msb							lsb	Byte Number
(Type Number = 183)	1	0	1	1	0	1	1	1	Byte 1
Status	0	0	0	0	0	0	L	E	Byte 2

9.3.9.9 Configure Input Tracking Functions

The Configure Input Tracking Functions frame shall be used to configure outputs to respond to transitions on a specified input. Each Output Number identified by Item Number shall respond as configured to the corresponding Input Number identified by the same Item Number. Input to Output mapping shall be one to one. If a command results in more than 8 input tracking outputs being configured, the response V bit shall be set to ‘1’ and the command shall not be implemented. The command and response frames are as follows:

Configure Input Tracking Functions Command

Description	msb							lsb	Byte Number
(Type Number = 56)	0	0	1	1	1	0	0	0	Byte 1
Number of Items	Number of Items								Byte 2
Item # - Byte 1	E	Output Number							Byte 2(I-1)+3
Item # - Byte 2	I	Input Number							Byte 2(I-1)+4

Configure Input Tracking Functions Response

Description	msb							lsb	Byte Number
(Type Number = 184)	1	0	1	1	1	0	0	0	Byte 1
Status	0	0	0	0	0	0	0	V	Byte 2
Timestamp MSB	x	x	x	x	x	x	x	x	Byte 3
Timestamp NMSB	x	x	x	x	x	x	x	x	Byte 4
Timestamp NLSB	x	x	x	x	x	x	x	x	Byte 5
Timestamp LSB	x	x	x	x	x	x	x	x	Byte 6

9.3.9.9.1 Definitions are as follows:

- E '1' - Enable input tracking functions for this output
- '0' - Disable input tracking functions for this output
- I '1' - The output is OFF when input is ON, ON when input OFF
- '0' - The output is ON when input is ON, OFF when input is OFF
- V '1' - The max. number of 8 configurable outputs has been exceeded
- '0' - No error

Number of Items - The number of entries in the frame. If zero, all outputs currently configured for input tracking shall be disabled.

9.3.9.9.2 Timestamp Value

The timestamp value shall be sampled prior to the response frame.

9.3.9.9.3 Outputs Tracks Inputs

Outputs which track inputs shall be updated no less than once per ms. Input to output signal propagation delay shall not exceed 2 ms.

9.3.9.9.4 Number of Item

The “Number of Item” field is valid from 0 to 16 (most that is sent at one time is 8 enables and 8 disables). If processing a command resulting in more than 8 Input Tracking functions being enabled, none of the command shall be implemented and response message “V” bit set to 1. If an invalid output or input number is specified for a function, the FIOM software shall not do that function definition. It shall also not be counted toward the maximum of 8 input tracking function allowed. The rest of the message shall be processed. When an Input Tracking function is disabled, the output is set according to the most recently received Set Outputs Command. When an input tracking function for an output is superseded (redefined as either another input tracking function or as a complex output function) nothing shall be done with the output. The most recent value remains until the new function changes it.

9.3.9.10 Configure Complex Output Functions

The Configure Complex Output Functions frame shall be used to specify a complex output for one to eight of any of the outputs. If a Configure Complex Output Function command results in more than eight outputs being configured, the 'V' bit in the response message shall be set to a '1', and the command shall not be implemented. Two output forms shall be provided, single pulse and continuous oscillation. These

output forms shall be configurable to begin immediately or on a specified input trigger and, in the case of continuous oscillation, to continue until otherwise configured or to oscillate only while gated active by a specified input. If the command gate bit is active, the command trigger bit shall be ignored and the specified input shall be used as a gate signal. The command and response frames are as follows:

Configure Complex Output Functions Command

Description	msb								lsb	Byte Number
(Type Number = 57)	0	0	1	1	1	0	0	1	Byte 1	
Number of Items	Number of Items								Byte 2	
Item # - Byte 1	0	Output Number							Byte 7(I-1)+3	
Item # - Byte 2	Primary Duration (MSB)								Byte 7(I-1)+4	
Item # - Byte 3	Primary Duration (LSB)								Byte 7(I-1)+5	
Item # - Byte 4	Secondary Duration (MSB)								Byte 7(I-1)+6	
Item # - Byte 5	Secondary Duration (LSB)								Byte 7(I-1)+7	
Item # - Byte 6	0	Input Number							Byte 7(I-1)+8	
Item # - Byte 7	P	W	G	E	J	F	R	L	Byte 7(I-1)+9	

Configure Complex Output Functions Response

Description	msb								lsb	Byte Number
(Type Number = 185)	1	0	1	1	1	0	0	1		Byte 1
Status	0	0	0	0	0	0	0	V		Byte 2
Timestamp (MSB)	x	x	x	x	x	x	x	x		Byte 3
Timestamp (NMSB)	x	x	x	x	x	x	x	x		Byte 4
Timestamp (NLSB)	x	x	x	x	x	x	x	x		Byte 5
Timestamp (LSB)	x	x	x	x	x	x	x	x		Byte 6

9.3.9.10.1 Bit Field

The bit fields of the command frame are defined as follows:

E	'1'	-	enable complex output function for this output
	'0'	-	disable complex output function for this output
J	'1'	-	During the primary duration, the output shall be written as a logic '1'. During the secondary duration, the output shall be written as a logic '0'.
	'0'	-	During the primary duration, the output shall be written as a logic '0'. During the secondary duration, the output shall be written as a logic '1'.
			Output Number - 7-bit output number identifying outputs
			Primary Duration - For single pulse operation, this shall determine the number of 'ticks' preceding the pulse. For continuous oscillation, this shall determine the length of the inactive (first) portion of the cycle.
			Secondary Duration - For single pulse operation, this shall determine the number of 'ticks' the pulse is active. Subsequent to the secondary duration, the output shall return to the state set according to the most recently received Set Outputs command. For continuous oscillation, this shall determine the length of the active (second) portion of the cycle. 0 = hold output state until otherwise configured.
F	'1'	-	The trigger or gate shall be acquired subsequent to filtering the specified input. The raw input signal shall be used if filtering is not enabled for the specified input.
	'0'	-	The trigger or gate shall be derived from the raw input.
R	'1'	-	For triggered output, the output shall be triggered by an ON-to-OFF transition of the specified input and shall be triggered immediately upon command receipt if the input is OFF. For gated output, the output shall be active while the input is OFF.
	'0'	-	For triggered output, the output shall be triggered by an OFF-to-ON transition of the specified input and shall be triggered immediately upon command receipt if the input is ON. For gated output, the output shall be active while the input is ON.
			Input Number - 7-bit input number identifying inputs 0 Up.
P	'1'	-	The output is configured for single-pulse operation. Once complete, the complex output function shall be disabled.
	'0'	-	The output is configured for continuous oscillation.
W	'1'	-	It is triggered by the specified input. Triggered complex output shall commence within 2 ms of the associated trigger.
	'0'	-	Operation shall begin within 2 ms of the command receipt.
G	'1'	-	Operation shall be gated active by the specified input.
	'0'	-	Gating is inactive.
L	'1'	-	The LINESYNC based clock shall be used for the time ticks.
	'0'	-	The MC shall be used for the time ticks.
V	'1'	-	Indicates maximum number of configurable outputs is exceeded.
	'0'	-	No error
			Number of items - The number of entries in the frame. If 0, all outputs currently configured as complex outputs shall be disabled.

9.3.9.10.2 Controlling Input Signals

Controlling input signals shall be sampled at least once per millisecond.

9.3.9.10.3 Number of Items

The “Number of Items” field is valid from 0 to 16. Zero means disable all Complex Output functions. Sixteen is the maximum because the most that is sent at one time is 8 enables and 8 disables. If processing a command results in more than 8 Complex Output functions being enabled, none of the command shall be implemented and the response message “V” bit shall be set to 1. If an invalid output or input number (the “G” or “W” bits being set to 1 is specified for a function, that function definition is not done by the FIOM software. It shall also not be counted towards the maximum of 8 Complex Output functions allowed. The rest of the message shall be processed. When a Complex Output function is disabled, the output is set according to the most recently received Set Outputs command. When a complex output function for an output is superseded, that is, redefined as wither another Complex Output function, or as an Input Tracking function, nothing special is done with the output. The most recent value remains until the new function changes it. The “G” bit (gating) set to 1 takes precedence over the “W” bit (triggering). If gating is ON, triggering is turned OFF, regardless of the value of the “W” bit in the command message. If a Complex Output is configured with the “G” bit set to 1 (gating) and the “P” bit set to 0 (continuous oscillation), the output is set to OFF (0) whenever the specified input changes state so that the oscillation should cease (output inactive). For a single pulse operation (“G” bit set to 1), after the secondary duration completes the Complex Output function shall be disabled, and the output shall be set according to the most recently received Set Outputs command.

9.3.9.11 Configure Watchdog

The Configure Watchdog frames shall be used to change the software watchdog timeout value. The Command and response frames are as follows:

Configure Watchdog Command

Description	msb								lsb	Byte Number
(Type Number = 58)	0	0	1	1	1	0	1	0		Byte 1
Timeout Value	x	x	x	x	x	x	x	x		Byte 2

Configure Watchdog Response

Description	msb								lsb	Byte Number
(Type Number = 186)	1	0	1	1	1	0	1	0		Byte 1
Status	0	0	0	0	0	0	0	0	Y	Byte 2

9.3.9.11.1 Timeout Value

The timeout value shall be in the range between 10 to 100 ms. If the value is lower than 10, 10 shall be assumed. If the value is greater than 100, 100 shall be assumed.

9.3.9.11.2 Watchdog Timeout Value

On receipt of this frame, the watchdog timeout value shall be changed to the value in the message and the “Y” bit set. The response frame bit (Y) shall indicate a '1' if the watchdog has been previously set and a '0' if not.

9.3.9.12 Controller Identification

This is a legacy message command / response for FI/O modules with Datakey resident. Upon command, a response frame containing the 128 bytes of the Datakey. On NRESET transition to High or immediately prior to any interrogation of the Datakey, the FI/O shall test the presence of the Key. If absent, the FI/O Status Bit “K” shall be set and no interrogation shall take place. If an error occurs during the interrogation, Bit “K” shall be set. If “K” bit set, only the first two bytes shall be returned. The Command Response frames are as follows:

Controller Identification Command

Description	msb								lsb	Byte Number
(Type Number = 59)	0	0	1	1	1	0	1	1	1	Byte 1

Controller Identification Response

Description	msb								lsb	Byte Number
(Type Number = 187)	1	0	1	1	1	0	1	1	1	Byte 1
Status	0	0	0	0	0	0	0	0	K	Byte 2
Datakey	x	x	x	x	x	x	x	x	x	Byte 3 to 130

9.3.9.13 Module Identification

The [Field](#) I/O Identification command frame shall be used to request the FI/O Identification. [A](#) value Response of “1” for [the](#) 2070-2A, “2” for the 2070-8, and “3” for 2070-2N. [Response values 32 to 40 are reserved for the ITS Cabinet \(See Chapter 3\).](#) The command and response frames are shown as follows:

I/O Module Identification Command

Description	msb								lsb	Byte Number
(Type Number = 60)	0	0	1	1	1	1	0	0	0	Byte 1

I/O Module Identification Response

Description	msb								lsb	Byte Number
(Type Number = 188)	1	0	1	1	1	1	0	0	0	Byte 1
FI/O ID byte	x	x	x	x	x	x	x	x	x	Byte 2

CHAPTER 9-SECTION 4

MODEL 2070-3 FRONT PANEL ASSEMBLY (FPA)

9.4.1 Model 2070-3 Front Panel Assembly

The Model 2070-3 Front Panel Assembly shall be delivered with one of the three options as called out under Chapter 9, Section 1 or in the contract's special provisions (governs). All options shall consist of a panel with latch assembly and two TSD #1 hinge attaching devices, assembly PCB, external serial port connectors (DB9 and RJ-45), CPU_ACTIVE LED indicator, and FP Harness Interface. The options shall include the additional features, as follows:

OPTION 3A- FPA controller, two keyboards, AUX switch, alarm bell & Display A.

OPTION 3B - FPA controller, two keyboards, AUX switch, alarm bell & Display B.

OPTION 3C - System Serial Port 6 Lines, isolated and vectored to Connector C60P.

OPTION 3D- FPA controller, two keyboards, AUX switch, alarm bell & Display D

9.4.2 Keyboards

Two Keyboards shall be provided, one with sixteen keys for hexadecimal alphanumeric entry and the other with twelve keys to be used for cursor control and action symbol entry. Each key shall be engraved or embossed with its function character. Each key shall have an actuation force between 1.764 ounce and 3.527 ounce and provide a positive tactile indication of contact closure. Key contacts shall be hermetically sealed, have a design life of over one million operations, shall be rated for the current and voltage levels used, and shall stabilize within 5 ms following contact closure.

9.4.3 CPU_ACTIVE LED Indicator

The cathode of the CPU_ACTIVE LED Indicator shall be electrically connected to the CPU_ACTIVE signal and shall be pulled up to +5 VDC.

9.4.4 Display Liquid Crystal Display (LCD)

The Display shall consist of a Liquid Crystal Display (LCD), a backlight, and a contrast potentiometer control. Display A shall have 4 lines of 40 characters each with minimum character dimensions of 0.197 in. wide by 0.411 in. high and an electro-luminescent (EL) backlight. Display B shall have 8 lines of 40 characters each with minimum dimensions of 0.104 in. wide by 0.167 in. high and either LED or EL backlight. Display D shall have 16 lines of 40 characters each with minimum dimensions of 0.104 in wide by 0.167 in high and either LED or EL backlight.

9.4.4.1 Characters and Angles of Liquid Crystal Display (LCD)

Each character shall be composed of a 5x7 dot matrix with a underline row or a 5x8 dot matrix. The viewing angle of the LCD shall be optimized for direct (90°) viewing, ±35° vertical, ±45° horizontal. The LCD shall have variable contrast with a minimum ratio of 4:1. The LCD shall be capable of displaying, at any position on the Display, any of the standard ASCII characters as well as user-defined characters.

9.4.4.2 Backlight

The backlight shall be turned on and off by the Controller Circuitry. The backlight and associated circuitry shall consume no power when in off state. A potentiometer shall control the LCD contrast with clockwise rotation increasing contrast. The contrast

shall depend on the angular position of the potentiometer, which shall provide the entire contrast range of the LCD.

9.4.4.3 Cursor Display

Cursor display shall be turned ON and OFF by command. When ON, the cursor shall be displayed at the current cursor position. When OFF, no cursor shall be displayed. All other cursor functions (positioning, etc.) shall remain in effect.

9.4.5 FPA Controller

The FPA Controller shall function as the Front Panel Device controller interfacing with the CPU Module.

9.4.5.1 FPA Reset

A FPA Reset Switch shall be provided on the Assembly PCB. The momentary Control switch shall be logic OR'd with the **CPU_Reset** Line, producing a FPA Reset Output. Upon FPA Reset being active or receipt of a valid Soft Reset display command, the following shall occur:

- Auto-repeat, blinking, auto-wrap, and auto-scroll shall be set to OFF.

- Each special character shall be set to ASCII SPC (space).

- The tab stops shall be set to columns 9, 17, 25, and 33.

- The backlight timeout value shall be set to 6 (60 seconds).

- The backlight shall be extinguished.

- The display shall be cleared (all ASCII SPC).

- The cursor display shall be turn OFF**

- The FPA module shall transmit a power up string through /sp6 to the CPU once power is applied to the FPA, or the FPA hardware Reset Button is pushed.

- The string is "ESC [PU", hex value "1B 5B 50 55".

9.4.5.2 Key Press

When a key press is detected, the appropriate key code shall be transmitted to SP6-RxD. If two or more keys are depressed simultaneously, no code shall be sent. If a key is depressed while another key is depressed, no additional code shall be sent.

9.4.5.3 Auto Repeat

Auto-repeat shall be turned ON and OFF by command. When ON, the key code shall be repeated at a rate of 5 times per second starting when the key has been depressed continuously for 0.5 second, and shall terminate when the key is released or another key is pressed.

9.4.5.4 AUX

When the AUX Switch is toggled, the appropriate AUX Switch code shall be transmitted to the CPU.

9.4.5.5 Controller Circuitry

The controller circuitry shall be capable of composing and storing eight special graphical characters on command, and displaying any number of these characters in combination with the standard ASCII characters. Undefined characters shall be ignored. User-composed characters shall be represented in the **communication command codes on Page A9-12**. P1 represents the special character number (1-8). Pn's represent columns of pixels from left to right. The most significant bit of each Pn represents the top pixel in a column and the least significant bit shall represent the bottom pixel. A logic '1' shall turn the pixel ON. There shall be a minimum of 5 Pn's for 5 columns of pixels in a command code sequence terminated by an "f." If the number of Pn's are more than the number of columns available on the LCD, the extra

Pn's shall be ignored. P1 and all Pn's shall be in ASCII coded decimal characters without leading zero.

9.4.5.6 Character Overwrite

Character Overwrite mode shall be the only display mode supported. A displayable character received shall always overwrite the current cursor position on the Display. The cursor shall automatically move right one character position on the Display after each character write operation. When the rightmost character on a line (position 40) has been overwritten, the cursor position shall be determined based on the current settings of the auto-wrap mode.

9.4.5.7 Auto Wrap

Auto-Wrap shall be turned ON & OFF by command. When ON, a new line operation shall be performed after writing to position 40. When OFF, upon reaching position 40, input characters shall continue to overwrite position 40.

9.4.5.8 Cursor Positioning

Cursor positioning shall be non-destructive. Cursor movement shall not affect the current display, other than blinking the cursor momentarily and periodically hiding the character at that cursor position.

9.4.5.9 Blinking Characters

Blinking characters shall be supported, and shall be turned ON and OFF by command. When ON, all subsequently received displayable characters shall blink at the rate of 1 Hz with a 60% ON / 40% OFF duty cycle. It shall be possible to display both blinking and non-blinking characters simultaneously.

9.4.5.10 Tab Stops

Tab stops shall be configurable at all columns. A tab stop shall be set at the current cursor position when a SetTabStop command is received. Tab Stop(s) shall be cleared on receipt of a ClearTabStop command. On receipt of the HT (tab) code, the cursor shall move to the next tab stop to the right of the cursor position. If no tab stop is set to the right of the current cursor position, the cursor shall not move.

Tab stops shall be set based only upon the column (horizontal) position of the cursor; the row position shall be ignored. Each tab that is set shall apply to all rows of the display. In this way, tabs shall operate similarly to a typewriter or line printer. For example, if the cursor is positioned at column 21, row 3 when a Set Tab Stop command (ESC H) is received, a tab stop is placed at column 21 and applies to every row of the display. If the cursor is then positioned to column 21, row 5, and a Clear Tab Stop command (ESC[0g) is received, the tab stop on column 21 is removed and there will be no tab stop on any row of the display at that column position.

9.4.5.11 Auto Scroll

Auto-scroll shall be turned ON and OFF by command. When ON, a Line Feed or new line operation from the bottom line shall result in the display moving up one line. When OFF, a Line Feed or new line from the bottom line shall result in the top line clearing, and the cursor being positioned on the top line.

9.4.5.12 Displayable Characters

Displayable characters shall be refreshed at least 20 times per second.

9.4.5.13 Display Back Light Illuminate

The Display back light shall illuminate when any key is pressed and shall illuminate or extinguish by command. The backlight shall extinguish when no key is pressed for a specified time. This time shall be program selected by command, by a number in the range 0 to 63 corresponding to that number of 10-second intervals. A value of 1 shall correspond to a timeout interval of 10 seconds. A value of 0 shall indicate no timeout.

9.4.5.14 Command Codes

The Command Codes shall use the following conventions:

1. Parameters and Options: Parameters are depicted in both the ASCII and hexadecimal representations as the letter 'P' followed by a lower-case character or number. These are interpreted as follows:
 - Pn: Value parameter, to be replaced by a value, using one ASCII character per digit without leading zeros.
 - P1: Ordered and numbered parameter. One of a listed known parameters with a specified order and number (Continues with P2, P3, etc.)
 - Px: Display column number (1-40), using one ASCII character per digit without leading zero.
 - Py: Display line (1-4) one ASCII character
 - ...: Continue the list in the same fashionValues of 'h' (\$68) and 'l' (\$6C) are used to indicate binary operations. 'h' represents ON (high), 'l' represents OFF (low).
2. ASCII Representation: Individual characters are separated by spaces; these are not to be interpreted as the space character, which is depicted by SPC.
3. Hexadecimal Representation: Characters are shown as their hexadecimal values and will be in the range 00 to 7F (7 bits).

9.4.5.15 Controller Circuit

The Controller Circuit shall communicate via a SP6 asynchronous serial interface. The interface shall be configured for 38.4 Kbps, 8 data bits, 1 stop bit, and no parity.

C50 Enable Function

C50 ENABLE function when grounded by Connector C50 Pins 1 and 5 shall be brought to Connector A1 Pin B21 for the purpose of disabling the module Channel 2.

9.4.6 Front Panel

The Front Panel shall include an electronic bell to signal receipt of ^G (hex 07). The bell shall sound at 2,000 Hz, with a minimum output rating of 85 dB at a distance of 4 feet, for 350±100 ms upon receipt of ^G (hex 07). Receipt of all other characters and ESC codes shall continue during the time the bell sounds.

CHAPTER 9-SECTION 5

MODEL 2070-4 POWER SUPPLY MODULE

9.5.1 Model 2070-4 Power Supply Module

The Model 2070-4 Power Supply Module shall be independent, self contained Module, vented, and cooled by convection only. The Module shall slide into the unit's power supply compartment from the back of the Chassis and be attached to the Backplane Mounting Surface by its four TSD #3 Devices.

9.5.2 On/Off Power Switch

An "On/Off" POWER Switch, four LED DC Power Indicators, PS Receptacle POWER Connectors, and the Incoming AC Fuse protection shall be provided on the Module Front. The LED DC POWER Indicators shall indicate all required DC voltages meet the following conditions: the +5 VDC and 12 VDC are within 5% and of their nominal levels.

9.5.3 Input Protection

Two 0.5-Ohm, 10-watt wire-wound power resistors with a 0.2 μ H inductance shall be provided (one on the AC+ Line & on the AC- Line). Three 20 Joule surge arresters shall be provided between AC+ to AC-, AC+ to EG, and AC- to EG. A 0.68 μ F capacitor shall be placed between AC+ & AC- (between the resistor & arresters).

9.5.4 +5 VDC Standby Power

+5 VDC Standby Power shall be provided to hold up specified circuitry during the power down period. It shall consist of the monitor circuitry; hold up capacitors, and charging circuitry. A charging circuit shall be provided, that under normal operation, shall fully charge and float the capacitors consistent with the manufacturers' recommendations. The Hold Up power requirements shall be a minimum constant drain of 600 μ A at a range of +5 to +2 VDC for over 600 minutes.

9.5.5 Monitor Circuitry

Monitor Circuitry shall be provided to monitor incoming AC Power for Power Failure and Restoration and LINESYNC generation.

9.5.5.1 AC Fail/Power Down Output Lines

The AC Fail/Power Down Output Lines shall go Low (ground true) immediately upon Power Failure. The Lines shall transition to High within 50 ms after both Power Restoration and supply is fully recovered. The Lines shall be driven separately. The Sysreset/Powerup Output Lines shall transition to Low 525 +/-25 ms after AC Fail/Power Down transition to Low. The Lines shall transition to HIGH 225 +/- 25 ms after both Power Restoration and the supply is fully recovered. The Lines shall be driven separately.

9.5.5.2 Monitor Circuitry

The monitor circuitry shall switch the +5 VDC Standby ON immediately upon Power Failure and isolate (OFF) the line at Power Up.

9.5.5.3 60 Hz Square Wave Linesync

The 60 Hz Square Wave Linesync signal shall be generated by a crystal oscillator, which shall synchronize to the 60-Hz VAC incoming power line at 120 and 300 degrees. A continuous square wave signal shall be +5 VDC amplitude, 8.333 ms half-cycle pulse duration, and $50 \pm 1\%$ duty cycle. The output shall have drive sink capability of 16 mA. A 2 K-Ohm pull-up resistor shall be connected between the output and +5 VDC. The monitor circuit shall compensate for missing pulses and line

noise during normal operation.

9.5.5.4 Linesync

The Linesync shall continue until Sysreset transitions Low and begin then Sysreset transitions High.

9.5.6 Power Supply Requirements

Voltage	Minimum Load	Maximum Load	Load Reg.	Line Reg.	Ripple & Noise
+5 VDC	0.0 Amp	10.0 Amp	± 5%	± 1%	50mV P-P
+12 VDC Serial	0.0 Amp	0.5 Amp	± 5%	± 1%	50mV P-P
-12 VDC Serial	0.0 Amp	0.5 Amp	± 5%	± 1%	50mV P-P
+12 VDC	0.0 Amp	1.0 Amp	± 5%	± 1%	50mV P-P

9.5.6.1 Line / Load Regulation

The Power Supply Module shall meet Line/Load Regulation for input voltage range of 90 to 135 VAC, minimum and maximum loads called out in the table including ripple and noise.

9.5.6.2 Efficiency

70 % minimum.

9.5.6.3 Ripple & noise

Less than 0.2% rms, 1% peak to peak or 50 mV, whichever is greater.

9.5.6.4 Voltage Overshoot

No greater than 5 %, all outputs.

9.5.6.5 Over voltage Protection

130% Vout for all outputs.

9.5.6.6 Circuit Protection

Automatic recovery upon removal of fault.

9.5.6.7 Inrush Current

Cold Start Inrush shall be less than 25 Amperes at 115VAC.

9.5.6.8 Transient response

Output voltage back to within 1% in less than 500 μ s on a 50% Load change. Peak transient not to exceed 5%.

9.5.6.9 Holdup Time

The power supply shall supply 30 watts minimum for 550 ms after ACFAIL going LOW. The supply shall be capable of holding up the Unit for two 500 ms Power Loss periods occurring in a 1.5-second period.

9.5.6.10 Remote Sense

+5 VDC compensates 250 mV total line drop. Open sense load protection required.

CHAPTER 9-SECTION 6

UNIT CHASSIS AND MODEL 2070-5

VME CAGE ASSEMBLY

9.6.1 General

The Chassis shall consist of the metal housing, Serial Motherboard, Back-plane Mounting Surface, Power Supply Module Supports, slot card guides, Wiring Harnesses, and Cover Plate(s). All external screws shall be countersunk and shall be Phillips flat head stainless steel type. The housing shall be treated with clear chromate and the slot designation labeled on the back-plane mounting surface above the upper slot card guide. The Chassis shall be cooled by convection only. The top and bottom pieces of the housing shall be slotted for vertical ventilation.

9.6.2 Serial Motherboard

Serial Motherboard shall function as support for its connectors, A1 to A5 and FP, and as the interface between the CPU and the dedicated modules/Front Panel carrying both serial communications, logic, and power circuits. The PCB shall be multi-layered, with one layer plane assigned to DC Ground. A wiring harness PS2 shall be provided between the Model 2070-4 Power Supply and the Motherboard PCB (provide strain relief). Test points shall be provided on the FPA side of the Motherboard for PS2 lines. A wiring harness FP shall be provided, linking the Motherboard with the FPA.

9.6.3 Model 2070-5 VME Cage Assembly

MODEL 2070-5 VME Cage Assembly shall consist of 3U five slot/connector VME Cage, Front Mounting Plate, and PS1 Harness. **The VME Cage shall conform to VME Standard IEEE P1014/D12 and ANSI/VITA 1-1994 for 3U Cage.** All slot/connectors shall be A24: D16 Interface.

9.6.4 Model 2070-1A

The Model 2070 – 1A CPU Main Controller Board shall either be affixed to the Transition Board via at least four stand-off devices or mounted in a one slot VME board assembly (removable). A PS1L Harness shall be supplied with one end mating to the PS1 power supply connector and the other end mated to the MCB DIN Connector. The VME bus lines shall be terminated by a 100-Ohm resistor per line.

CHAPTER 9-SECTION 7

MODEL 2070 UNIT DETAILS

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CHAPTER 10
MODEL 2070 PERIPHERAL
EQUIPMENT SPECIFICATIONS

CHAPTER 10-SECTION 1

MODEL 2070-6 A & B, AE & BE ASYNC/MODEM SERIAL COMMUNICATION MODULES

10.1.1 Fuse Isolation

A fused isolated +5 VDC with a of 100 mA power supply shall be provided for external use.

Option – BOURNS MF – MSMD020 PTC (Positive Temperature Coefficient) Resettable Fuse allowed.

10.1.2 Half & Full Duplex Switch

A switch shall be used to vertically switch between Half-Duplex (Down) and Full-Duplex (Up). In Half-Duplex mode, the Transmit connections shall be used for both Receive and Transmit.

10.1.3 Circuits

Two independent circuits designated Circuits #1 and Circuits #2, shall be provided. Both circuit functions shall be identical, except for their Serial Communications Port and external connector (Circuits #1 to SP1 [or SP3] and C2S Connector and Circuits #2 to SP2 [or SP4] and C20S Connector). Circuits #1 & #2 shall optically isolate the FSK, C2 and C20 Serial Ports from the Motherboard SP EIA-495 signals. Each circuit shall provide full isolation from each other and the Model 2070 Motherboard. Line drivers/receivers shall be socket or surface mounted.

The 2070-6x module's isolation circuitry shall be capable of reliably passing a minimum of 1.0 Mbps. The EIA-485 drivers to the external connectors must be capable of supporting either two times the maximum applicable baud rate for the port or 1Mbps, which ever is less. The EIA-232 drivers to the external connectors must be capable of supporting a minimum of 115,200 bits per second.

10.1.4 Modem

Each circuit shall have a common power independent Modem with the following requirements:

Modulation: Phase coherent frequency shift keying (FSK).

Data Format: Asynchronous, serial by bit.

Line & Signal Requirements: Type 3002 voice-grade, unconditioned Tone Carrier Frequencies (Transmit and Receive), MARK and SPACE: $\pm 1\%$ tolerance. The operating band shall be (half power, -3 dB) between 1.0 KHz & 2.4 KHz for 2070-6A and 9.9 KHz & 18.9 KHz for 2070-6B.

Transmitting Output Signal Level: 0, -2, -4, -6, and -8 dB (at 1.7 KHz for 2070-6A, 3.4 KHz for 2070-6AE, 14.7 KHz for 2070-6B and 28.8 KHz for 2070-6BE) continuous or switch selectable.

Receiver Input Sensitivity: 0 to -40 dB.

Receiver Bandpass Filter: Shall meet the error rate requirement specified below and shall provide 20dB/octave, minimum active attenuation for all frequencies outside the operating band.

Clear-to-Send (CTS) Delay: 11 $\pm$ 3 ms.

Receive Line Signal Detect Time: 8 $\pm$ 2 ms mark frequency.

Receive Line Squelch: 6.5 ($\pm$ 1) ms, 0 ms (OUT).

Soft Carrier Turn Off Time: 10 $\pm$ 2 ms. When the RTS is unasserted; the carrier shall turn off or go to soft carrier frequency.

Modem Recovery Timer: Capable of receiving data within 22 ms after completion of transmission.

Error Rate: Shall not exceed 1 bit in 100 Kbits, with a signal-to-noise ratio of 16 dB measured with flat-weight over a 300 to 3,000 Hz band.

Transmit Noise: Less than -50 dB across 600-Ohms resistive load within the frequency spectrum of 300 to 3,000 Hz at maximum output.

Modem interface: EIA-232 Standards.

Frequencies and Data Rates:

Model	Mark Hz	Space Hz	Soft Carrier Hz	Data Rate bps
2070-6A	1200	2200	900	300 - 1200
2070-6AE	2400	4400	1800	300 - 2400
2070-6B	11200	17600	7800	300 - 9600
2070-6BE	19200	38400	13800	300 - 19200

10.1.5 Enable/Disable Feature

The 2070-6x modules shall provide circuitry to disable their Channel 2 and EIA 232 control lines when a ground-true state is presented at Connector A1 Pin B21 (C50 Enable). C50 Enable shall disable Channel 2 via disabling the RS-485 signals to and from the motherboard. The Disable line shall be pulled up on these modules.

10.1.6 Hot Swappable

The 2070-6x module shall be “Hot” swappable without damage to its circuitry or operations. A communication “glitch” occurring during insertion/removal is acceptable since the application program should be able to recover/retry. Power-on and hot-swap current surges shall not exceed a 10 ms surge at three times (3x) the maximum rating of each voltage supply used by the module.

CHAPTER 10-SECTION 2

MODEL 2070-7A & 7B ASYNC / SYNC SERIAL COMM MODULE

10.2.1 Circuits

Two opto-isolated independent circuits designated circuits #1 (Channel 1) and circuits #2 (Channel 2), shall be provided. Their functions are identical, except for the CPU Serial Communications Port and external connector (circuits #1 to SP1 [or SP3] and Connector C21S and circuits #2 to SP2 [or SP4] and Connector C22S). Line drivers/receivers shall be socket or surface mounted.

The 2070-7x module's isolation circuitry shall be capable of reliably passing a minimum of 1.0 Mbps. The EIA-485 drivers to the external connectors must be capable of supporting either two times the maximum applicable baud rate for the port or 1Mbps, which ever is less. The EIA-232 drivers to the external connectors must be capable of supporting a minimum of 115,200 bits per second.

10.2.2 2070 -7A

Each circuit shall convert its EIA-485 signal lines (RX, TX, RTS, CTS and DCD) to/from board TTL Level Signals; isolate both signal and ground; and drive / receive external EIA-232 devices via C21 / C22 Connectors. Connectors shall be DB-9S type.

10.2.3 2070 - 7B

Each circuit EIA -485 signal lines, (RX, TX, TXC (I), TXC (O) and RXC) and associated signal ground shall be board terminated to matching drivers/receivers; isolated both signal and ground, and drive/receiver external EIA-485 devices via C21/C22 Connectors. Connectors shall be DB-15S type.

10.2.4 LED Indicator

Each circuit signal TX and RX line shall have an LED Indicator mounted on the front plate and labeled according to function.

10.2.5 Enable/Disable Features

The 2070-7x modules shall provide circuitry to disable their Channel 2 and EIA 232 control lines when a ground-true state is presented at Connector A1 Pin B21 (C50 Enable). C50 Enable shall disable Channel 2 via disabling the RS-485 signals to and from the motherboard. The Disable line shall be pulled up on these modules.

The 2070-7x modules shall provide circuitry to manually disable Channel 1. When Channel 1 is manually disable, the "Ch. A Disable" LED indicator shall be turn ON.

10.2.6 Hot Swappable

The 2070-7x module shall be “Hot” swappable without damage to its circuitry or operations. A communication “glitch” occurring during insertion/removal is acceptable since the application program should be able to recover/retry. Power-on and hot-swap current surges shall not exceed a 10 ms surge at three times (3x) the maximum rating of each voltage supply used by the module.

CHAPTER 10-SECTION 3

MODEL 2070-6D FIBER OPTIC MODULE

10.3.1 Model 2070-6D Fiber Optics Module

The Model 2070-6D Fiber Optics Module shall provide an RS232/485 Asynchronous communications channel. The FO Module shall be a Plug-in Card style version for the 2070 Controller. The Model 2070-6D Fiber Optics Module (FO Module) shall operate over Singlemode Fiber.

10.3.2 Mechanical/Electrical Requirements.

The Plug-in Card FO Module shall have a protective cover or enclosure.

The FO Modules card edge connector shall be fully compatible with the 2070 Controller's Modem card slot.

The Auxiliary Data port shall be a RJ45 connector.

The Serial Port shall be a RJ45 connector.

All DIP Switches shall be accessed externally without disassembly of the FO Module.

The FO Module shall be powered direct from the 2070 Controller's edge connector.

All electro/optical communications circuitry shall be implemented using digital electronics utilizing packetizing techniques, no analog circuitry or adjustable potentiometers is allowed.

10.3.3 FO Module Requirements

All Electro Optics shall be physically protected from external damage and contamination by isolating them from the FO Modules Optical Ports by means of internal replaceable mini patch-cords that connect between the Electro Optics and the Optical Bulkhead Adapters (FO Modules Optical Ports).

The FO Modules Optical Ports (Bulkhead Adapters) shall be metal and shall be ST style and interchangeable with SC and FC style connectors when required.

The Plug-in optical FO Module shall provide Optical Continuity between other FO Modules on either side should external power fail.

10.3.3.1 Network Topologies

The FO Module shall be capable of operating on Single Mode Fiber in all of the following Switch Selectable Topologies:

Self-Healing Fault Tolerant Dual Counter Rotating Rings.

Defined as 2 Fiber Rings (closed loop cable ring), one fiber transmitting data clockwise, the other fiber anti-clockwise. Every FO Module will have 4 fibers

attached to it, the incoming cable utilizes R1/T2 fiber pair and the outgoing cable utilizes T1/R2 fiber pair. Should an optical communications failure occur, such as a single or dual fiber cut or FO Module failure, the system will automatically fold back on both sides of the failure point to form a new ring and restore communications. The system shall automatically restore when there is no longer a failure point.

Single Ring.

Defined as a Single Fiber Ring (closed loop), only one fiber transmitting data clockwise. Every FO Module will have 2 fibers attached to it R1 & T1, the incoming cable utilizes R1 fiber and the outgoing cable utilizes the T1 fiber. Each fiber starts as transmit and ends as receive.

Daisy Chain.

Defined as an “open ended chain of FO Modules”. The designated Master, Auxiliary Master and Slave FO Modules may be placed anywhere in the Daisy Chain, i.e., at the beginning, at the end or anywhere in between.

The FO Module shall be immune to optical overloads thus requiring no optical attenuators.

The FO Modules optical output level shall be non-adjustable.

10.3.3.2 Modes of Operation

The FO Module shall support the following modes of operation:

Master

When the optical FO Module is set as a Master, the FO Module supervises the Slave FO Modules and provides an asynchronous, bi-directional communications channel between the Master and the Slave FO Modules.

Auxiliary Master, Co- or Remote Located Master (Disaster Recovery)

When set as an Auxiliary Master, the optical FO Module will monitor optical data transmissions from the Master, should the Master fail, the Auxiliary Master will automatically take over as a temporary Master. Control of the ring will be automatically transferred back to any optical FO Module that is designated as a Master.

Slave

When the optical FO Module is set as a Slave, the FO Module will provide repeater, drop and insert capabilities between the data ports and the optical transport layer.

Display

All FO Modules shall have a Dual Seven Segment Display that graphically indicates the switching status of the transport layer of the fiber system. Switch status information shall graphically show:

Normal Operation
Dual Ring Operation
Single Ring Operation
Daisy Chain Operation
All Optical Routing Conditions
Separate LOS Alarm indication for R1 or R2

10.3.3.3 Fiber Identification

The FO Module shall be capable of Fiber Identification by means of indicating numeral 1 or 2 on the Dual Seven Segment Display to identify which circuit the fiber belongs to.

10.3.3.4 Auxiliary Data Port

The FO Module shall have an Auxiliary Data Port with the following capabilities:

The Auxiliary Data Port shall be capable of being switched to operate as a **DCE** in parallel with the Card Edge Port; communications shall originate to and from the fiber.

The Auxiliary Data Port shall be capable of being switched to operate as a **DTE**. This permits any host attached to the card edge port to appear at the Auxiliary port as a DTE with full handshaking; communications shall originate from the card edge port to and from the auxiliary port and the fiber.

The Auxiliary Ports Carrier Detect (CD) shall be capable of being switched to operate in the following modes:

The Auxiliary Data Port is designed to emulate FSK FO Module handshaking

The Card Edge (EIA-485), Auxiliary Data Port (EIA-232) and the Serial Ports front panel connector (EIA-232) shall operate Asynchronous communications and shall encompass all ITS standard rates of 1200, 2400, 9600, 19.2Kbp/s, 38.4Kbt/s, 56Kbt/s and 115.2Kbp/s.

The RTS/CTS handshaking function shall be switch selectable:

Off position allows the FO Module to stream **transmit** data without RTS handshaking. On position requires RTS to be asserted to enable data transmission.

The Card edge and Auxiliary Data Ports shall have a switch selectable RTS to CTS Delay of 0ms and 8ms.

10.3.3.5 Anti-Streaming

The FO Module shall include a switch selectable Anti-Streaming (anti-babbling) logic control over electrical to optical signal transmission with a time out changeable by the user, the time-outs shall be switch selectable from 2, 4, 8, 16, 32 & 64 seconds, all times are additive to a max of 126 seconds.

The Anti-Streaming logic shall detect the presence of an RTS signal from the attached device. Should the transmission time from the attached device exceed the selected time, the Anti-Streaming logic will cause the CTS control line to go low, this signals the attached device to stop the transmitting data. At the same time the transmission path from the data port to the optical ring will be disconnected. The circuit will automatically reset should RTS go low and data stops babbling.

When the Anti-Streaming logic has automatically disabled the port it shall then turn on the Anti-Streaming Alarm (LED), this alarm is latched ON until manually reset.

10.3.4 Electro Optical Requirements

The FO Module Optical Transmitting Device shall use a 1310nm Singlemode Laser.

Optical Budget

The FO Module shall support a minimum of 20dB Optical budget with a maximum of 1×10^{-9} Bit Error Rate (BER).

M.T.B.F.

Shall be in excess of 100, 000 Hrs.

Optical Ports

Optical Ports shall be Metal Bulkheads, ST style, optional SC or FC.

Data Interfaces

Card Edge	EIA-485
Front Panel Serial Port	EIA-232 (RJ45 EIA 561 Pin Out)
Auxiliary Data Port	EIA-232 (RJ45 EIA 561 Pin Out)

Switch Selections are as follows:

Battery	ON or OFF
Master or Slave	Selection
Auxiliary Master	ON or OFF
Ring Topologies	Single Ring
	Dual Counter Rotating Ring (Self Healing)
	Daisy Chain

RS232 or RS422	Selection
Baud Rates	1200, 2400, 9600, 38400, 5760, 115200 bps
Parity Selections	None, Odd, Even
RTS/CTS Handshaking	ON or OFF
RTS to CTS Delay Timing	0 or 8ms
Anti Streaming	ON or OFF
Anti-Streaming Delay Times	2, 4, 8, 16, 32 & 64 seconds or any addition.
Auxiliary Port	DCE or DTE Selection

Indicators shall be Super Bright LED

TX DATA	Green	Transmit EIA-232/485 Data
RX DATA	Green	Transmit EIA-232/485 Data
ANTI- STRM	Red	Anti- Streaming
RING STATUS DISPLAY	Red	Dual Seven Segment Display
PWR Fail	Red	Dual Seven Segment Display

10.3.5 Form Factor

See A10-3 for Details

10.3.6 Power Requirements

The power requirements of the FO Module be within the power limitations of the Model 2070 UNIT as describe elsewhere in this specifications.

10.3.7 Environmental

The FO Module shall operate within the specifications listed in Chapter 1 Section 1.8.4.

CHAPTER 10-SECTION 4

MODEL 2070-FX NETWORK COMMUNICATIONS MODULE

10.4.1 Model 2070-Fx Network Module

The Model 2070-Fx Module shall provide 5 ports for Network Communications to and from the Model 2070 Controller.

An integrated 5-Port Store-and-Forward Network Switch shall be used as the core for the Model 2070-Fx Module. A network port shall be used to route Ethernet Traffic across the Motherboard to the “A” Connector’s Network Lines. DC Grounding around the network connectors and lines shall be provided. The Network Lines shall be assigned as: NetP5 TX+, TX-, RX+ and RX- respectively. Two network ports shall be brought to RJ-45 Connectors on the Front Panel and two network ports shall routed to 100Base-FX modules.

The 10/100Base-FX Module outputs shall be optically linked through short patch cords (Mini Patch Cords) to ST connectors on the Front Panel. The 10/100Base-FX modules shall operate over Single Mode Fiber.

The Model 2070-Fx Module shall be a Plug-in Card style version for the 2070 Controller.

10.4.2 Mechanical/Electrical Requirements.

The Model 2070-Fx Modules card edge connector shall be fully compatible with the 2070 Controller’s Motherboard Ax Card Slots.

The Model 2070-Fx Module shall be powered direct from the 2070 Controller’s edge connector.

10.4.3 Model 2070-Fx Module Requirements

The 10/100Base-FX modules of the Model 2070-Fx Module shall be connected by means of internal replaceable Mini Patch-Cords that connects between the 10/100Base-FX modules and the Optical Bulkhead Adapters (Model 2070-Fx Module Ports).

Model 2070-Fx Modules Optical Ports (Bulkhead Adapters) shall be metal and shall be ST style and interchangeable with SC and FC style connectors when required.

10.4.4 Network Standards

The Model 2070-Fx Module shall meet the IEEE802.3 10Base-T, IEEE 802.3u, IEEE 802.3x, 100Base-TX, and 100Base-FX Standards.

The Model 2070-Fx Module shall have 10/100Base-TX auto-negotiation on all RJ-45 ports and Auto-negotiation 10/100Mbps connection speed and Half/Full-Duplex mode on all 10/100Base-TX ports.

The Model 2070-Fx Module shall have MDIX for all 10/100Base-TX ports.

10.4.5 Modes of Operation

The Model 2070-Fx Module shall have Half/Full-Duplex mode selection on the fiber ports.

10.4.6 Network Media Support

The Model 2070-Fx Module shall be configured as a Multiple Channel Media Converter to route network traffic between the Model 2070 CPU, Two RJ-45 Front Panel Connectors and the two 10/100Base-FX Front Panel Ports.

The Model 2070-Fx Module shall support the following Media:

100Base-FX: Single-Mode fiber optic cable 9/125 μm .

100Base-TX: Cat. 5, EIA/TIA-568 100-Ohm UTP cable.

10.4.7 Electro Optical Requirements

The 10/100Base-FX Modules shall use a 1300nm Single Mode Lasers.

M.T.B.F.

Shall be in excess of 100,000 Hrs.

Optical Ports

Optical Ports shall be Metal Bulkheads, ST style, optional SC or FC.

10.4.8 Form Factor

See A10-4 for Details

10.4.9 Power Requirements

The power requirements of the 2070-Fx Module be within the power limitations of the Model 2070 UNIT as describe elsewhere in this specifications.

10.4.10 Environmental

The 2070-Fx Module shall operate within the specifications listed in Chapter 1 Section 1.8.4.

CHAPTER 10-SECTION 5

MODEL 2070-6W WIRELESS MODEM COMM MODULE

10.5.1 Model 2070-6W Wireless Modem

The Model 2070-6W Wireless Modem shall provide two EIA-485/ EIA-232 Asynchronous communications channels. The Model 2070-6W Wireless Modem shall be a 2070 plug-in module with EIA-232 activity LEDs on the front edge. The Model 2070-6W Wireless Modem shall convert EIA-485 data to frequency hopping spread spectrum data.

10.5.2 Circuits

Two circuits, designated Circuits #1 and Circuits #2, shall be provided. Both circuits functions shall be identical, except for Circuit #1 which shall be routed to a Spread Spectrum Radio and Circuit #2 shall routed directly to the front panel's DB-9 connector. Each circuit shall provide full isolation from the Model 2070 Motherboard. Line drivers/receivers shall be socket or surface mounted.

The Model 2070-6W Wireless Modem's isolation circuitry shall be capable of reliably passing a minimum of 1.0 Mbps. The EIA-485 drivers to the external connectors must be capable of supporting either two times the maximum applicable baud rate for the port or 1Mbps, which ever is less. The EIA-232 drivers to the external connectors must be capable of supporting a minimum of 115,200 bits per second.

Each circuit shall convert its EIA-485 signal lines (RX, TX, RTS, CTS and DCD) to/from board TTL Level Signals; isolate both signal and ground.

10.5.3 Mechanical/Electrical Requirements

The Model 2070-6W Wireless Modem shall be designed to fit in a single slot of a Model 2070 Controller.

The Model 2070-6W Wireless Modem shall be provided with LED indicators for as shown in details A10-5 of these specifications.

The User Serial port shall be a DB9 Female connector accessible from the front and shall be used to configure the Spread Spectrum Radio and as Serial Port Com2..

The Model 2070-6W Wireless Modem shall be powered direct from the 2070 Controller's edge connector.

The Model 2070-6W Wireless Modem shall have a MTBF of over 60,000 hours.

10.5.4 Functional Requirements.

The Card Edge (EIA-485) and the Serial Ports front panel connector (EIA-232) shall operate Asynchronous communications and shall encompass all ITS standard rates of 1200 bps, 2400 bps, 9600 bps, 19.2 Kbps, 38.4 Kbps, 56 Kbps and 115.2 Kbps.

10.5.5 Local Mode

The Model 2070-6W Wireless Modem shall be provided with a switch allowing the user to switch Com 2 into local mode. Local mode shall allow the user to perform modem configuration on the Spread Spectrum Radio. On non-local mode, Com 2 shall meet the requirements as specified for the Model 2070-7A Module as specified elsewhere in these specifications.

10.5.6 Spread Spectrum Radio

The Model 2070-6W Wireless Modem shall meet the following Spread Spectrum Radio requirements:

Frequency Range	902-928 MHz
Output Power	1mW, 10mW,100mW,1000mW
Software Programmable	Yes
Min Hop Patterns	62
Number of RF Channels	139
RF Channel Spacing	200kHs
Error Checking	16Bit-CRC
Encryption	32 Bit
Receiver Sensitivity/BER	-110dBm @ 10-6 BER
System Gain	152 dBm
Antenna Port	RP TNC-F
Certification	FCC Approved
Operation Mode	Transceiver
Error Correction	Forward Error Correction
System Configuration	Point-to-Point, Point-to-Multipoint

10.5.7 Data Interfaces

Channel 1 and 2 Model 2070 Card Edge Connector

User Serial Port EIA-232 (DB9 Female)

10.5.8 LED Indicators

TXD Green or Red: DTE Transmit EIA-232 Data

RXD Green or Red: DTE Receive EIA-232 Data

Multiple Mini-LEDs indicating Field Strength.

10.5.9 Power Requirements

The power requirements of the Model 2070-6W Wireless Modem shall be within the power limitations of the Model 2070 UNIT as describe elsewhere in this specifications.

10.5.10 Environmental

The Model 2070-6W Wireless Modem shall operate within the specifications listed in Chapter 1 Section 1.8.4.

10.5.11 Form Factor

See A10-5 Details

CHAPTER 10-SECTION 6

MODEL 2070-9A, B & E FSK/DIAL-UP MODEM COMM MODULES

10.6.1 2070-9A, B & E Modem

The Model 2070-9x Modem shall consist of a Dial-Up and an FSK Modem. The 9x Modem Module shall be a Plug-in Card style version for the 2070 Controller.

10.6.2 Dial-Up Modem

The Dial-Up Modem shall consist of a 33.6Kbps dial-up modem meeting the V.34 AT Command set standard. The Modem shall contain two RJ-11 connectors, one designated as the Line and the second as Phone. An internal speaker shall be provided as an indicator for phone call progress. The speaker shall be controlled through AT standard commands. Front Panel LED indicators shall also be provided as shown in the A10-6 of these specifications.

10.6.2.1 Modem default configuration

The Dial-Up Modem shall contain the following default configurations:

ACTIVE PROFILE:

B1 E1 L1 M1 N0 Q0 T V1 W0 X4 Y0 &C1 &D0 &G0 &J0 &K0 &Q5 &R1 &S0
&T5 &X0 &Y0

S00:001	S11:095
S01:000	S12:050
S02:043	S18:000
S03:013	S25:005
S04:010	S26:001
S05:008	S36:007
S06:002	S38:020
S07:050	S46:007
S08:002	S48:007
S09:006	S95:000
S10:014	

STORED PROFILE 0:

B1 E1 L1 M1 N0 Q0 T V1 W0 X4 Y0 &C1 &D0 &G0 &J0 &K0 &Q5 &R1 &S0
&T5 &X0

S00:001	S12:050
S02:043	S18:000
S06:002	S36:007
S07:050	S40:104

S08:002	S41:195
S09:006	S46:138
S10:014	S95:000
S11:095	

Profile 0 should be configured as shown above and default as the active profile on wake up. Factory default shall wake up at 2400 Baud, Parity 8, N, 1 and no handshaking.

The Modem shall have a switch (S1) and shall be factory configured as follows:

	S1 DESCRIPTION	OPEN	CLOSE
1	Modem Select	Smart Modem	Dumb
2	“SMART Modem DB-9 Aux” Sel	DTE	DCE
3	RTS Override	Normal	RTS High
4	“Modem /DB9 DTE Serial” Sel	Modem	DB9-DTE

All switches shall be OPEN as factory default except for position #2, which shall be closed as default. User shall be able to disable the SMART Modem Mode and set user baud rate, handshaking, and parity. In SMART Mode the user shall have the ability to set the baud rate, handshaking and parity.

10.6.2.2 Modulation

The Dial-Up Modem shall use Quadrature Amplitude Modulation and Operate within the following frequencies:

Data Carrier 1800 ± 0.5 Hz
Calling Tone 1300 ± 10 Hz
Answering Tone 2100 ± 15 Hz

The Modem shall have Receiver Frequency Tolerance of ± 14 Hz

10.6.2.3 Modem Standards

The Dial-Up Modem shall be ITU V.90, V.34 and Rockwell V.FC compatible. It shall meet the standards:

V.90, V.34, V.32 bis, V.32, V.22 bis, V.22A/B, V.23, V.21, Bell 212, Bell 103, V.33, V.17, V.29, V.27 ter, and V.21 Channel 2.

10.6.2.4 Data Rates

The Dial-Up Modem shall support the following data rates:

33.6Kbps, 31.3Kbps, 28.8Kbps, 26.4Kbps, 24.0Kbps, 21.6Kbps, 19.2Kbps, 16.8Kbps, 14.4Kbps, 12.0Kbps, 9.6Kbps, 7.2Kbps, 4.8Kbps, 2.4Kbps, 1.2Kbps, and 300 baud.

The Modem shall automatically select the best operating speed as indicated in Section 10.6.2.1 of these specifications.

10.6.2.5 Error Correction & Data Compression

The Modem shall use V.42 LAPM, MNP2-4 and MNP 10 for error correction and V.42 Bis, MNP 5 for Data Compression.

10.6.2.6 Tx/Rx Power Level

The transmit level shall be fixed at -11 ± 2 dB and the receiver shall have a S/N Ratio of -26 dB with a Dynamic Range of 12 dBm to -42 dBm.

The Ring detect Sensitivity shall be 38 VRMS.

10.6.2.7 Line Interface

The Dial-Up Modem shall have a Ring Equivalent of 1 Bel and a terminating Impedance of 600 Ohms. It shall have return loss of better than 14 dB.

10.6.3 FSK Modem

10.6.3.1 Fused Isolated +5 VDC

A fused isolated +5 VDC with a of 100 mA power supply shall be provided for external use.

Option – BOURNS MF – MSMD020 PTC (Positive Temperature Coefficient) Resettable Fuse allowed.

10.6.3.2 Half & Full Duplex Switch

A switch on for FSK modem shall be used to vertically switch between Half-Duplex (Down) and Full-Duplex (Up). In Half-Duplex mode, the Transmit connections shall be used for both Receive and Transmit.

10.6.3.3 Modem

The FSK modem circuit shall have meet the requirements as listed in Section 10.1.4 for the corresponding match (6A, 6B and 6BE).

10.6.3.4 Enable/Disable Feature

The FSK modem shall provide circuitry to disable Channel 2 and EIA 232 control lines when a ground-true state is presented at Connector A1 Pin B21 (C50 Enable). C50 Enable shall disable Channel 2 via disabling the RS-485 signals to and from the motherboard. The Disable line shall be pulled up on these modules.

10.6.4 Circuits

Two independent circuits designated Circuits #1 and Circuits #2, shall be provided. Both circuit functions shall be identical, except for their Serial Communications Port and external connector (Circuits #1 to SP1 [or SP3] and C2S Connector and Circuits #2 to SP2 [or SP4] and C20S Connector). Circuits #1 & #2 shall optically isolate the FSK, C2 and C20 Serial Ports from the Motherboard SP EIA-495 signals. Each circuit shall provide full isolation from each other and the Model 2070 Motherboard. Line drivers/receivers shall be socket or surface mounted.

The 2070-9x module's isolation circuitry shall be capable of reliably passing a minimum of 1.0 Mbps. The EIA-485 drivers to the external connectors must be capable of supporting either two times the maximum applicable baud rate for the port or 1Mbps, which ever is less. The EIA-232 drivers to the external connectors must be capable of supporting a minimum of 115,200 bits per second.

10.6.5 Hot Swappable

The 2070-9x module shall be "Hot" swappable without damage to its circuitry or operations. A communication "glitch" occurring during insertion/removal is acceptable since the application program should be able to recover/retry. Power-on and hot-swap current surges shall not exceed a 10 ms surge at three times (3x) the maximum rating of each voltage supply used by the module.

10.6.6 Power Requirements

The power requirements of the Model 2070-9x Modem shall be within the power limitations of the Model 2070 UNIT as describe elsewhere in this specifications.

10.6.7 Environmental

The Model 2070-9x Modem shall operate within the specifications listed in Chapter 1 Section 1.8.4.

10.6.8 Form Factor
See A10-6 for Details

CHAPTER 10-SECTION 7

MODEL 2070-6E SERIAL 2 NETWORK COMM MODULE

10.7.1 Model 2070-6E Serial 2 Network Module

The Model 2070-6E Serial 2 Network (S2NET) Module shall provide two EIA-485/EIA-232 Asynchronous communications channels. The Model 2070-6E S2NET Module shall be a 2070 plug-in module with EIA-232 activity LEDs on the front edge. The Model 2070-6E S2NET Module shall communicate over standard IEEE 802.3 networks using both TCP (point-to-point) and UDP (point-to-multipoint) protocols.

10.7.2 Circuits

Two circuits, designated Circuits #1 and Circuits #2, shall be provided. Both circuits functions shall be identical, except for Circuit #1 which shall be routed to the terminal server and Circuit #2 shall routed directly to the front panel's DB-9 connector. Each circuit shall provide full isolation from the Model 2070 Motherboard. Line drivers/receivers shall be socket or surface mounted.

The Model 2070-6E S2NET Module's isolation circuitry shall be capable of reliably passing a minimum of 1.0 Mbps. The EIA-485 drivers to the external connectors must be capable of supporting either two times the maximum applicable baud rate for the port or 1Mbps, which ever is less. The EIA-232 drivers to the external connectors must be capable of supporting a minimum of 115,200 bits per second.

Each circuit shall convert its EIA-485 signal lines (RX, TX, RTS, CTS and DCD) to/from board TTL Level Signals; isolate both signal and ground.

10.7.3 Mechanical/Electrical Requirements

The Model 2070-6E S2NET Module shall be designed to fit in a single slot of a Model 2070 Controller.

The Model 2070-6E S2NET Module shall be provided with LED indicators for 10/100 and Half/Full Duplex Network Communications.

The User Serial port shall be a DB9 Female connector accessible from the front.

The Network port shall be a RJ45 modular jack connector accessible from the front. DIP switches shall be externally accessible.

The Model 2070-6E S2NET Module shall be powered direct from the 2070 Controller's edge connector.

10.7.4 Functional Requirements.

The Card Edge (EIA-485) and the Serial Ports front panel connector (EIA-232) shall operate Asynchronous communications and shall encompass all ITS standard rates of 1200 bps, 2400 bps, 9600 bps, 19.2 Kbps, 38.4 Kbps, 56 Kbps and 115.2 Kbps.

The Model 2070-6E S2NET Module Network Interface shall meet IEEE 802.3 and ANSI 8802-3 Standards and support 10/100 Mbps.

10.7.5 Echo Mode

The Model 2070-6E S2NET Module shall provided with a switch allowing the user to switch module into Echo Mode. In Echo Mode communications from the external network shall be routed serially to the DB-9 on the front panel. An LED indicator shall be provided to indicate the Echo Mode communications.

10.7.6 Network Configuration

The Model 2070-6E S2NET Module shall support the following features:

Provide TCP and UDP over IP protocol communications.

Subnet masks for Class A, B, and C networks (see table below):

NETWORK CLASS	HOST BITS	Subnet Mask	Example IP Address
A	24	255.0.0.0	10.0.0.100
B	16	255.255.0.0	172.31.0.100
C	8	255.255.255.0	192.168.0.100

Allow Manual or Automatic TCP/IP socket connections configuration.

Provide Telnet access for both configuration and communications.

Provide Dumb Terminal access using a User Serial port for configuring network parameters.

Provide the Ability to adjust packet size and packing algorithm.

The Model 2070-6E S2NET Module shall be provided with a Web-Based-Interface (WBI). The WBI shall allow the user to set Network Configuration Parameters and Serial Settings using a Web Browser.

10.7.7 Data Interfaces

Channel 1 and 2 Model 2070 Card Edge Connector

User Serial Port EIA-232 (DB9 Female)

Ethernet Data Port RJ45 EIA 568B Pin Out

10.7.8 LED Indicators

RTS Green or Red: DTE Request to Send

CTS Green or Red: Network Clear to Send

TXD Green or Red: DTE Transmit EIA-232 Data

RXD Green or Red: DTE Receive EIA-232 Data

DCD Green or Red: Network Data

10.7.9 Power Requirements

The power requirements of the Model 2070-6E S2NET Module be within the power limitations of the Model 2070 UNIT as describe elsewhere in this specifications.

10.7.10 Environmental

The Model 2070-6E S2NET Module shall operate within the specifications listed in Chapter 1 Section 1.8.4.

10.7.11 Form Factor

See A10-7 for Details

CHAPTER 10-SECTION 8

MODEL 2070-9D DIAL-UP MODEM COMM MODULE

10.8.1 2070-9D Modem

The Model 2070-9D Modem shall consist of a Dial-Up Modem and shall be a Plug-in Card style version for the 2070 Controller.

10.8.2 Dial-Up Modem

The Dial-Up Modem shall consist of a 33.6Kbps dial-up modem meeting the V.34 AT Command set standard. The Modem shall contain two RJ-11 connectors, one designated as the Line and the second as Phone. An internal speaker shall be provided as an indicator for phone call progress. The speaker shall be controlled through AT standard commands. Front Panel LED indicators shall also be provided as shown in the A10-8 of these specifications.

10.8.2.1 Modem default configuration

The Modem shall contain the following default configurations:

ACTIVE PROFILE:

B1 E1 L1 M1 N0 Q0 T V1 W0 X4 Y0 &C1 &D0 &G0 &J0 &K0 &Q5 &R1 &S0 &T5
&X0 &Y0

S00:001	S11:095
S01:000	S12:050
S02:043	S18:000
S03:013	S25:005
S04:010	S26:001
S05:008	S36:007
S06:002	S38:020
S07:050	S46:007
S08:002	S48:007
S09:006	S95:000
S10:014	

STORED PROFILE 0:

B1 E1 L1 M1 N0 Q0 T V1 W0 X4 Y0 &C1 &D0 &G0 &J0 &K0 &Q5 &R1 &S0 &T5
&X0

S00:001	S12:050
S02:043	S18:000

S06:002	S36:007
S07:050	S40:104
S08:002	S41:195
S09:006	S46:138
S10:014	S95:000
S11:095	

Profile 0 should be configured as shown above and default as the active profile on wake up. Factory default shall wake up at 2400 Baud, Parity 8, N, 1 and no handshaking.

The Modem shall have a switch (S1) and shall be factory configured as follows:

	S1 DESCRIPTION	OPEN	CLOSE
1	Modem Select	Smart Modem	Dumb
2	“SMART Modem DB-9 Aux” Sel	DTE	DCE
3	RTS Override	Normal	RTS High
4	“Modem /DB9 DTE Serial” Sel	Modem	DB9-DTE

All switches shall be OPEN as factory default except for position #2, which shall be closed as default. User shall be able to disable the SMART Modem Mode and set user baud rate, handshaking, and parity. In SMART Mode the user shall have the ability to set the baud rate, handshaking and parity.

10.8.2.2 Modulation

The Dial-Up Modem shall use Quadrature Amplitude Modulation and Operate within the following frequencies:

Data Carrier 1800 ± 0.5 Hz
 Calling Tone 1300 ± 10 Hz
 Answering Tone 2100 ± 15 Hz

The Modem shall have Receiver Frequency Tolerance of ± 14 Hz

10.8.2.3 Modem Standards

The Dial-Up Modem shall be ITU V.90, V.34 and Rockwell V.FC compatible. It shall meet the standards:

V.90, V.34, V.32 bis, V.32, V.22 bis, V.22A/B, V.23, V.21, Bell 212, Bell 103, V.33, V.17, V.29, V.27 ter, and V.21 Channel 2.

10.8.2.4 Data Rates

The Dial-Up Modem shall support the following data rates:

33.6Kbps, 31.3Kbps, 28.8Kbps, 26.4Kbps, 24.0Kbps, 21.6Kbps, 19.2Kbps, 16.8Kbps, 14.4Kbps, 12.0Kbps, 9.6Kbps, 7.2Kbps, 4.8Kbps, 2.4Kbps, 1.2Kbps, and 300 baud.

The Modem shall automatically select the best operating speed as indicated in Section 10.6.2.1 of these specifications.

10.8.2.5 Error Correction & Data Compression

The Modem shall use V.42 LAPM, MNP2-4 and MNP 10 for error correction and V.42 Bis, MNP 5 for Data Compression.

10.8.2.6 Tx/Rx Power Level

The transmit level shall be fixed at -11 ± 2 dB and the receiver shall have a S/N Ratio of -26 dB with a Dynamic Range of 12 dBm to -42 dBm.

The Ring detect Sensitivity shall be 38 VRMS.

10.8.2.7 Line Interface

The Dial-Up Modem shall have a Ring Equivalent of 1 Bel and a terminating Impedance of 600 Ohms. It shall have return loss of better than 14 dB.

10.8.3 Circuit

The Model 2070-9D shall be provided with full isolation from the Model 2070 Motherboard. Line drivers/receivers shall be socket or surface mounted.

The 2070-9D module's isolation circuitry shall be capable of reliably passing a minimum of 1.0 Mbps. The EIA-485 drivers to the external connectors must be capable of

supporting either two times the maximum applicable baud rate for the port or 1Mbps, which ever is less.

10.8.4 Hot Swappable

The 2070-9 D Module shall be “Hot” swappable without damage to its circuitry or operations. A communication “glitch” occurring during insertion/removal is acceptable since the application program should be able to recover/retry. Power-on and hot-swap current surges shall not exceed a 10 ms surge at three times (3x) the maximum rating of each voltage supply used by the module.

10.8.5 Power Requirements

The power requirements of the Model 2070-9D Modem shall be within the power limitations of the Model 2070 UNIT as describe elsewhere in this specifications.

10.8.6 Environmental

The Model 2070-9D Modem shall operate within the specifications listed in Chapter 1 [Section 1.8.4](#).

10.8.7 Form Factor

See A10-8 for Details

CHAPTER 10-SECTION 9

2070 COMM MODULE DETAILS

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TRANSPORTATION ELECTRICAL EQUIPMENT SPECIFICATIONS

TEES 2009 ERRATA No.1



January 21st, 2010

**STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION**



Arnold Schwarzenegger
Governor

Dale Bonner
Secretary
Business, Transportation & Housing
Agency

Will Kempton
Director
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Michael Miles
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Sr. TEE, Office ITS Projects and Standards

The following TEES dated March 12th, 2009 and Chapter 4 dated July 7, 2009 plans and sections should be modified or added.

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Errata No. 1

1.3.10 Fuses

All Fuses shall be [3.15 Amp Glass Slow Blow type](#) and resident in a holder. Fuse size rating shall be labeled on the chassis, PCB or beside the holder. Fuses shall be easily accessible and removable without use of tools.

2.5.1 Mechanical/Electrical Requirements

[The Model 400N Ethernet Module shall be dimensionally and electrically designed to fit in a single slot of a standard 170 controller.](#)

2.5.5 Data Interfaces

Main Data Port Model 170 male 44 pin Edge Connector

User Serial Port EIA-232 (DB9 Female); [Optional](#)

Ethernet Data Port RJ45 EIA 568B Pin Out

3.4.2.11 Output Turn-on Delay

[The Model 206L shall have an Output Turn-On Delay of less than 200mSec from AC turn-on.](#)

4.2.10.1 AC Connection

The AC input and output shall be [quick disconnect](#) plug / receptacles that allow no possibility of accidental exposure to dangerous voltages (male receptacle for AC Input and female receptacle for AC Output). The receptacles shall utilize some form of locking mechanism or hold down clamps to in order to prevent any accidental disconnects.

6.4.3.1.1 PDA #2L

- 1 -- Duplex NEMA 5-15R Controller Receptacle
- 2 -- Duplex NEMA 5-15R Equipment Receptacle (one with GFCI)
- 1 -- 1 Pole 15 Amperes minimum, 120 VAC Signal Bus Circuit Breaker
- 1 -- 1 Pole 15 Amperes minimum, 120 VAC Clean Power Circuit Breaker
- 6 -- 1 Pole Ganged, 10 Amperes, 120 VAC Signal Bus Circuit Breaker with Auxiliary Switch
- 1 -- 1 Pole 15 Amperes, 120 VAC Equipment Circuit Breaker
- 1 -- 2 Pole Ganged, 10 Amperes, 120 VAC Flash Bus Circuit Breaker
- 1 -- Solid State Relay (Normally Closed) - rated minimum 50 Amperes, 120 VAC, [Crydom A2450-B](#) or equal.
- 2 -- Model 204 Flasher Unit and Socket
- 1 -- Model 206L Power Supply Module and Socket
- 1 -- AUTO/FLASH Control Switch
- 1 -- Flash On Indicator Light
- 3 -- 10 Position TBK T1, T2 & T4
- 1 -- 4 Position TBK T3
- 1 -- SSR Fault Indicator Light
- 1 -- [HI Health Indicator Relay](#)
- 1 -- [K24 24VDC Controlled Relay](#)

9.1.1 Controller Unit

The Controller Unit shall be composed of the Unit Chassis, modules and assemblies per their version. The following is a list of 2070 Versions, their interface rolls and composition:

UNIT VERSION	DESCRIPTION
2070V UNIT	Provides directly driven VME and mates to 170 & ITS cabinets. It consists of: UNIT CHASSIS, 2070-1A TB, 2070-1A MCB, 2070-2A FI/O, 2070-3A FRONT PANEL, 2070-4 POWER SUPPLY, and 2070-5 VME CAGE ASSEMBLY.
2070E UNIT	LITE Unit mates to the 170 & ITS cabinets. It consists of: UNIT CHASSIS, 2070-1E CPU, 2070-2A (2B if ITS CABINET), FI/O, 2070-3B FRONT PANEL and 2070- 4 POWER SUPPLY
2070EC UNIT	LITE unit mates to ITS cabinets only. It consists of: UNIT CHASSIS, 2070-1E CPU, 2070-2B FI/O, 2070-3C FRONT PANEL and 2070-4 POWER SUPPLY
2070LX UNIT	LX Unit mates to the 170 & ITS cabinets. It consists of: UNIT CHASSIS, 2070-1C CPU, 2070-2A (2B if ITS CABINET), FI/O, 2070-3B FRONT PANEL and 2070- 4 POWER SUPPLY
Note: See Chapter 11 for 2070 NEMA Versions	

9.2.2.1 Dual SCC Device

A Dual SCC Device (asynch / synch) and associated circuitry shall be furnished to provide two additional system serial ports. The Dual SCC1 shall be assigned to the System Serial Port SP1 meeting all requirements called out for SP1 except where noted.

The Dual SCC2 shall be assigned as System Serial Port SP8. The SP8 and associated circuitry shall interface with the MC68EN360 address and data structure and serially be connected to the external world via the DB 25 Pin C13S Connector located on the module front panel. The SP8 shall meet all SP2 Port requirements except where noted, including EIA 485 drivers / receivers and synchronous data rate of 153.3 Kbps.

9.2.7.2.3 MC68360 Internal Timers

A driver to handle each of the four internal timers under the OS-9 Kernel shall be provided. Timer resolution shall be one count equals 100 μ S and all timer periods shall be specified in units of hundreds of microseconds (μ S).

A signal of "0" shall be an invalid signal and the driver shall return an E\$PARAM error if received.

Access to the MC68360 internal timers shall be through the descriptors as listed under Descriptor.

The timers should be set to the SS2070_Timer_Null Mode upon initialization.

9.2.7.2.5 Flow Control Modes

The asynchronous serial communications device drivers shall support the six flow control modes (FCM#) described below:

FCM#	Description
0.	No Flow Control Mode: The driver transmits data regardless of the state of CTS. Upon a write command, the driver asserts RTS, and de-asserts RTS when data transmission is completed. This is the default mode. When user programs issue the first RTS related command, the driver switches to Manual Flow Control Mode (FCM# 1).

1. Manual Flow Control Mode: The driver transmits data regardless of the state of CTS. The user program has absolute control of the RTS state. The driver doesn't automatically assert or de-assert RTS.
2. Auto-CTS Flow Control Mode: The driver transmits data only when CTS is externally asserted. The user program has absolute control of the RTS state. The driver doesn't automatically assert or de-assert RTS.
3. Auto-RTS Flow Control Mode: The driver transmits data regardless of the state of CTS. Upon a write command, the driver asserts RTS, and de-asserts RTS when data transmission is completed and any configured RTS extension is elapsed. If the user program asserts RTS, then RTS remains on until the user program de-asserts RTS. If the user program de-asserts RTS before the transmission buffer is empty, the driver holds RTS on until the transmission buffer is empty and any configured RTS extension is elapsed.
4. Fully Automatic Flow Control Mode: The driver transmits data only when CTS is externally asserted. Upon a write command, the driver asserts RTS and waits for CTS, starts data transmission when CTS is asserted, and de-asserts RTS when data transmission is completed and any configured RTS extension is elapsed. If user program asserts RTS, then RTS remains on until the user program de-asserts RTS. If the user program de-asserts RTS before the transmission buffer is empty, the driver holds RTS on until the transmission buffer is empty and any configured RTS extension is elapsed.
5. Dynamic Flow Control Mode: The driver transmits data only when CTS is externally asserted. The driver controls RTS based on the status of its receiving buffer. The driver asserts RTS continuously as long as its receiving buffer has sufficient capacity to store incoming data. If the receiving buffer approaches full, the driver de-asserts RTS until enough data has been read from the buffer to create sufficient receive capacity.

9.2.7.3.1 Startup Procedure

The boot image init module shall be configured with the default directory name as /f0wp and sysgo as the first executable module.

Sysgo shall operate as follows:

1. Sysgo shall set the execution directory to /f0wp/CMDS
2. Sysgo shall check if the backspace key (0x08) is being received on /sp4 (c50j). If received, Sysgo shall:
 - a. Fork a shell with no arguments on /sp4 using the current directory.
 - b. Remain an active process and monitor the shell for termination. If the shell does terminate, Sysgo shall fork another shell with no arguments on /sp4. Unless Sysgo dies, a shell shall always be provided on /sp4.

3. If the backspace key was not received, Sysgo shall check for the presence of a Datakey. If present and valid (Datakey Header Version 2 or greater), Sysgo shall check the Startup Override Byte in the Datakey header.

If Startup Override is 0x01, Sysgo shall:

- a. Fork a shell that executes a shell script stored on the Datakey in the following format. Immediately following the key header shall be the size of the script in bytes. The script shall immediately follow the size value, and shall be stored as ASCII text.
- b. If there is any error reading or starting the script or if the shell terminates with an error, Sysgo shall display an error message on /sp4 and fork another shell as described in step 2. If there are no errors executing the script, Sysgo shall exit without forking another shell.

If Startup Override is 0x02, Sysgo shall:

- a. Fork an executable module stored on the Datakey immediately following the header.
- b. If there is any error loading or forking the module, Sysgo shall display an error message on /sp4 and fork a shell as described in step 2. If there are no errors forking the module, Sysgo shall then exit without forking a shell.

4. If the backspace key was not received and Startup Override Byte is 0xFF:
 - a. Sysgo shall fork the module named /f0wp/OPEXEC if present at /f0wp.
 - b. If there is any error loading or forking OPEXEC, Sysgo shall display an error message on /sp4 and fork a shell as described in step 2. If there are no errors forking OPEXEC, Sysgo shall then exit without forking a shell.
5. If the backspace key was not received, Startup Override Byte is 0xFF, and there is no OPEXEC file:
 - a. Sysgo shall fork a shell that executes a shell script named /f0wp/startup if present at /f0wp.
 - b. If there is any error reading or starting the script or if the shell terminates with an error, Sysgo shall display an error message on /sp4 and fork another shell as described in step 2. If there are no errors executing the script, Sysgo shall exit without forking another shell.
6. If the backspace key was not received, Startup Override Byte is 0xFF, and there is no OPEXEC and no startup file:

- a. Sysgo shall fork a shell as described in step 2.

9.2.7.5.1 CMDS

The following Network utilities shall be included and shall reside in the /f0/CMDS directory as identified in this specification.

arp, dhcp, ftp, ftpd, ftpdc, idbdump, idbgen, rpcdbgen, ifconfig, inetd, ipstart, ndbmod, netstat, ping, route, routed, telnet, telnetdc, hostname, nfsc, mount, rpcdump, nfsstat, exportfs, portmap, pppd, chat, pppauth, nfsd, mountd, and showmount.

9.2.7.6.1 Ver

A Ver utility shall be provided as part of the OS-9 Image and shall allow access to Controller's Manufacturer Name, Image Build Number, TEES Version, Image Build Date and CPU Module Type. Ver should display the contents of a data module named "bootid" which contains in it's data area the following structure:

```
/* bootid_body*/
Struct bootid_body {

char *mfgname;           /* Manufacturer Name */
char *cpumoduletype;     /* CPU Module Type */
char *teesrelease;       /* TEES Release */
char *imagebuilddate;    /* Image Build Date */
u_int 16 majv;           /* Major Version*/
u_int 16 minv;           /* Minor Version */
u_int 16 sv1;            /* Sub-Version 1 */
u_int 16 sv2;            /* Sub-Version 2 */
u_int 16 sv3;            /* Sub-Version 3 */
u_int 16 dv;             /* Development Version */
};
```

Os9 Edimod shall be used to generate the heater file and the "bootid" module using the following config.des file:

```
#cinclude "defines.h" /*this file contains customization for the module */
#include <module.des> /* required for module definitions in modhcom */

struct bootid_body /* this is the bootid module structure */
{
    pointer u_int32 mfgname = mn, "Manufacturer Name";
    pointer u_int32 cpumoduletype = cmt, "CPU Module Type";
    pointer u_int32 teesrelease = tr, "TEES Release";
```

```

    pointer u_int32 imagebulddate = ibd, "Image Build Date ";
    u_int16 majv, "Major Version";
    u_int16 minv, "Minor Version";
        u_int16 sv1, "Sub-Version 1";
        u_int16 sv2, "Sub-Version 2";
        u_int16 sv3, "Sub-Version 3";
        u_int16 dv, "Development Version";
}, "bootid_body";

string mn = MfgName;
string cmt = CPUModuleType;
string tr = TEESRelease;
string ibd = ImageBuildDate;
string mod_name = "bootid";

init bootid_body
{
    majv = MajorVer;
    minv = MinorVer;
    sv1 = SubVer1;
    sv2 = SubVer2;
    sv3 = SubVer3;
};

init modhcom
{
    _maccess = 0x555;
    _mtype = MT_DATA;
    _mlang = 0;
    _mattr = 0x80;
    _mrev = 1;
    _medit = 1;
};

module
{
    modhcom,
    bootid_body
};

```

9.2.8.2.1 Datakey

This driver provides full capability for manipulating Datakey devices. [Datakeys of size 2Mbit and above](#) as listed in Section 9.2.6 of these specifications shall be supported.

10.6.2.1 Modem default configuration

The Modem shall contain the following default configurations:

ACTIVE PROFILE:

B1 E1 L1 M1 N0 Q0 T V1 W0 X4 Y0 &C1 &D0 &G0 &J0 &K0 &Q5 &R1 &S0 &T5
&X0 &Y0

S00:001	S11:095
S01:000	S12:050
S02:043	S18:000
S03:013	S25:005
S04:010	S26:001
S05:008	S36:007
S06:002	S38:020
S07:050	S46:138
S08:002	S48:007
S09:006	S95:000
S10:014	

The Modem shall have a switch (S1) and shall be factory configured as follows:

	S1 DESCRIPTION	OPEN	CLOSE
1	Modem Select	Smart Modem	Lock
2	“SMART Modem DB-9 Aux” Sel	DTE	DCE
3	RTS Override	Normal	RTS High
4	“Modem /DB9 DTE Serial” Sel	Modem	DB9-DTE

All switches shall be in the OPEN position as factory default except for position #2, which shall be closed as default. User shall be able to disable the SMART Modem Mode and set user baud rate, handshaking, and parity.

10.8.2.1 Modem default configuration

The Modem shall contain the following default configurations:

ACTIVE PROFILE:

B1 E1 L1 M1 N0 Q0 T V1 W0 X4 Y0 &C1 &D0 &G0 &J0 &K0 &Q5 &R1 &S0 &T5
&X0 &Y0

S00:001	S11:095
S01:000	S12:050
S02:043	S18:000
S03:013	S25:005
S04:010	S26:001
S05:008	S36:007
S06:002	S38:020
S07:050	S46:138
S08:002	S48:007
S09:006	S95:000
S10:014	

The Modem shall have a switch (S1) and shall be factory configured as follows:

	S1 DESCRIPTION	OPEN	CLOSE
1	Modem Select	Smart Modem	Lock
2	“SMART Modem DB-9 Aux” Sel	DTE	DCE
3	RTS Override	Normal	RTS High
4	“Modem /DB9 DTE Serial” Sel	Modem	DB9-DTE

[All switches shall be in the OPEN position as factory default except for position #2, which shall be closed as default. User shall be able to disable the SMART Modem Mode and set user baud rate, handshaking, and parity.](#)

CHAPTER 10-SECTION 9

MODEL 2070-7G UNIVERSAL TIME BASE MODULE

10.9.1 Model 2070-7G Universal Time Base Module

The Model 2070-7G Universal Time Base Module shall consist of a GPS receiver with antenna and a microprocessor-based circuit. It shall read raw GPS time data and accept user commands via Com 2 as defined elsewhere in these specifications. The Model 2070-7G Universal Time Base Module shall be a Plug-in Style Card version for the Model 2070 Controller. The Model 2070-7G shall be provided with two communications channels Com 1 and Com 2. Com 1 shall be use to establish serial communications between the Model 2070 Controller and a GPS receiver resident in the Model 2070-7G Universal Time Base Module. Com 2 shall be switch selectable between a Config Mode to the GPS receiver and a straight serial port for the Model 2070 Controller.

10.9.2 GPS Receiver/Antenna

The Model 2070-7G shall be provided with a Land-Based L1, C/A code GPS Receiver operating at a frequency of 1575.42MHz. The GPS Receiver shall contain a minimum of 20 Channels. The receiver shall have a tracking sensitivity level greater than -159dBm at the receiver input.

The Model 2070-7G shall be provided with an active permanently mount GPS Antenna. The Antenna mount shall consist of GPS roof-mount antenna with double threaded bolt, through hole, wing nut fastener, and locking nuts. The mounting shall consist of a Bulkhead mount with 0.8 inch threaded wing nut.

The Antenna System shall be comprised of an Antenna Element, Cable and Connector, and Low Noise Amplifier (LNA).

The Cable and Connector shall consist of a 2 Meter RG174/U Coaxial cable terminated at the non-antenna end with an SMA male straight connector.

The Antenna Element shall use Right Handed Circular Polarization (R.H.C.P) and shall have a minimum Gain of +5 dBi. The antenna shall have a VSWR of 1.5:1 max. and an output impedance of 50 Ohms.

The Low Noise Amplifier shall operate from a 3.3 to 5.5 V DC source and shall provide an Outer Band Attenuation of 20dB min. at $F_o \pm 50$ MHz and a Gain of 31dB min.

The Overall Performance of the Antenna System including Antenna Element, LNA and Coax Cable shall be as follows:

Center Frequency: 1575	1575.42 MHz
Gain	27dB min.
Noise Figure	2.0 dB max.
Axial Ratio	3.0 dB max.
Bandwidth	2 MHz min.
VSWR	2.0:1 max.
Output Impedance	50 Ohms

10.9.3 Default Configurations

The Model 2070-7G Universal Time Base Module shall have the following default configuration parameters:

Baud Rate	1200 bps
Time Zone	8, Pacific Time Zone
New Line Character	ASCII Carriage Return, Except QC, which CR+LF
Hour Format	24 hour (Military Time)
Daylight Savings Time	Enabled
Begin DST Clock Correction	March, Second Sunday at 02:00AM
End DST Clock Correction	November, First Sunday at 2:00 AM

These parameters shall be configurable using the QS Command Set as defined in Section 10.9.4 of these specifications.

10.9.4 QS Command Set

The “Q” Commands

“Q” commands shall be used to request information from the Model 2070-7G, such as global position, date and time. The Model 207-7G shall support the “Q” commands as listed in the following table.

Model 2070-7G "Q" COMMANDS			
COMMAND	RETURNS	FORMAT	EXAMPLES
QA n1 n2 0 0	Status, DOY, time	13 byte Binary string	See detail comments below
QD	Date and Day of year	YY/MM/DD/day {newline}	02/02/05/036
QT	TIME	mHH:MM:SS:Thtd {newline}	A10:51:21:697 17:45:05:489D
QC	Date, time status and day of week	YYMMDDHHmmSSThtLW {cr+lf}	020821231706945Y6
QD, QT, QL & QC	Message	ASCII string “NOT LOCKED ON”	NOT LOCKED ON
QM	Data stored in ROM	Bw:Dx:My:Ncr:Oz Baud: DST: 12/24: new line: TimeZone	B7:D0:M1:Ncr:O6 {newline}
QV	Firmware version	ASCII version number	v1.2
QI	Get Daylight saving time configuration	bMbsbhbmeMesechem {newline}	0302020011010200 {newline}
QL	Get Position (latitude and longitude)	DD.MM.SS.THTA ddd.mm.ss.thtO	38.53.23.123N 077.00.27.123W

“Q” Commands

QD When the “QD” command is received by the Model 2070-7G it shall respond with either the ASCII message “NOT LOCKED ON” or with the date in the format YY/MM/DD/day followed by the new line character. “doy” is the day of the year in a 3 digit format, January 1 being 001. If the Model 2070-7G has not yet found at least one satellite to insure correct data, the response shall be “NOT LOCKED ON”.

An example of a normal response from the Model 2070-7G to a “QD” command sent to it would be “02/02/05/036(new line character)”. This sample data stream would represent February 5, 2002 and that date would be the 36th day of the year 2002.

Note: If the device is configured for a time zone other than the local time zone, the date and “doy” shown could differ from the local date, depending on the time of day.

QT When the “QT” command is received by the Model 2070-7G it shall respond with either the ASCII message “NOT LOCKED ON” or with the time of day in the format of an A or a P or an ASCII space (to signify A.M. or P.M. or 24 hour time format) immediately followed by “HH:MM:SS:Tht” and a “D”, if Daylight Savings Time function is “Enabled” and ending with the new line character.

Two sample “QT” responses are:

“A10:51:21:697{NEW LINE}”, which could be interpreted as 10:51 A.M. plus 21.697 seconds and not corrected for daylight savings time.

“_17:45:05:489D{new line}”, which could be interpreted as 1745 plus 5.489 seconds (using the 24 hour format), with Daylight Savings Time Enabled. The “_” represents an ASCII “space” character and signifies that the output is in 24 hour format.

As with the “QD” command, if the Model 2070-7G is not receiving a valid signal from at least one satellite, the response to a “QT” command shall be the ASCII message “NOT LOCKED ON”.

QC This command reply shall provide a combination of the information found in the “QT” and “QD” commands but in slightly different format and with some additional information.

As with the “QT”, “QL” and “QD” commands, the message “NOT LOCKED ON” shall be the reply if the Model 2070-7G does not have at least one satellite in view to determine the precise time and date.

A special synchronization character in the data stream (either Y or N) shall signify whether or not the date and time data are synchronized with UTC (Universal Coordinated Time).

In order for the Model 2070-7G to report fully synchronized data with the special character changed to “Y”, the unit must be tracking at least 4 satellites. If the synchronization character is “N” the time reported will be less precise but still within a few milliseconds of the UTC synchronized time. The “QC” command hour format is always 24 hour (military time) since there is no character in the data stream to indicate A.M. or P.M. An additional bit of information included in the “QC” data stream is a “day of the week” number. The number 0 (zero) indicates Sunday, 1 indicates Monday and so on through 6, which indicates Saturday. Unlike the “QT” and “QD” commands, the “new line” character shall not be changed. It shall always be ASCII “carriage return

+ line feed”. The format of the “QC” data stream shall be YYMMDDHHmmSSThtLW followed by an ASCII carriage return and line feed.

A sample “QC” data stream generated by the Model 2070-7G would be:

“02032123176945Y6{cr+lf}”. This data stream would be interpreted as March 21, 2002, the time, in 24 hour format, would be 2317 plus 6.945 seconds, the time is synchronized to UTC (Y) and the day of the week is Saturday (6). Note that the data stream does not indicate whether or not Daylight savings time is “Enabled or Disabled”.

QM The “QM” command shall reply with the parameters stored in non-volatile memory, which shall be the baud rate, daylight savings time enable-disable, time format, new line character and time zone. Parameters shall be separated by a colon and the data stream shall be terminated with the new line character. The data stream B7:DO:M1:Ncr:O6{newline} would represent a baud rate = 19200 bps, Daylight savings time = disabled, 12 hour time reporting format, new line character = carriage return and Time Zone = Central. This command shall be used to determine the current configuration.

QV When the “QV” command is received by the Model 2070-7G it shall reply with the firmware version number. The format for the firmware version shall be as VX.X where X.X shall digits from 0 to9. An example of a response to the QV command would be “V1.2” without the quotation marks. The “NOT LOCKED ON” message shall never reply to this query command.

QI The “QI” command shall replay the currently loaded Daylight saving time parameters; these shall be stored in the non-volatile memory. A total of 8 parameters are shall be sent. The data stream is bMbshbhbmeMesehem{newline} and the parameters are as follow:

- Begin Month (bM). The month when starts to observe the DST changes. This value shall be a two digits number. 01 means January, 02 February, 03 March and so on.
- Begin Sunday (bs). The Sunday number of “begin month (bM)”. This value shall be a two digits number.
- Begin Hour (bh) and Begin Minutes (bm). The time when starts to observe the DST. This time shall be expressed in a 24 hour format.
- End Month (eM). The month when ends the DST changes. This value shall be a two digits number. 01 means January, 02 February, 03 March and so on.
- End Sunday (es). The Sunday number of “end month (eM)”. This value shall be a two digits number.
- End Hour (eh) and End Minutes (em). The time when the DST observation ends. This time shall be expressed in a 24 hour format.

An example data stream 0302020011010200{newline} would represent DST clock adjust will begin at second Sunday of March at 02:00 AM and DST will end at first Sunday of November at 02:00 AM.

When the Model 2070-7G module detects any of both DST conditions, either Begin or End, it corrects the time by adding or subtracting one hour to local time. Once “begin DST” conditions met (Month, Sunday and time) it adds one hour to local time. When “end DST” conditions met (Month, Sunday and time) it subtracts one hour to local time. The Model 2070-7G shall always respond to this command.

QL The “QL” command will replay the latitude and longitude of the current Global Position expressed in degrees, minutes, seconds and milliseconds, north (N) or south(S) for Latitude, east (E) or west (W) for longitude. The data stream shall be expressed as follows, DD.MM.SS.THTA_ddd.mm.ss.thtO{newline}.

- DD = latitude degrees
- MM = latitude minutes
- SS = latitude seconds
- THT = latitude milliseconds
- A = latitude, North or South
- ddd = longitude degrees
- mm = longitude minutes
- ss = longitude seconds
- tht = longitude milliseconds
- O = longitude, East or West

An example data stream 38.53.23.123N_077.00.27.123W{newline} would represent 38 degrees latitude north, with 53 minutes, 23 seconds and 123 milliseconds and 077 degrees longitude west with 00 minutes, 27 seconds and 123 milliseconds. As with the “QT”, “QC” and “QD” commands, the message “NOT LOCKED ON” shall be the response if the Model 2070-7G does not have at least one satellite in view to determine the precise position.

Please note: the “_” represent an ASCII space.

QA The “QA” command differs from the other Q commands in that it must include two additional user selected variables n1 and n2, and two fixed variables n3 and n4, which are always zero. The output from the QA command depends on the variables sent with the command. It also differs from the other Q commands in that the information returned is not ASCII but rather binary. A list of the user defined variables and the information returned follows.

User defined variables

n1– Time zone. The variable entered must be the sum of an ASCII 0 + (0 – 11) depending on the time zone desired. For example ASCII 38 signifies time zone 8, Pacific.
n2 – Daylight savings time correction, 0 = disabled, 1 = enabled.

Possible replies from the Model 2070-7G to a QA command

Byte 0

Bits 1-3 are not used.

Bit 4 is 0 if valid time is not currently available and 1 if time is valid.

Bit 5 is 1 during the initialization phase only (before first lock on, i.e. LED changes to green for the first time. This bit changes to 0 at the first lock on and never changes even in subsequent amber conditions.

Bit 6 is always 0.

Bit 7 is normally 0 but if no satellite information is received for 24 hours, this bit will be 1.

Bit 8 is not used.

Byte 1

Bits 1-4 are not used, always zero.

Bits 5-6 are always 0 indicating that the time is in 24-hour format.

Bit 7, Daylight Savings Time indicator is 1 when DST is enabled and the date is within the DST period. This bit is 0 if DST correction is disabled or the date is outside of the DST period.

Bit 8 is not used, always zero.

Bytes 2 and 3

Milliseconds portion of current time, the Hex equivalent of BCD.

Byte 4

Seconds portion of current time, the Hex equivalent of BCD.

Byte 5

Minutes portion of current time, the Hex equivalent of BCD.

Byte 6

Hours portion of current time, the Hex equivalent of BCD.

Bytes 7 and 8

Day of Year, the Hex equivalent of BCD.

Byte 9

Year (this byte is actually the offset from 1986) i.e. 18 = 2004, the Hex equivalent of BCD.

Bytes 10 and 11

Always zero.

Byte 12

Always a new line character (CR).

The “S” Commands

The Model 2070-7G shall accept instructions from the user in the form of “S” (Set) commands. The “S” commands, their variables, and their meanings that shall be supported shall consist of the following:

Model 2070-7G "S" COMMANDS				
COMMAND	NAME OF COMMAND	"n" variable	SETTING (default)	(Notes)
SB_n	SET BAUD RATE	0	Reserved	
		1	Reserved	
		2	Reserved	
		3	(1200)	
		4	2400	
		5	4800	
		6	9600	
		7	19200	
		8	38400	
SD_n	SET DAYLIGHT SAVINGS TIME	0	Disabled	
		1	(Enabled)	
SM_n	SET 12 OR 24 HOUR TIME FORMAT	0	(24 Hour)	
		1	12 Hour (AM/PM)	
SN_n	SET NEW LINE CHARACTER	ASCII characters except colon and /	(carriage return)	
SO_n	SET TIME ZONE	0	Time zone 0	UTC
		1	Time zone 1	
		2	Time zone 2	
		3	Time zone 3	
		4	Time zone 4	
		5	Time zone 5	Eastern
		6	Time zone 6	Central
		7	Time zone 7	Mountain
		8	(Time zone 8)	Pacific
		9	Time zone 9	Alaska
		: (colon)	Time zone 10	Hawaii
		; (semi-colon)	Time zone 11	
SI1bMbsbhbmeMeseh em	SET DAYLIGHT SAVING TIME	bM	03	

(Begin

		month)		
	CONFIGURATION	bs (Begin Sunday)	02	
		bh (Begin hour)	02	
		bm (Begin minutes)	00	
		eM (End month)	11	
		es (end Sunday)	01	
		eh (end hour)	02	
		em (End minutes)	00	

“S” Commands

“S” Commands shall be sent to the Model 2070-7G without an “end of line” character.

The Model 2070-7G shall not send any acknowledgement when it receives an “S” command however the QM command can be used to confirm the change was made. All setting changes shall be stored in non-volatile memory and used in place of the factory default settings.

The following describes the “S” commands that shall be supported by Model 2070-7G:

SBn (Set Baud Rate). This command shall be used to change the Model 2070-7G’s serial communication speed. The baud rate of the controller and the Model 2070-7G must be the same. When the unit is first powered up it shall be configured with the factory default baud rate of 1200.

When communications between the Model 2070-7G and the controller is established, the SB command can be used to change the baud rate to the preferred speed. The available baud rates are shown in "S" Commands table. Generally the highest baud rate, that provides reliable communication, should be used. For example, to change the unit’s default baud rate to 4800 baud, the proper “S” command to send would be “SB5” (without quotation marks). Any baud rate changes will go onto effect immediately.

SDn (Enable/Disable Daylight Savings Time). This command shall be used to enable or disable the device’s one hour offset to accommodate Daylight Savings Time rules. If the

unit is to be used to output local time in an area that observes Daylight Savings Time rules, the “SD1” command should be used. The factory default setting is “Enabled”, which means the Model 2070-7G will automatically adjust the local time output by one hour at the beginning and end of the Daylight Savings Time period. Users can change the configuration when these changes must occur with the SI1 command. If the unit will be used in areas that do not observe Daylight Savings Time, the appropriate “S” command to use would be “SD0”.

SMn (Set time output format). This command shall be used to specify how the time of day data will be formatted. The factory default setting is the 24 hour, Military Time, format. If the user prefers to have the data output in a 12 hour format, (with A.M. or P.M. noted) the “SM1” (without the quotation marks) command must be sent once to change the format setting.

SNn (Set new line character). The Model 2070-7G’s response to a valid “Q” command shall be a data stream that ends with a “new line” character. The default new line character is an ASCII carriage return. If the user prefers to have the data stream end in different ASCII character it can be changed using the “SN” command. Any ASCII character except the “/” (slash) and the “:” (colon) characters may be used as the variable. For example to use “#” as the new line character the proper command to send would be “SN#” (without the quotation marks). Only one “new line character” is permitted.

SO n (Set time zone). This command allows the user to set the Model 2070-7G’s output to reflect the local time. Each time zone is assigned a number or ASCII character that is used as the variable for the “SO” command. The Model 2070-7G firmware shall accommodate time zones 0 through 11. Time zone 0 shall be used to output UTC (Universal Coordinated Time) or GMT (Greenwich Mean Time) if the user prefers that reference instead of local time. The default factory value shall be 8, as listed under default configurations, which shall represent Pacific Standard Time in the United States.

SI1bMbsbhbmeMesehem (Set daylight saving time parameters). This command shall allow the user to set the Model 2070-7G’s daylight saving time settings. The modification of these parameters will determine when DST begin & end:

- **Begin Month(bM)**. The month when starts to observe the DST changes. This value shall be a two digits number. 01 means January, 02 February, 03 March and so on.
- **Begin Sunday(bs)**. The Sunday number of “begin month (bM)”. This value shall be a two digits number.
- **Begin Hour(bh) and Begin Minutes(bm)**. The time when starts to observe the DST. This time shall be expressed in a 24 hour format.
- **End Month(eM)**. The month when ends the DST changes. This value shall be a two digits number. 01 means January, 02 February, 03 March and so on.
- **End Sunday(es)**. The Sunday number of “end month(eM)”. This value shall be a two digits number.

- End Hour(eh) and End Minutes(em). The time when the DST observation ends. This time shall be expressed in a 24 hour format.

These parameters shall be set in the Non-Volatile memory.

10.9.5 Config Mode

The Model 2070-7G Module shall be provided with a switch allowing the user to switch Com 2 into Config Mode. In Config Mode, Com 2 loops back to the GPS Receiver and provides the user with a communications port to run Q and S Commands to configure the GPS receiver or query it for data. During Config Mode, the Config Mode LED indicator shall be turn ON to indicate configuration mode. When the Config Model is OFF, Com 2 shall consist of a serial port (serial pass through) to the Model 2070 Controller.

10.9.6 Connectors

The Model 2070-7G Universal Time Base Module shall contain the following connectors in the Faceplate:

Antenna	SMA Connector
Com 2 Port (C22S)	DB9 Female Connector

10.9.7 Data Output

When communicating to the GPS Receiver, the Date, Time, Day of Week, Signal Status, and Global Position shall be available. Data format shall be as defined in Section 10.9.4 of these specifications and the NMEA 0183 Standard. Serial Communications shall be software selectable at 1200, 2400, 4800, 9600, 19200 or 38400 bps.

10.9.8 Protocols

The Model 2070-7G shall support the NMEA 0183 Standard, Version 2.1 or later, as defined by the National Marine Electronics Association and the QC Command Set as defined in Section 10.9.4 of these specifications. A dipswitch marked "CMode" shall be provided which allows for the selection of one of three modes. The communication modes shall consist of a "NORM" (Normal Mode), "NB" (Normal Broadcast Mode) and GPS. When the CMode is in the "NORM" (Normal Mode) ON position, the Model 2070-7G shall respond to the QS command set as defined elsewhere in these specifications. When the dipswitch CMode is in the "NB", (Normal Broadcast Mode) ON Position, and the Model 2070-7G shall operate in a broadcast mode and shall not

respond to the QS command set. When operating in the NB mode, the Model 2070-7G shall use the default settings as defined in section 10.9.2.

When the CMode is in the "GPS", (GPS pass through mode) ON position, the Model 2070-7G shall act like a standard NMEA 0183 compliant GPS receiver. As a minimum, when set on GPS mode, the Model 2070-7G shall support the following NMEA 2.0 Standard sentences: RMC, GGA, GSA, GSV, GLL and ZDA. The sentences shall be preceded by the standard generic Global Positioning System (GPS) talker ID "GP".

=== GLL - Geographic Position - Latitude/Longitude ===

	1	2	3	4	5	6	7	8
\$-- GLL	,lll.ll	,a	,yyyy.yy	,a	,hhmmss.ss	,a	,m	,*hh

\$--GLL,lll.ll,a,yyyy.yy,a,hhmmss.ss,a,m,*hh<CR><LF>

Field Number:

1. Latitude
2. N or S (North or South)
3. Longitude
4. E or W (East or West)
5. Universal Time Coordinated (UTC)
6. Status A - Data Valid, V - Data Invalid
7. FAA mode indicator (NMEA 2.3 and later)
8. Checksum

=== GGA - Global Positioning System Fix Data ===

Time, Position and fix related data for a GPS receiver.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

\$-- GGA	,hhmmss.ss	,llll.ll	,a	,yyyyy.yy	,a	,x	,xx	,x.x	,x.x	,M	,x.x	,M	,x.x	,xxxx	*hh

\$--GGA,hhmmss.ss,llll.ll,a,yyyyy.yy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>

Field Number:

1. Universal Time Coordinated (UTC)
2. Latitude
3. N or S (North or South)
4. Longitude
5. E or W (East or West)
6. GPS Quality Indicator,
 - 0 - fix not available,
 - 1 - GPS fix,
 - 2 - Differential GPS fix
(values above 2 are 2.3 features)
 - 3 = PPS fix
 - 4 = Real Time Kinematic
 - 5 = Float RTK
 - 6 = estimated (dead reckoning)
 - 7 = Manual input mode
 - 8 = Simulation mode
7. Number of satellites in view, 00 - 12
8. Horizontal Dilution of precision (meters)
9. Antenna Altitude above/below mean-sea-level (geoid) (in meters)
10. Units of antenna altitude, meters
11. Geoidal separation, the difference between the WGS-84 earth ellipsoid and mean-sea-level (geoid), "-" means mean-sea-level below ellipsoid
12. Units of geoidal separation, meters
13. Age of differential GPS data, time in seconds since last SC104 type 1 or 9 update, null field when DGPS is not used
14. Differential reference station ID, 0000-1023
15. Checksum

Example:

\$GPGGA,180844.000,3211.10532,N,11055.20380,W,0,00,99.0,779.59,M,-27.7,M, ,*69

=== RMC - Recommended Minimum Navigation Information ===

	1	2	3	4	5	6	7	8	9	10	11	12	13
\$-- RMC	,hhmmss.ss	,A	,llll.ll	,a	,yyyyy.yy	,a	,x.x	,x.x	,xxxx	,x.x	,a	,m	*hh

\$--RMC,hhmmss.ss,A,llll.ll,a,yyyyy.yy,a,x.x,x.x,xxxx,x.x,a,m*hh<CR><LF>

Field Number:

1. UTC Time
2. Status, V=Navigation receiver warning A=Valid
3. Latitude
4. N or S
5. Longitude
6. E or W
7. Speed over ground, knots
8. Track made good, degrees true
9. Date, ddmmyy
10. Magnetic Variation, degrees
11. E or W
12. FAA mode indicator (NMEA 2.3 and later)
13. Checksum

A status of V means the GPS has a valid fix that is below an internal quality threshold, e.g. because the dilution of precision is too high or an elevation mask test failed.

Example:

\$GPRMC,180845.000,V,3211.105,N,11055.204,W,0.0,0.0,271009,9.4,E*6E

=== ZDA - Time & Date - UTC, day, month, year and local time zone ===

	1	2	3	4	5	6	7
\$--ZDA	,hhmmss.ss	,xx	,xx	,xxxx	,xx	,xx	*hh

\$--ZDA,hhmmss.ss,xx,xx,xxxx,xx,xx*hh<CR><LF>

Field Number:

1. UTC time (hours, minutes, seconds, may have fractional subsecond)
2. Day, 01 to 31
3. Month, 01 to 12
4. Year (4 digits)
5. Local zone description, 00 to +- 13 hours
6. Local zone minutes description, apply same sign as local hours
7. Checksum

Example: \$GPZDA,160012.71,11,03,2004,-1,00*7D

10.9.9 LED Indicators

Function	LEDs
Com 1	TxD RxD
Com 2	TxD RxD
Config Mode	Green or Red
Tracking	Tri-Color

10.9.10 Model 2070-7G Tracking

The Model 2070-7G Universal Time Base Module shall be provided with the following tracking functionality:

The Model 2070-7G shall be equipped with a tri-color LED (Light Emitting Diode) to indicate the unit's status during operation; the LED shall be located at the faceplate and labeled as TRACKING as shown in detail A10-9.

The various states of the TRACKING LED indicator and their meanings shall be as described in the section below.

Power up phase: At power up, the 2070-7G's microprocessor shall read the five parameters stored in the unit's non-volatile memory. These parameters are Baud Rate, Daylight Savings Time mode and configuration, Time Zone, Military Time format and new line character. The default values shall be read from memory if they have not been modified. Next, the communications port shall be initialized and the speed set to the stored baud rate parameter. The remaining three communications parameters shall be fixed at 8 data bits, no parity and 1 stop bit.

The power up process shall take approximately 200 milliseconds. During this period the unit may not respond to any "S" or "Q" commands and the LED will **start flashing green**.

GPS initialization phase: After the power up phase is complete the unit will query the GPS receiver to see if it is already initialized. This is usually the case when the unit is powered up. If there is not data output, the GPS receiver will be initialized by the firmware program, using initialization commands and known variables.

This process shall take approximately 1 second. During this period, the Model 2070-7G may not respond to any "Q" or "S" commands and the LED shall **flash red**, once per second.

Signal acquisition phase: Once the GPS initialization phase is complete, it shall take from 3 to 180 seconds for the unit to acquire and process the first satellite's signal. When the Model 2070-7G has received and processed the first satellite's information, unsynchronized time/date information shall be available using the "QC" data stream and the synchronization character shall be "N". When the synchronization character is "N", the "QC", and "QT" and "QD" replies will be complete but time is not fully synchronized to UTC.

When unsynchronized data is available, the LED shall **flash green and red**.

Fully synchronized phase: When the 2070-7G has acquired information from 4 satellites its output will be synchronized to UTC (Universal Coordinated Time). When the unit is synchronized to UTC it is said to be "LOCKED ON". At this point the "QT", "QD", "QL" and "QC" replies will contain the most accurate information (time and location) possible.

When the unit is fully synchronized (LOCKED ON), the synchronization character shall the letter "Y" in the "QC" data stream and the LED indicator shall be **solid green and red flashing** once per second.

10.9.11 Power Requirements

The power requirements of the Model 2070-7G Universal Time Base Module shall be within the power limitations of the Model 2070 UNIT as describe elsewhere in this specifications.

10.9.12 Environmental

The Model 2070-7G Universal Time Base Module shall operate within the specifications listed in Chapter 1 Section 1.8.4.

10.9.13 Form Factor

See A10-9 for Details

APPENDIX A CHAPTER DETAILS

APPENDIX A1

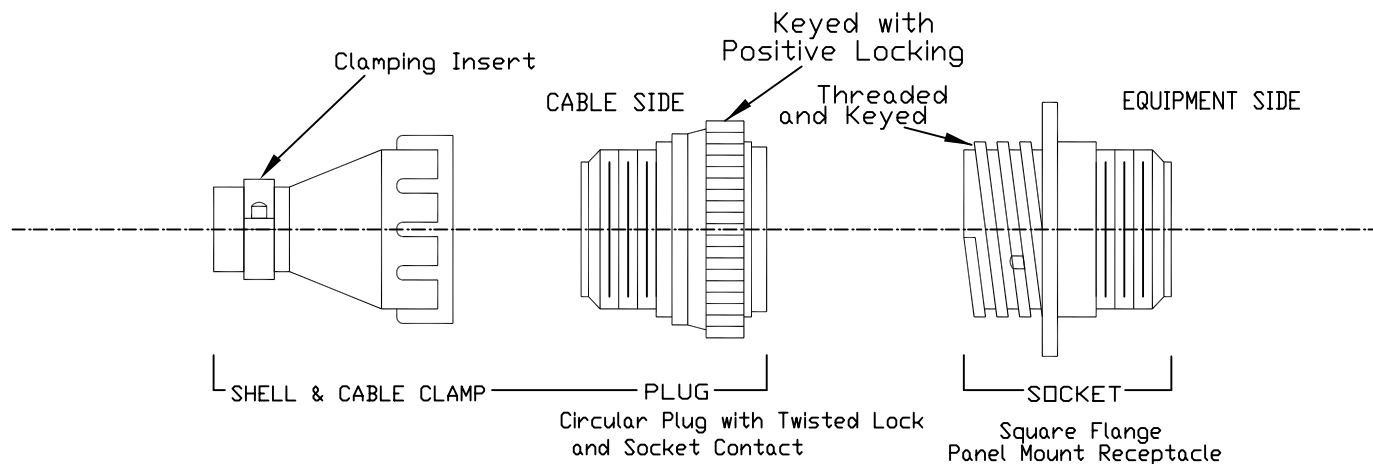
CHAPTER 1 DETAILS

M104 – Connector

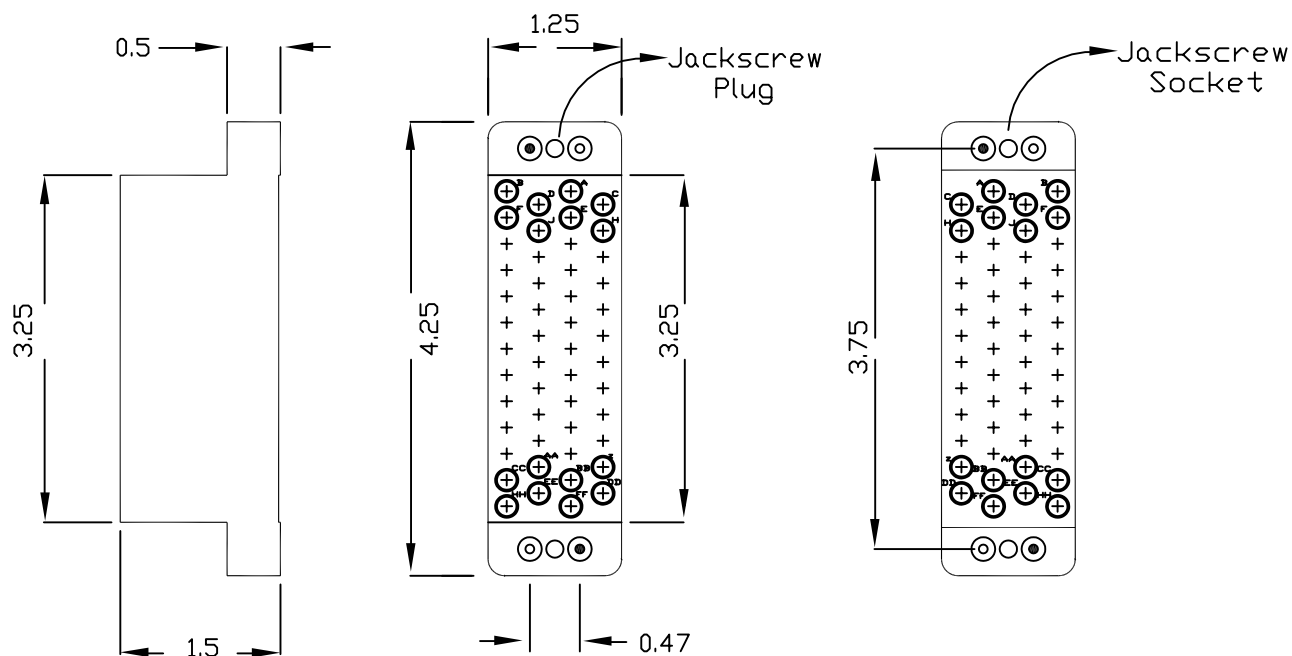
M50 & Circular Plastic Connectors

A1-1

A1-2



PLASTIC CIRCULAR PLUG AND SOCKET CONNECTOR



CONNECTOR PIN ARRANGEMENT

NOTES:

1. Guide Pins & Sockets, and Jackscrews are centered symmetrical to connector.
2. Key:
 - socket
 - plug
3. All dimensions shown are in inches.

TITLE: CONNECTOR DETAIL
M50 & CIRCULAR PLASTIC
CONNECTOR

1-21-2010, ERRATA 1

NO SCALE

TEES 2009

A1-2

APPENDIX A2

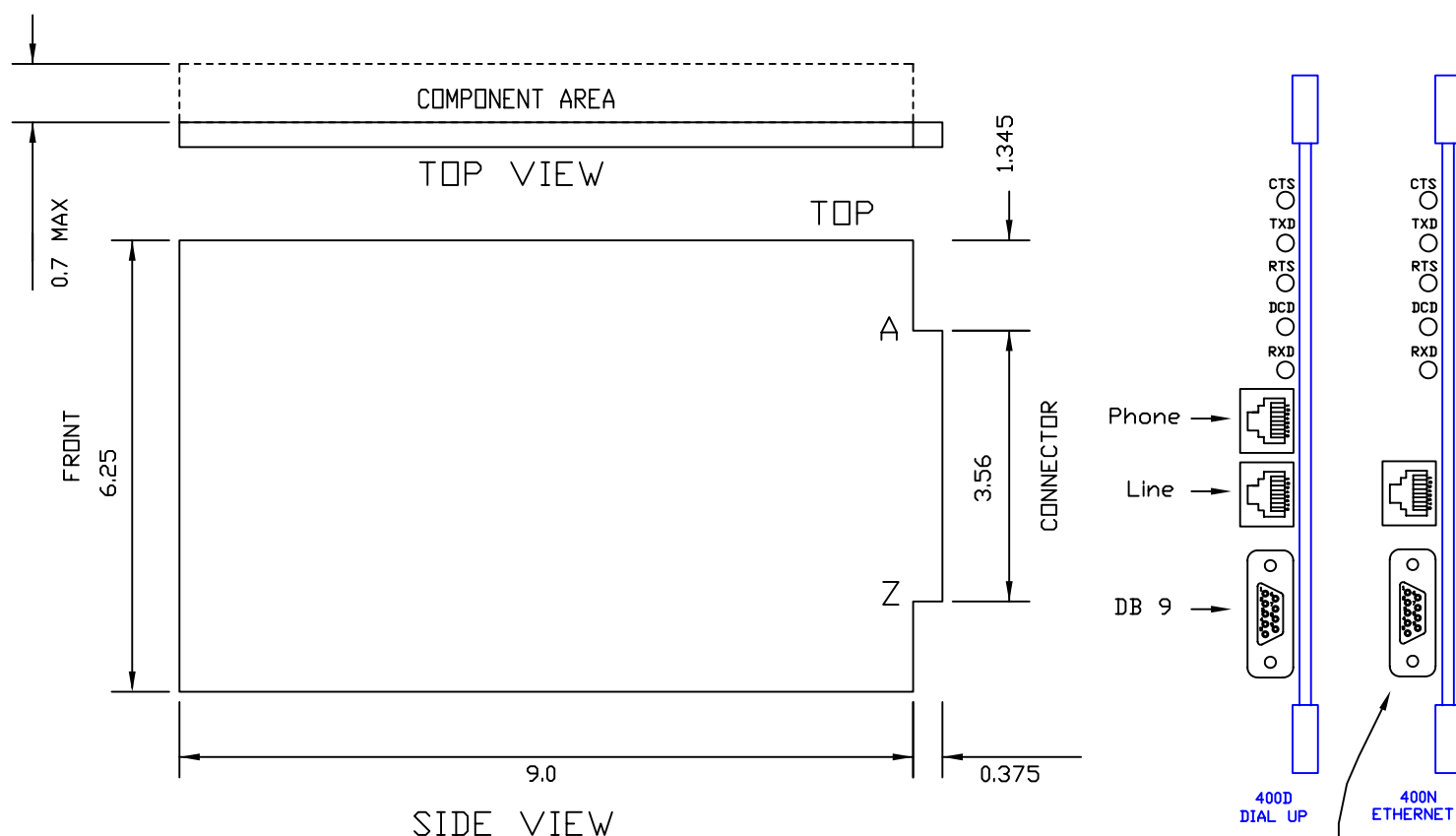
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Model 400D Dial-Up and 400N Ethernet Module	A2-7
Model 400F Fiber Module	A2-8

NOTES:

1. Program module' height and width dimensions are maximum.
2. C1 connector Pins 1, 14, 92 & 104 shall be connected to the controller unit DC logic ground.
3. All function under connector C2 & the terminal block T-1 are in reference to the MODEM
4. Detail Definitions:

BL	= BLANKING
CC	= CHARACTER CONTROL OR STROBE
CD	= CARRIER DETECT
CH	= CHARACTER
CTS	= CLEAR TO SEND
DP	= DECIMAL POINT
LS	= LEAST SIGNIFICANT
MS	= MOST SIGNIFICANT
NA	= PRESENTLY NOT ASSIGNED. CANNOT BE USED BY THE CONTRACTORS FOR OTHER PURPOSES.
NLS	= NEXT LEAST SIGNIFICANT
NMS	= NEST MOST SIGNIFICANT
P&I	= PHASE AND INTERVAL
RTS	= REQUEST TO SEND



CARD EDGE	
PIN	FUNCTION
A	DC GROUND
B	DC GROUND
C	+12 VDC
D	+12 VDC
E	-12 VDC
F	-12 VDC
H	NA
J	NA
K	DCD
L	RTS
M	TXD
N	CTS
P	RXD
R	NA
S	NA
T	NA
U	NA
V	NA
W	NA
X	NA
Y	NA
Z	NA

DB9-PIN ASSIGNMENT	
PIN	FUNCTION
1	DCD
2	RXD
3	TXD
4	NA
5	IFC GND
6	NA
7	RTS
8	CTS
9	NA

RJ-11 PIN-OUT	
PIN	FUNCTION
2	TIP TERMINAL
3	RING TERMINAL

RJ45 ETHERNET PIN ASSIGNMENT			
PIN	FUNCTION	PIN	FUNCTION
1	TX +	5	NA
2	TX -	6	NA
3	RX +	7	NA
4	RX-	8	NA

TITLE:

MODEL 400D & 400N

NOTE:

All dimensions shown are in inches.

1-21-2010, ERRATA 1

NO SCALE

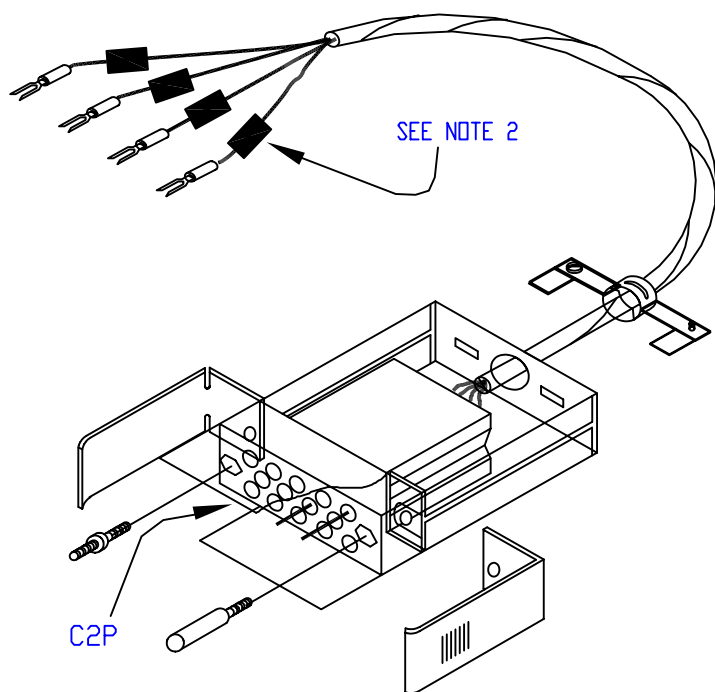
TEES 2009

A2-7

APPENDIX A3

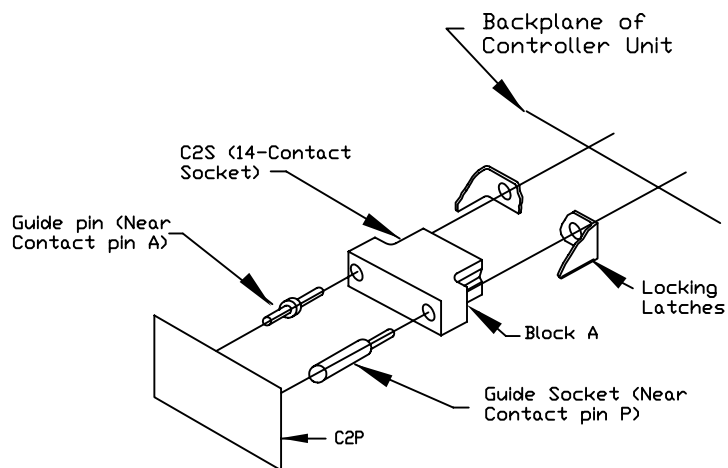
CHAPTER 3 DETAILS

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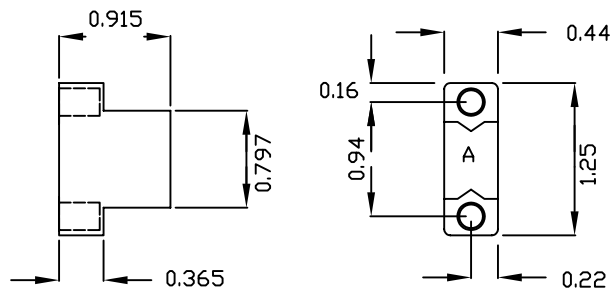


C2 MODEM HARNESS

C2P CONNECTOR ASSIGNMENT			
PIN	FUNCTION	PAIR	WIRE COLOR
A	AUDIO IN	PAIR 2	WHITE
B	AUDIO IN		GREEN
C	AUDIO OUT	PAIR 1	RED
E	AUDIO OUT		BLACK



CONNECTOR C2 DETAIL



CONNECTOR C2S

NOTES:

1. Cable length shall be 36.00in minimum. The cable shall be 2-pair #20 cable conductors, Belden 9402 or equal. The field end connections shall be #8 stud spring spade type.
2. Each conductor (AUDIO IN or AUDIO OUT) shall be labeled.
3. All dimensions shown are in inches.

TITLE:

C2 MODEM HARNESS

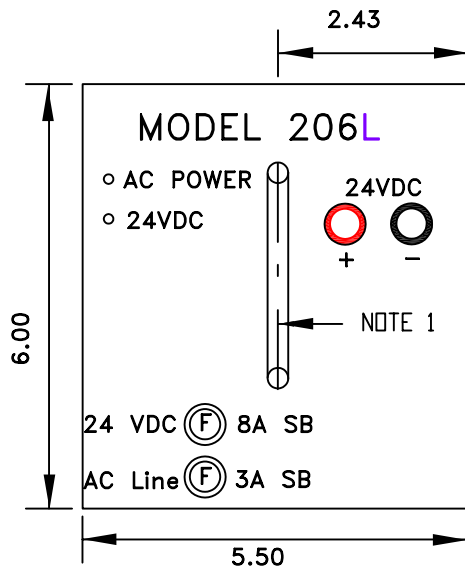
1-21-2010, ERRATA 1

NO SCALE

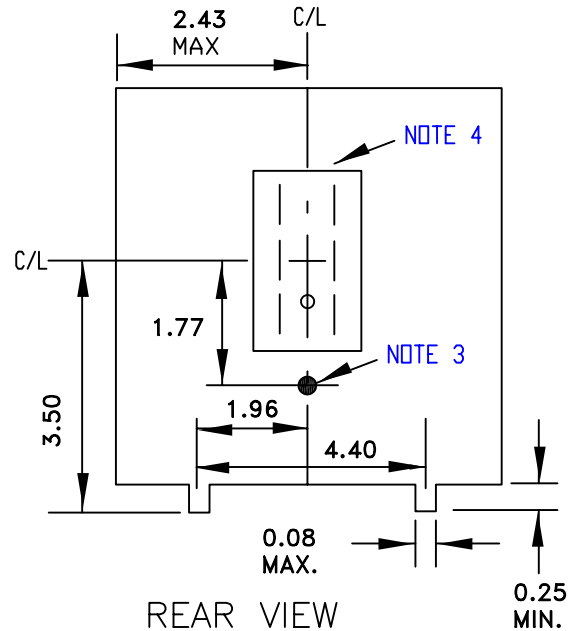
TEES 2009

A3-5

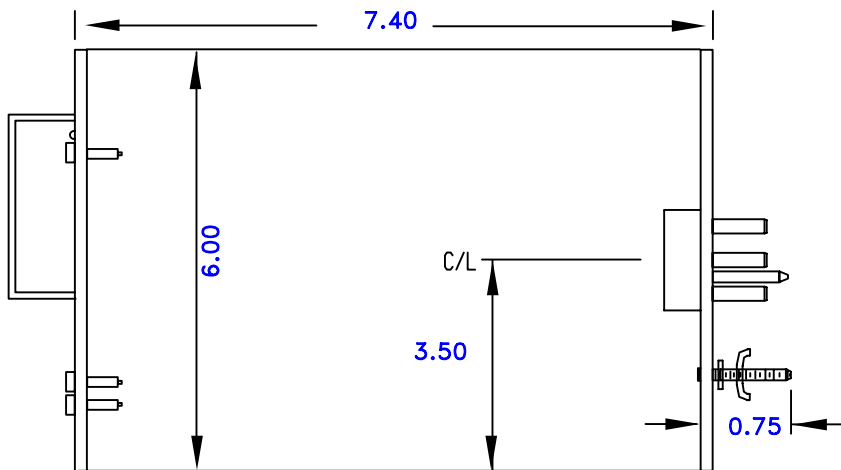
MODEL 206L POWER SUPPLY MODULE



FRONT VIEW

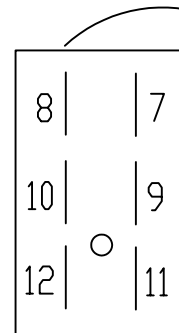


REAR VIEW



SIDE VIEW

POWER SUPPLY MODULE WIRING DETAIL



PIN NO.	CIRCUIT
7	+24 VDC
8	DC GND
9	EQUIPMENT GND
10	NA
11	AC- CLEAN
12	AC+ CLEAN

REAR VIEW

NOTE:

1. "U" sharpened rod handle fabricated of 0.25 ± 0.05 diameter, aluminum stock, with 4.00 ± 0.125 length, & rod center to center, shall be provided. The handle shall be vertically centered. The depth from the vertical centerline of the handle rod to the module from panel shall be 1.25 ± 0.125 .
2. The power supply module dimension, from panel to connector plug, shall be $7.375 + 0.000, - 0.125$
3. A standard 8-32 metal stud retaining screw shall provide proper securing of the power supply when installed in the PDA using washers and a wingnut.
4. Connector BEAU P-5406 or equivalent.
5. All dimensions shown are in inches.

TITLE:

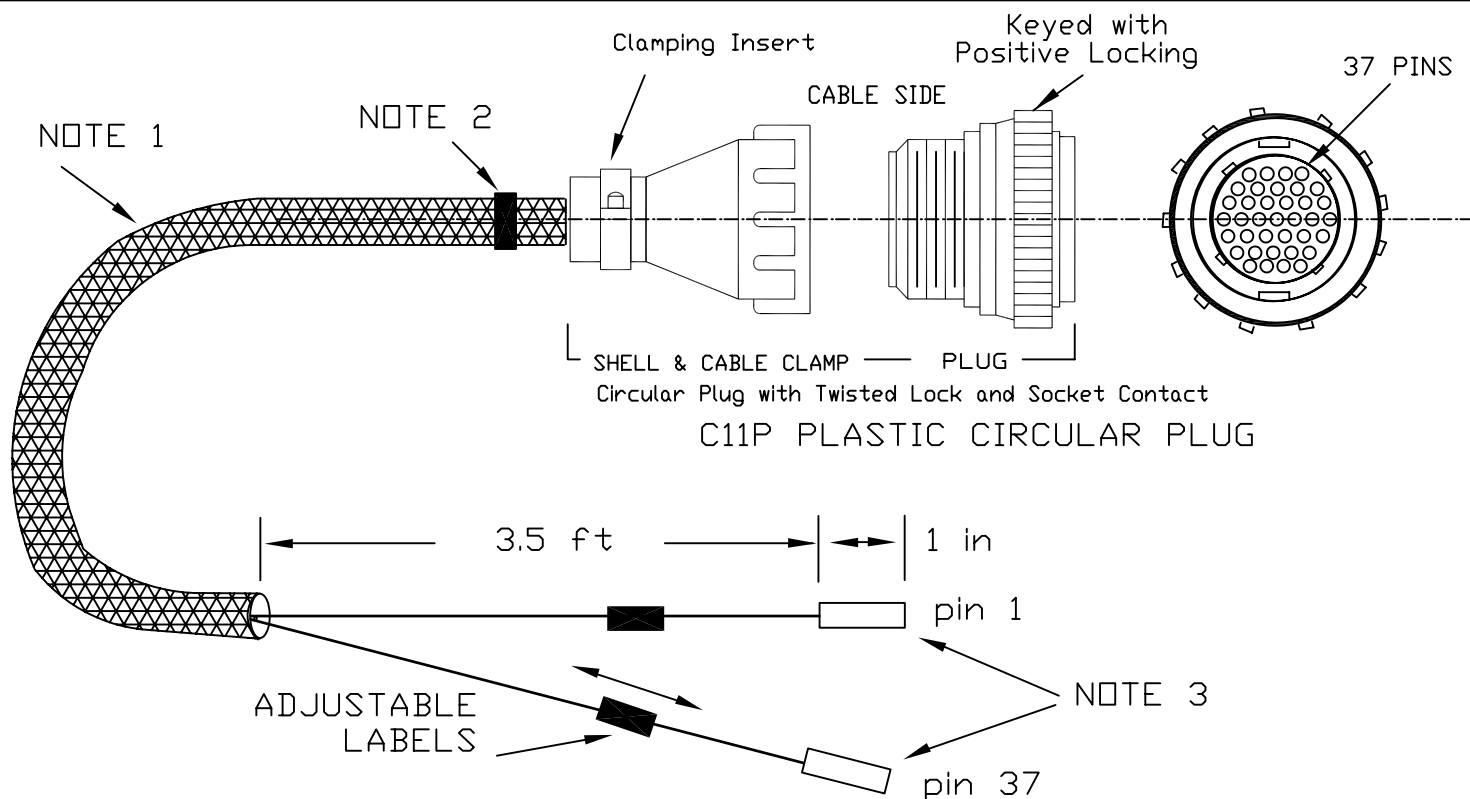
MODEL 206L POWER SUPPLY

1-21-2010, ERRATA 1

NO SCALE

TEES 2009

A3-6



C11P PIN ASSIGNMENT & LABELS

PIN 1	08-1	PIN 11	14-2	PIN 21	17-7	PIN 31	DCG #2
PIN 2	08-2	PIN 12	14-3	PIN 22	17-8	PIN 32	NC
PIN 3	08-3	PIN 13	14-4	PIN 23	18-1	PIN 33	NC
PIN 4	08-4	PIN 14	DCG #2	PIN 24	18-2	PIN 34	NC
PIN 5	08-5	PIN 15	17-1	PIN 25	18-3	PIN 35	NC
PIN 6	08-6	PIN 16	17-2	PIN 26	18-4	PIN 36	NC
PIN 7	08-7	PIN 17	17-3	PIN 27	18-5	PIN 37	NC
PIN 8	08-8	PIN 18	17-4	PIN 28	18-6		
PIN 9	DCG #2	PIN 19	17-5	PIN 29	18-7		
PIN 10	14-1	PIN 20	17-6	PIN 30	18-8		

TABLE 1

NOTES:

1. The C11 Harness shall be a minimum of 7.5ft in length. Four feet of the harness wire bundle shall be provided with external protection. The conductors shall be compliant to section 6.5.2
2. The connectorized end of the C11 harness shall be labeled as C11.
3. Each conductor of the loose end of the C11 Harness shall be labeled with the port assignment as indicated in Table 1. Each end of the conductors shall be cover with one inch of heat shrinkable tubing.
4. The C11P circular plastic connector shall have quick connect/disconnect capability with thread assist, positive detent coupling. The connector shall be UL Recognized, UL 94 V-1 rated and made of stabilized, heat resistant, self-extinguishing thermoplastic material.
5. The manufacturer shall be provide a bag with 45 #8 stud spring spades for each C11 harness.

TITLE:

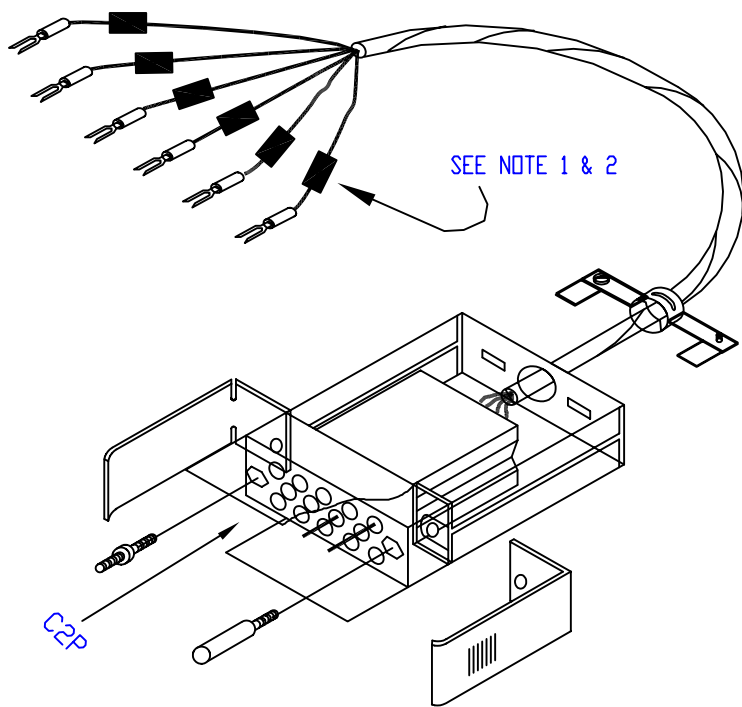
C11 HARNESS

1-21-2010, ERRATA 1

NO SCALE

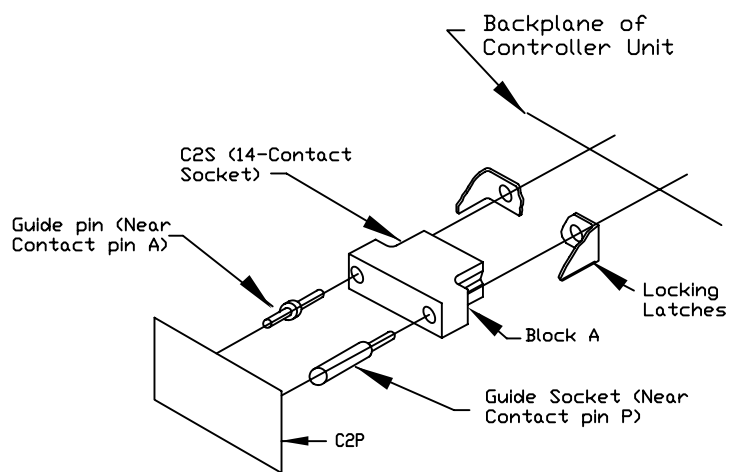
TEES 2009

A3-7

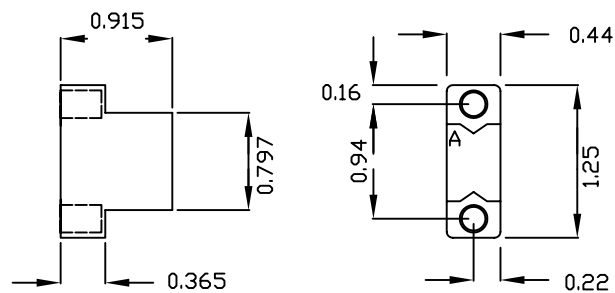


C2 SERIAL HARNESS

C2P CONNECTOR ASSIGNMENT			
PIN	FUNCTION	PIN	FUNCTION
A	NA	J	RTS
B	NA	K	RXD
C	NA	L	TXD
D	NA	M	CTS
E	NA	N	GND
F	NA	P	NA
H	DCD	R	NA



CONNECTOR C2 DETAIL



CONNECTOR C2S

NOTES:

1. Cable length shall be 36.00in minimum. The cable shall be 24AWG, 6 conductors, Belden 9536 or equal. The field end connections shall be #6 stud spring spade type.
2. Each conductor (DCD, RTS, RXD, TXD, CTS, GND) shall be labeled.
3. All dimensions shall be inches.

TITLE:

C2 SERIAL HARNESS

1-21-2010, ERRATA 1

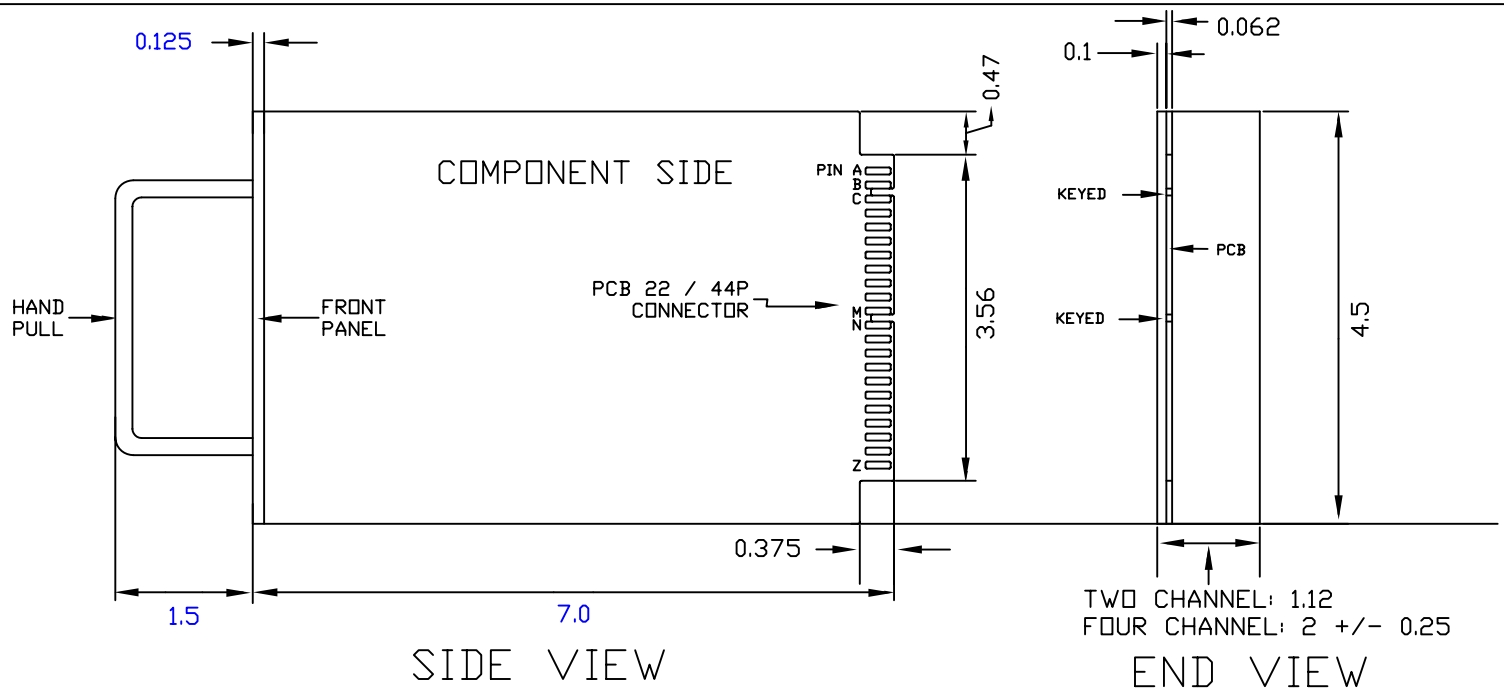
NO SCALE

TEES 2009

A3-8

APPENDIX A5

CHAPTER 5 DETAILS



MODEL 222, 224 & 232 CONNECTOR ASSIGNMENTS

PIN	FUNCTION (SENSORS)
A	DC GROUND
B	+24 VDC

*C	DETECTOR RESET
D	INPUT #1
E	INPUT #1
F	OUTPUT #1 (C)
H	OUTPUT #1 (E)
J	INPUT #2
K	INPUT #2
L	EQUIPMENT GROUND
M	AC-

N	AC+
P	INPUT #3
R	INPUT #3
S	OUTPUT #3 (C)
T	OUTPUT #3 (E)
U	INPUT #4
V	INPUT #4
W	OUTPUT #2 (C)
X	OUTPUT #2 (E)
Y	OUTPUT #4 (C)
Z	OUTPUT #4 (E)

MODEL 242 & 252 CONNECTOR ASSIGNMENTS

PIN	FUNCTION (ISOLATORS)
*A	DC GROUND
*B	+24 VDC

C	NA
D	INPUT #1
E	INPUT #1
F	OUTPUT #1 (C)
H	OUTPUT #1 (E)
J	INPUT #2
K	INPUT #2
L	EQUIPMENT GROUND
M	AC-

N	AC+
P	NA
R	NA
S	NA
T	NA
U	NA
V	NA
W	OUTPUT #2 (C)
X	OUTPUT #2 (E)
Y	NA
Z	NA

NOTES:

- Tolerance dimensions are +/-0.02 in except as noted
- Sheet definitions:
 ----= Slotted for keying
 (C) = Collector
 (E) = Emitter
 * = NA for these connections on Models 232 & 242
- "U" shape rod handle shall be fabricate of 0.18 in to 0.26 in diameter stock.
- All dimensions shall be in inches.

TITLE: SENSOR UNIT AND ISOLATOR
DETAILS

1-21-2010, ERRATA 1

NO SCALE

TEES 2009

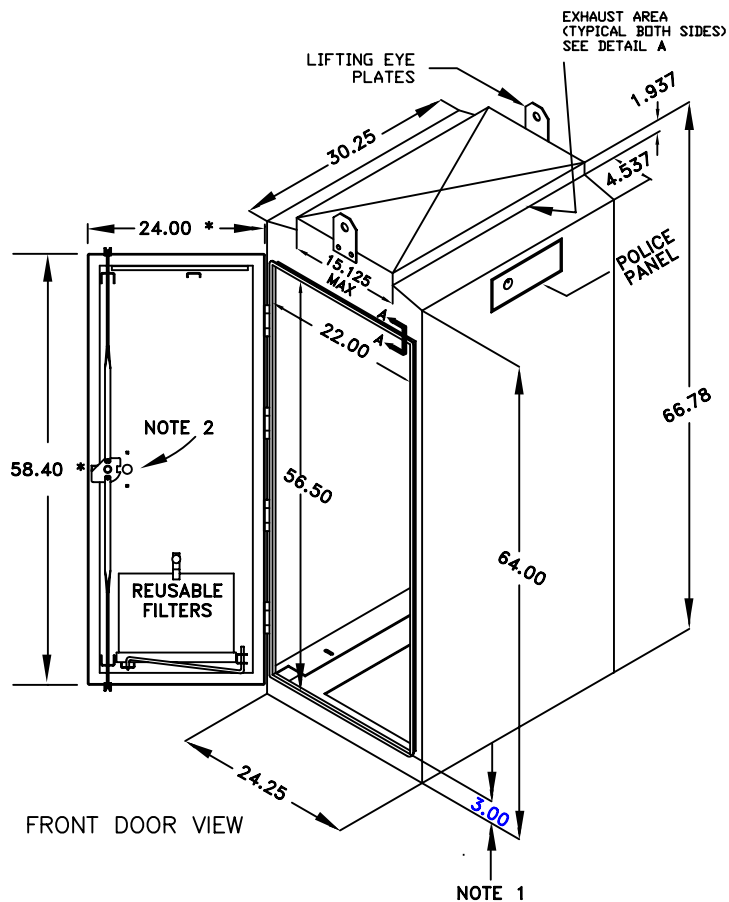
A5-1

APPENDIX A6

CHAPTER 6 DETAILS

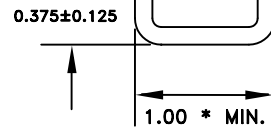
Cabinet Housing Details - sheet 1 of 4	A6-1
Cabinet Housing Details - sheet 2 of 4	A6-2
Cabinet Housing Details - sheet 3 of 4	A6-3
Cabinet Housing Details - sheet 4 of 4	A6-4
Cabinet Equipment Mounting Details	A6-5
Drawer Shelf Details	A6-6
Model 332L and 336L One Line Diagram	A6-7
SSR Installation Details	A6-8
Model 334L One Line Diagram	A6-9
Service Panel Assembly Details – sheet 1 of 3	A6-10
Service Panel Assembly Details – sheet 2 of 3	A6-11
Service Panel Assembly Details - sheet 3 of 3	A6-12
PDA #2L & #3L Details – sheet 1 of 3	A6-13
PDA #2L & #3L Details – sheet 2 of 3	A6-14
PDA #2L & #3L Details – sheet 3 of 3	A6-15
Input/Output Files Details - sheet 1 of 5	A6-16
Input/Output Files Details - sheet 2 of 5	A6-17
Input/Output Files Details - sheet 3 of 5	A6-18
Input/Output Files Details - sheet 4 of 5	A6-19
Input/Output Files Details - sheet 5 of 5	A6-20
Side Panel Details - sheet 1 of 4	A6-21
Side Panel Details - sheet 2 of 4	A6-22
Side Panel Details - sheet 3 of 4	A6-23
Side Panel Details - sheet 4 of 4	A6-24
Harness Wiring Details - sheet 1 of 5	A6-25
Harness Wiring Details - sheet 2 of 5	A6-26
Harness Wiring Details - sheet 3 of 5	A6-27
Harness Wiring Details - sheet 4 of 5	A6-28
Harness Wiring Details - sheet 5 of 5	A6-29
Fan and Thermostat Details	A6-30

CABINET HOUSING 1B



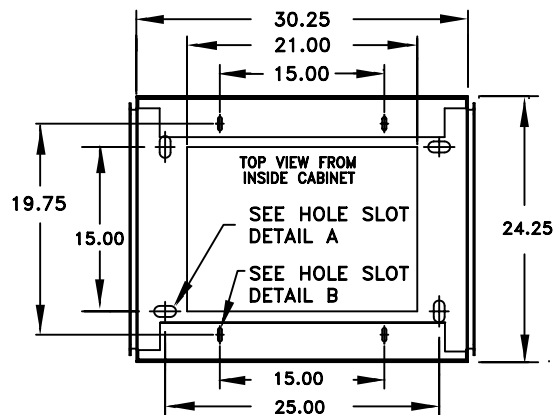
DETAIL A CABINET HOUSING 1B & 2 VENTILATION EXHAUST DETAIL

SECTION A-A CABINET HOUSING 1B & 2 FLANGE AROUND DOOR OPENING

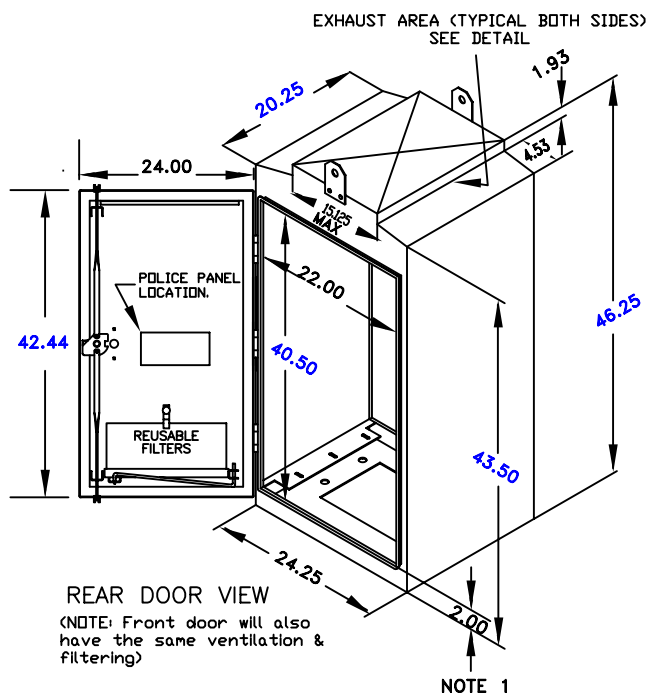


* TOLERANCE +0.0625, -0

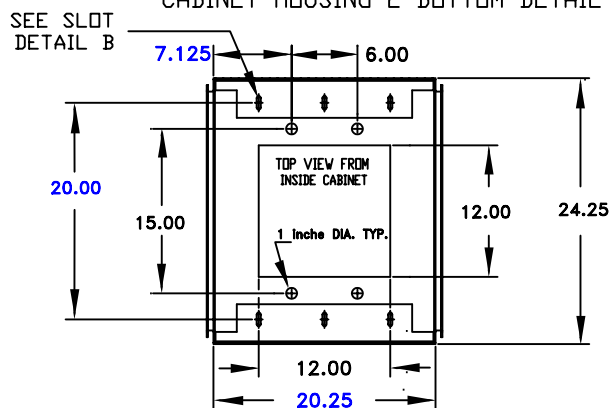
CABINET HOUSING 1B BOTTOM DETAIL



CABINET HOUSING 2

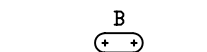
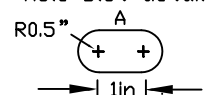


CABINET HOUSING 2 BOTTOM DETAIL



NOTE: ALL HOLE PATTERNS CENTERED ON CABINET BOTTOMS.

Hole slot detail



NOTE:

1. Cabinet base to door opening.
2. The locks & handles shall be on left side of the front door & the right side of the rear door (viewed externally)
3. All dimensions shown are in inches.

TITLE:

CABINET HOUSING DETAILS SHEET 1 OF 4

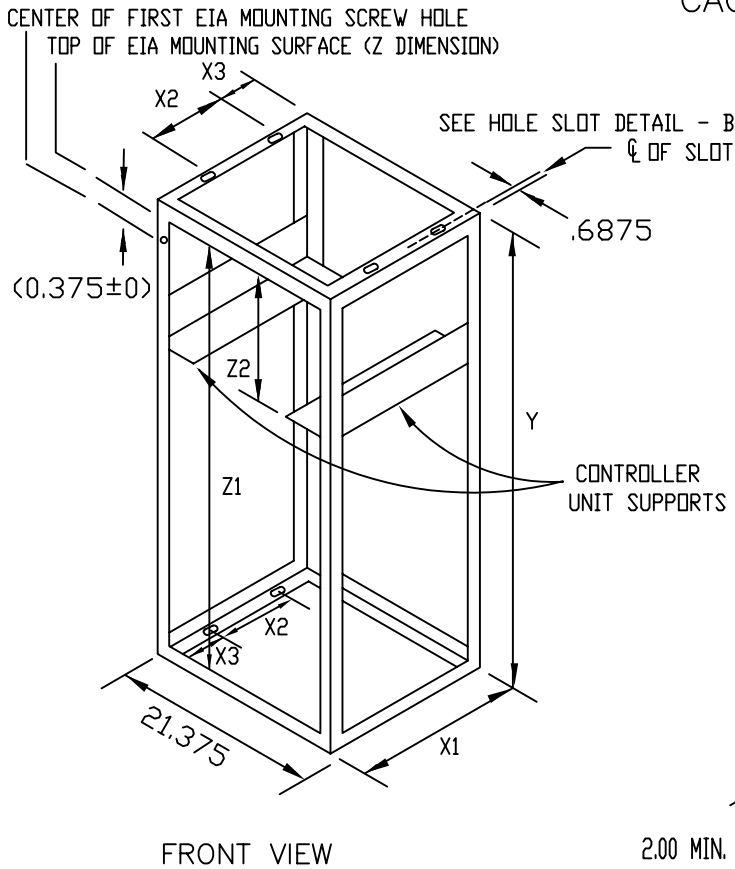
1-21-2010, ERRATA 1

NO SCALE

TEES 2009

A6-1

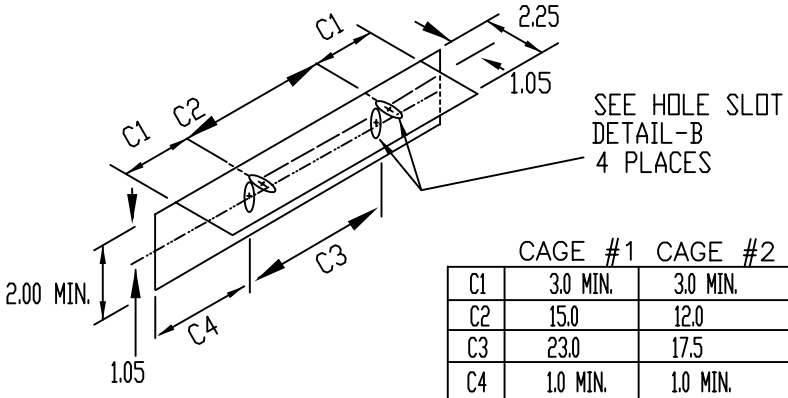
CAGE SUPPORT DETAIL



CABINET CAGE DIMENSIONS

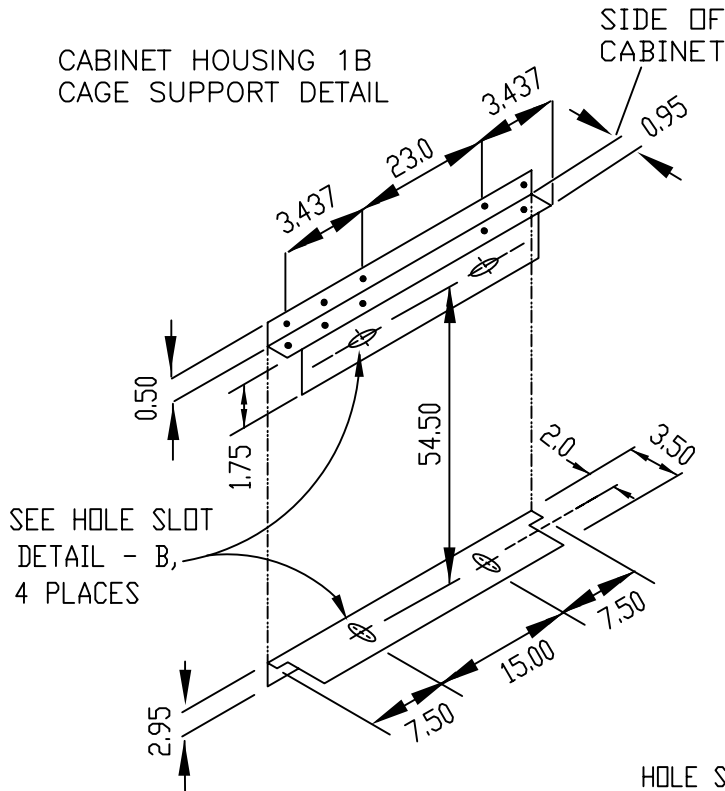
	CAGE #1	CAGE #2
X1	21.375	16.00
X2	15.00	12.00
X3	3.188	2.00
Y	55.50	40.00
Z1	53.00 MIN.	39.00 MIN.
Z2	15.75	7.25

SPACER BRACKET DETAIL

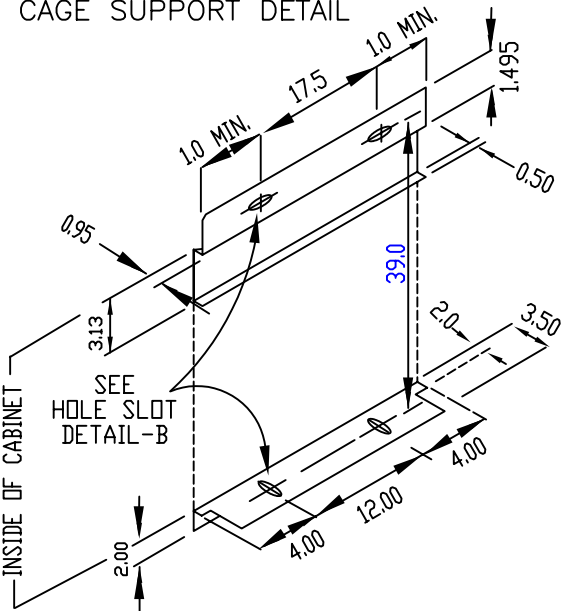


CAGE #1 CAGE #2

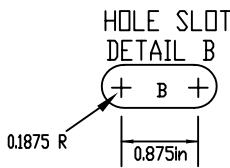
C1	3.0 MIN.	3.0 MIN.
C2	15.0	12.0
C3	23.0	17.5
C4	1.0 MIN.	1.0 MIN.



CABINET HOUSING 2 CAGE SUPPORT DETAIL



NOTE:
All dimensions shown are in inches



TITLE:

CABINET HOUSING DETAILS SHEET 2 OF 4

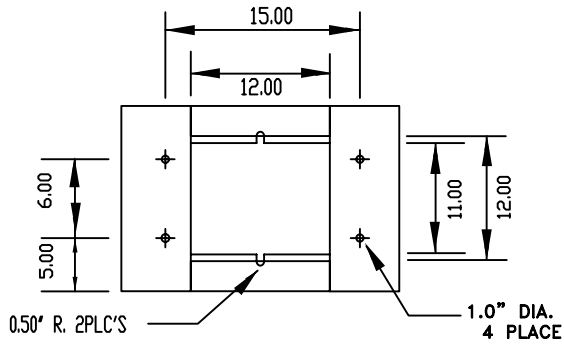
1-21-2010, ERRATA 1

NO SCALE

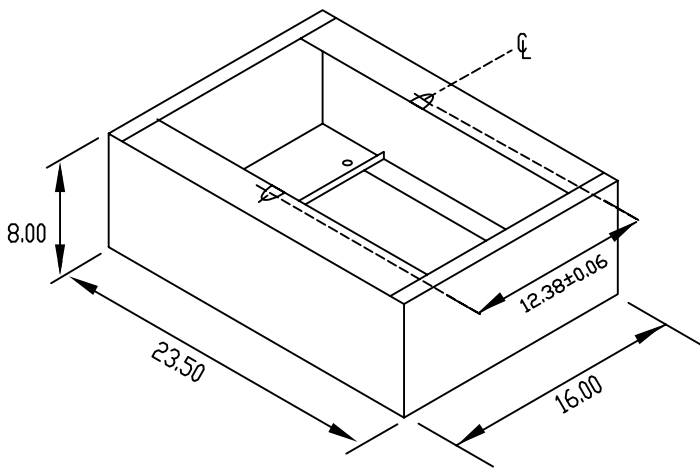
TEES 2009

A6-2

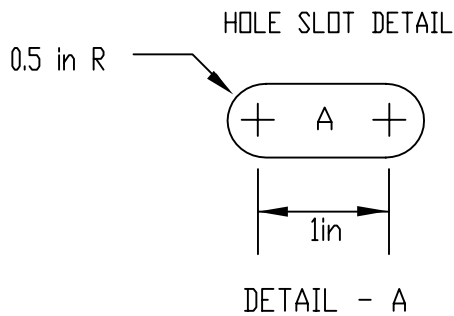
CABINET HOUSING 2
"M" BASE ADAPTOR DETAIL



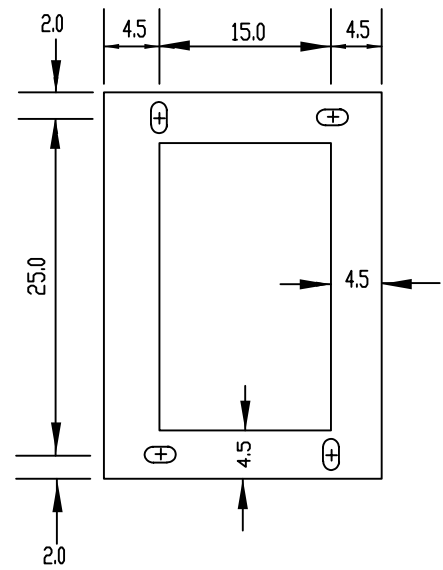
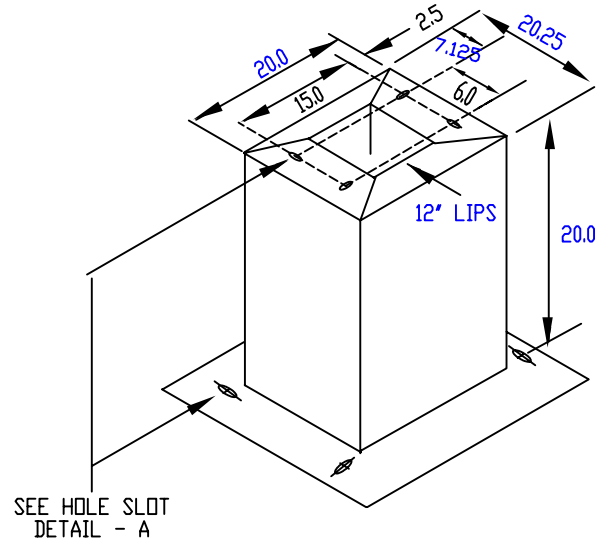
TOP VIEW



BOTTOM VIEW



TYPE 332/336 ADAPTOR



332 BASE VIEW

NOTE:

All dimensions shown are in inches.

TITLE:

CABINET HOUSING DETAILS
SHEET 3 OF 4

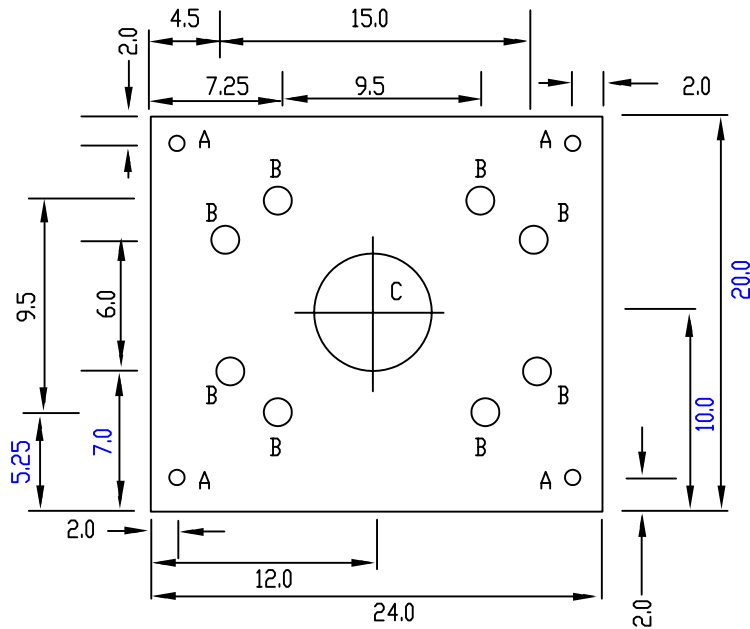
1-21-2010, ERRATA 1

NO SCALE

TEES 2009

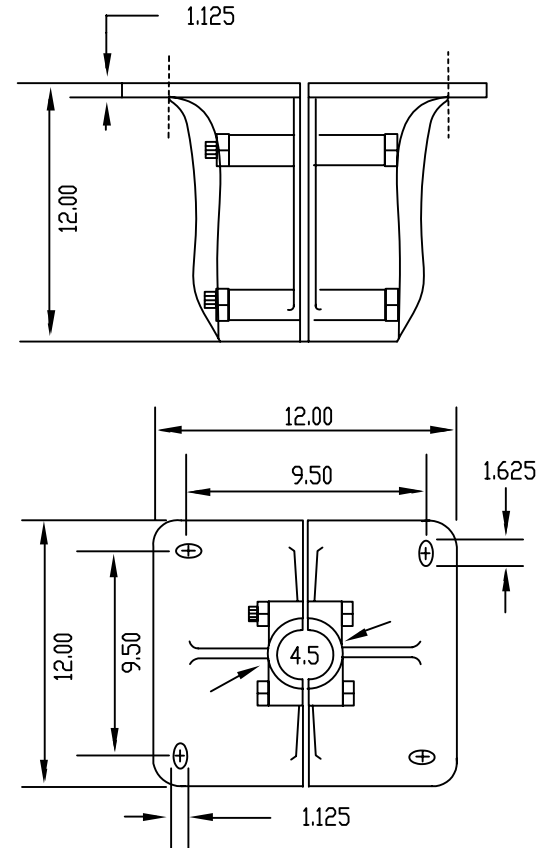
A6-3

CABINET HOUSING 2 PEDESTAL ADAPTOR

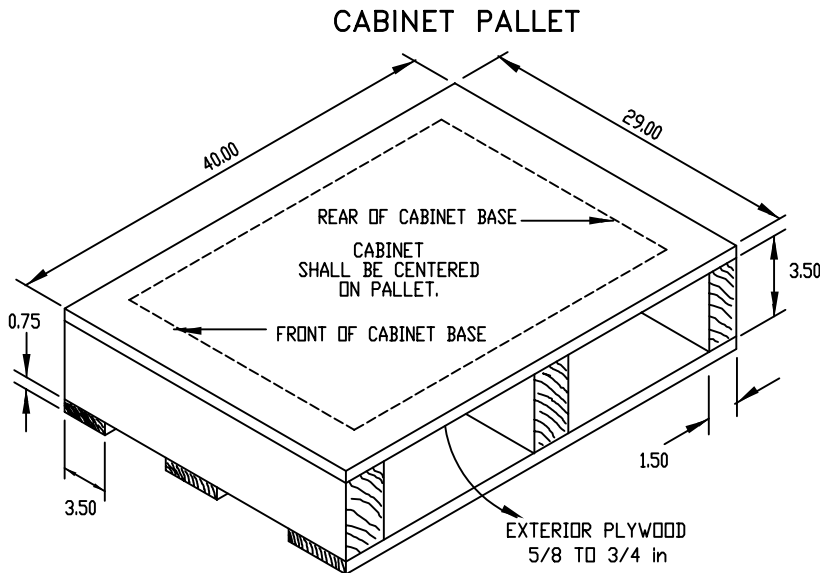


SLIPFITTER BASE PLATE DETAIL
(0.375 inches ALUMINUM)

A = 0.50 in DIA.
B = 1 in DIA.
C = 5 in DIA.



SLIPFITTER (CAST ALUMINUM)
DETAIL



NOTE: (FOR DETAILS A6-1 to A6-4)

1. Housing 1B used in cabinets 332L & 334L and Housing 2 in cabinet 336L.
2. Adaptors delivered separately shall be delivered centered and bolted on a plywood shipping pallet.
3. Dashed lines on cabinet cage support detail delineates the cabinet side wall.
4. The bottom cabinet cage supports shall be continuously welded along the sides of the cabinet & extended to the inside corner of door openings.
The top cabinet cage supports shall be continuously welded along the sides of the cabinet.
5. Cage support hole slots dimension shall be common for top & bottom.
6. All dimensions shown are in inches.

TITLE:

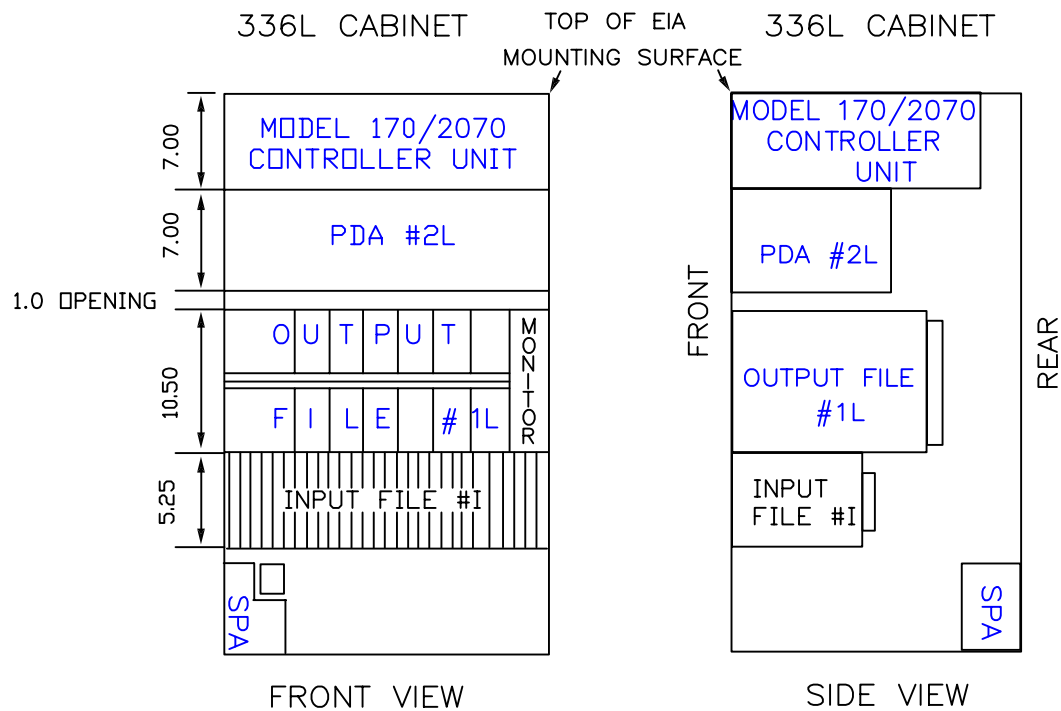
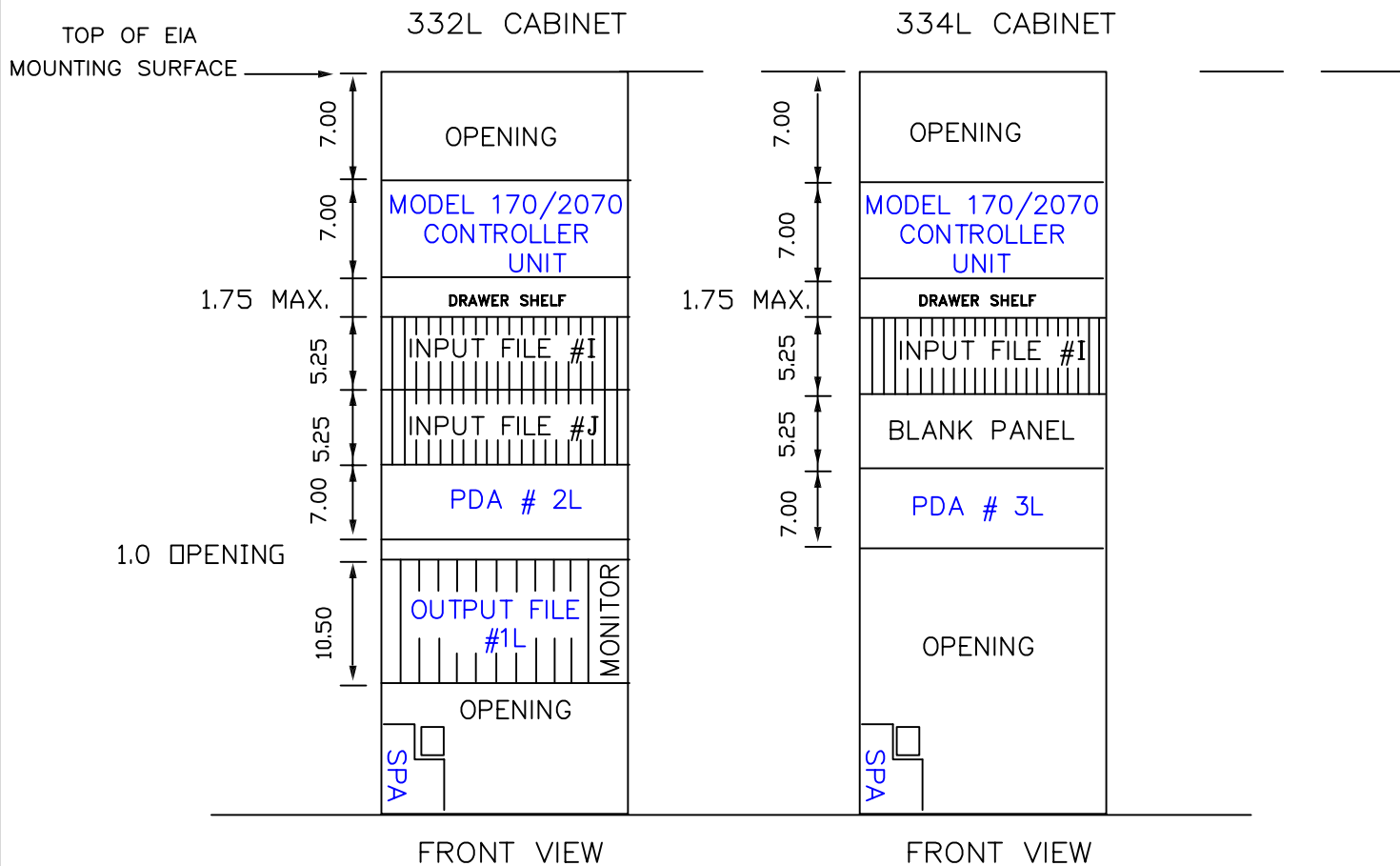
CABINET HOUSING DETAILS
SHEET 4 OF 4

1-21-2010, ERRATA 1

NO SCALE

TEES 2009

A6-4

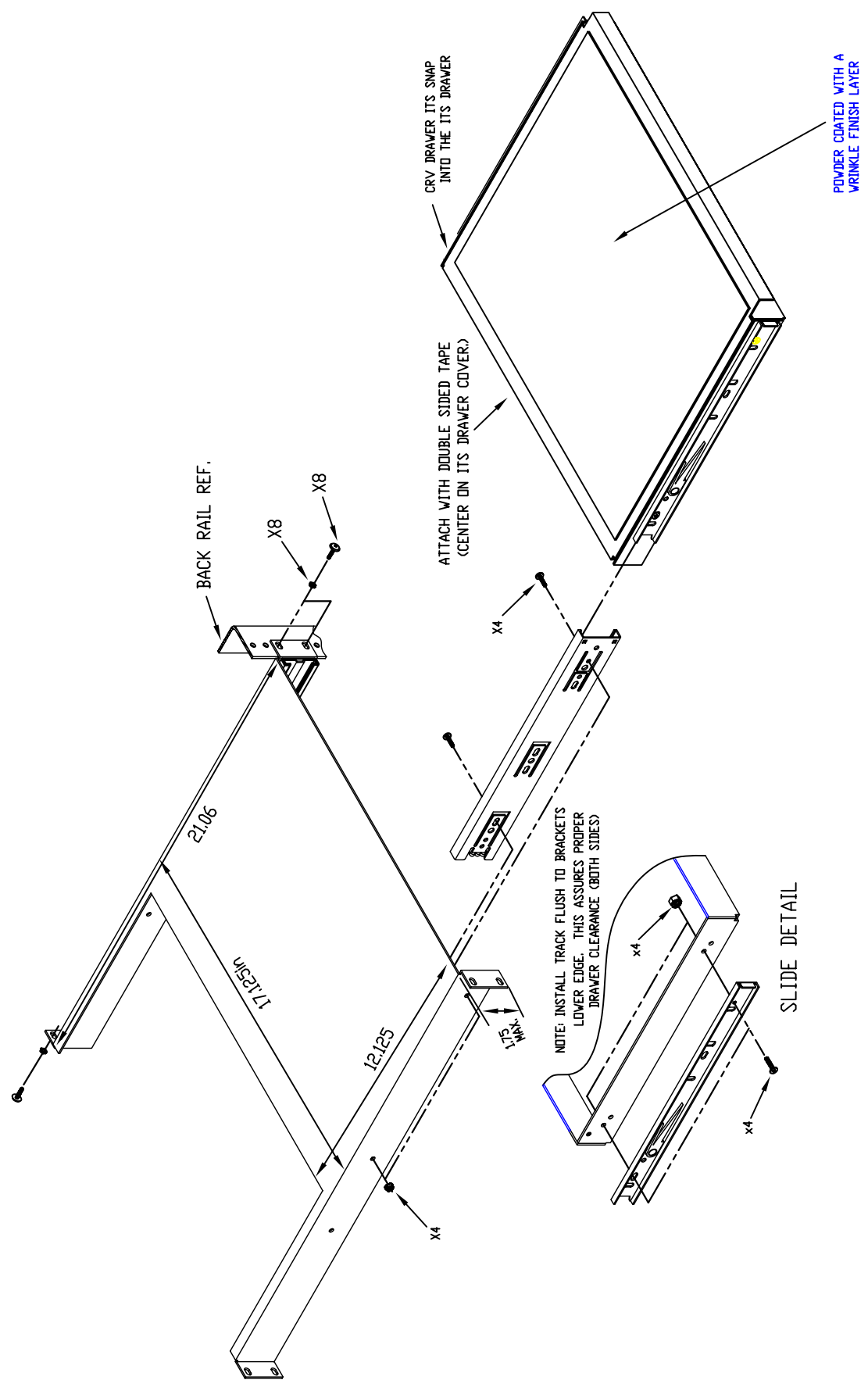


NOTE:

All dimensions shown are in inches.

TITLE: CABINET EQUIPMENT MOUNTING DETAILS	
1-21-2010, ERRATA 1	NO SCALE
TEES 2009	A6-5

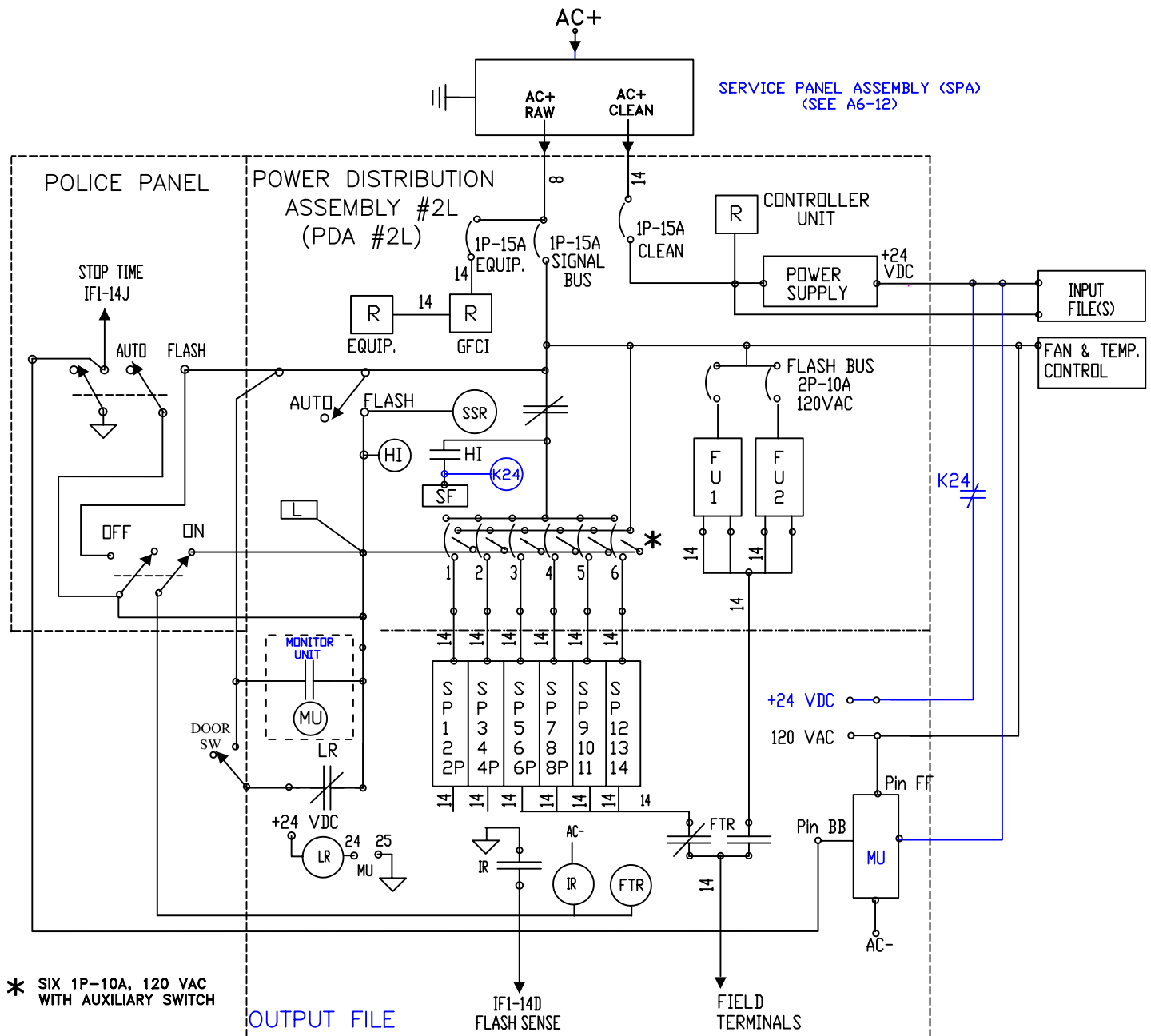
DRAWER SHELF UNIT



NOTE:
All dimensions shown are in inches

TITLE: DRAWER SHELF DETAILS	
1-21-2010, ERRATA 1	NO SCALE
TEES 2009	A6-6

332L & 336L CABINET ONE LINE DIAGRAM



SHEET DEFINITIONS

TBS	TERMINAL BLOCK - SERVICE	(*)	RELAY COIL - * RELAY NAME	TR	TRANSFER RELAY
	EQUIPMENT GROUND		FLU1	IR	ISOLATION RELAY
8	WIRE SIZE, IF NOT INDICATED SHALL BE #16 AWG OR LARGER		DC GROUND		SWITCH CONTACT
	CIRCUIT BREAKER	WDT	WATCHDOG TIMER	LR	LOGIC RELAY
	DUPLEX RECEPTACLE	FTR	FLASH TRANSFER RELAY	CB-1	SIGNAL CIRCUIT BREAKER 1 (SECONDARY)
WGFI	WITH GROUND FAULT INTERRUPTER		PDA FLASH ON DISPLAY LAMP	IF1-14J	INPUT FILE 1, TERM. BLOCK 14, TERM. DESIGNATION J (CHANNEL 2 INPUT)
	RELAY CONTACT, NORMALLY CLOSED	SPA	SERVICE PANEL ASSEMBLY	T2-6	TERMINAL BLOCK 2, POSITION 6
	RELAY CONTACT, NORMALLY OPEN	MU	MONITOR UNIT	C1-65	C1 CONNECTOR, PIN 65
SSR	SOLID STATE RELAY	SF	SSR Fault Indicator	(HI)	Health Indicator Relay
			K24		Disconnect 24VDC Relay

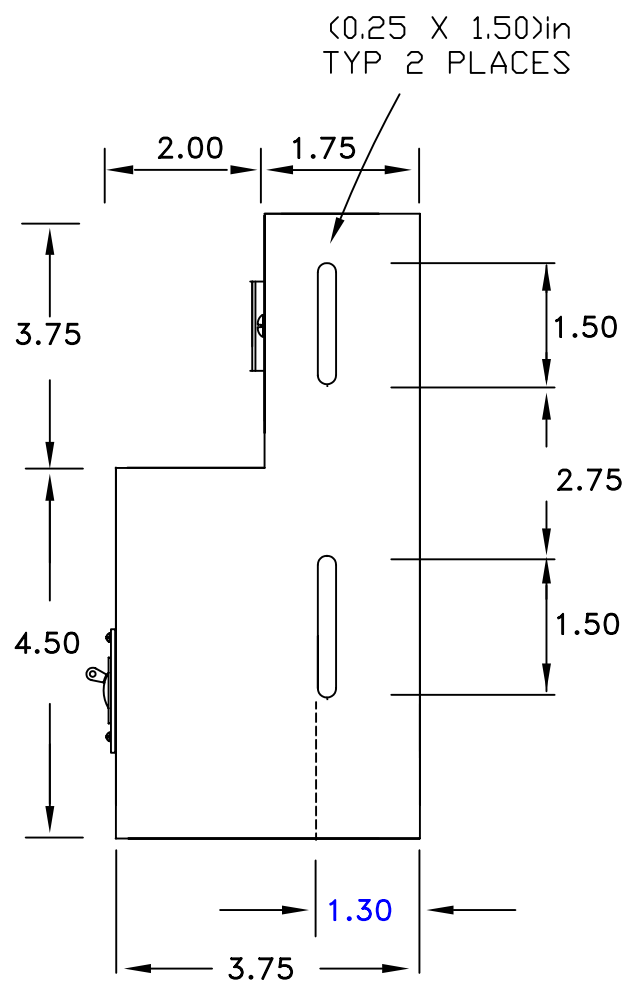
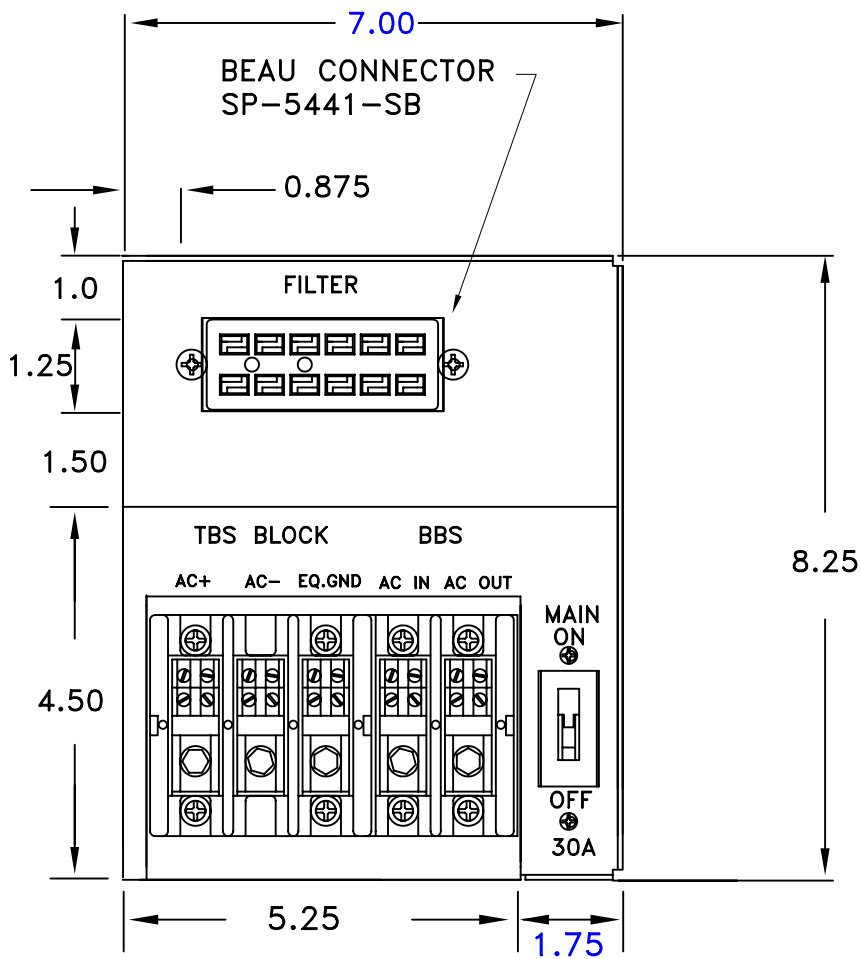
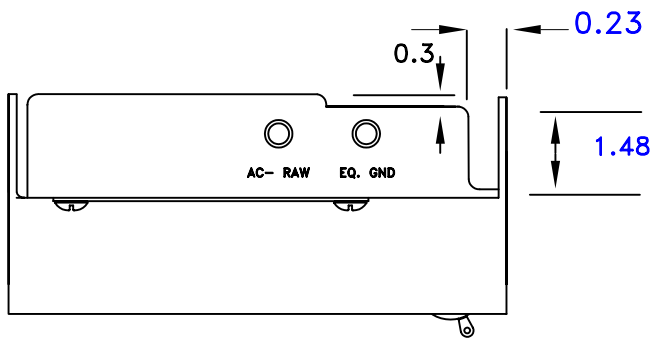
TITLE: MODEL 332L AND 336L ONE LINE DIAGRAM

1-21-2010, ERRATA 1

NO SCALE

TEES 2009

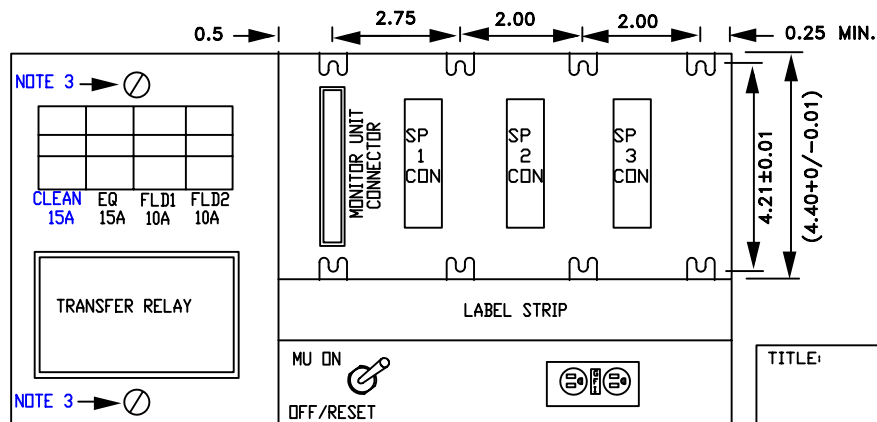
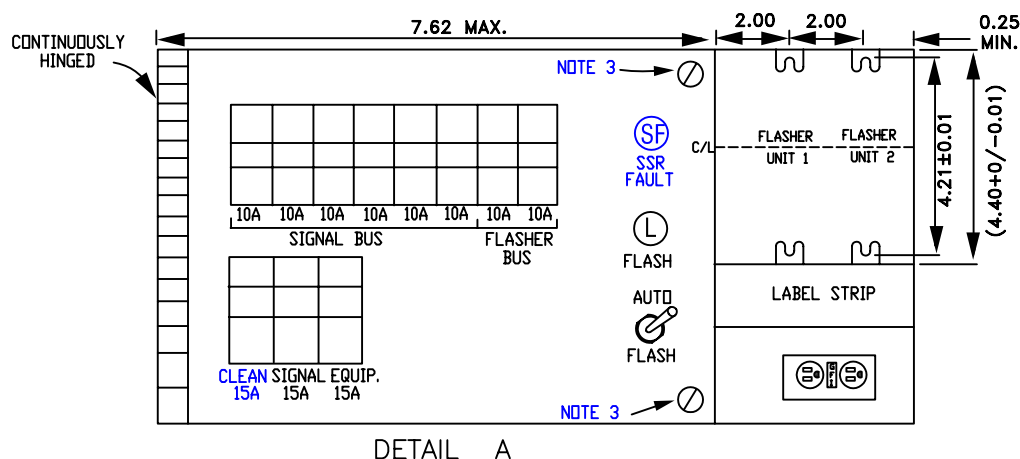
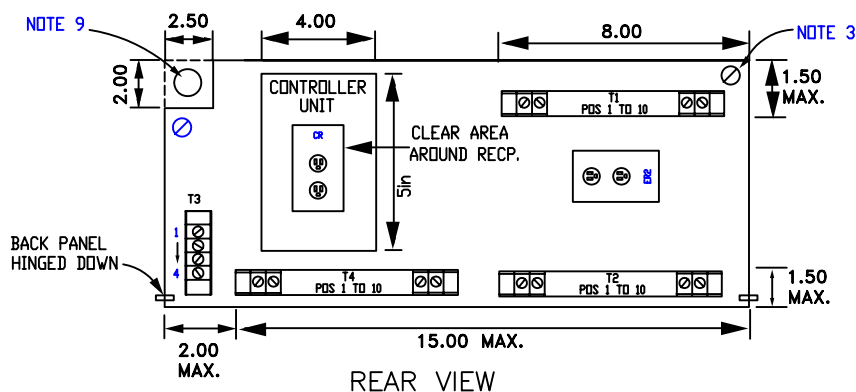
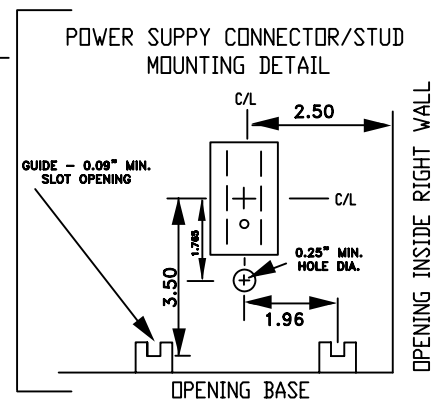
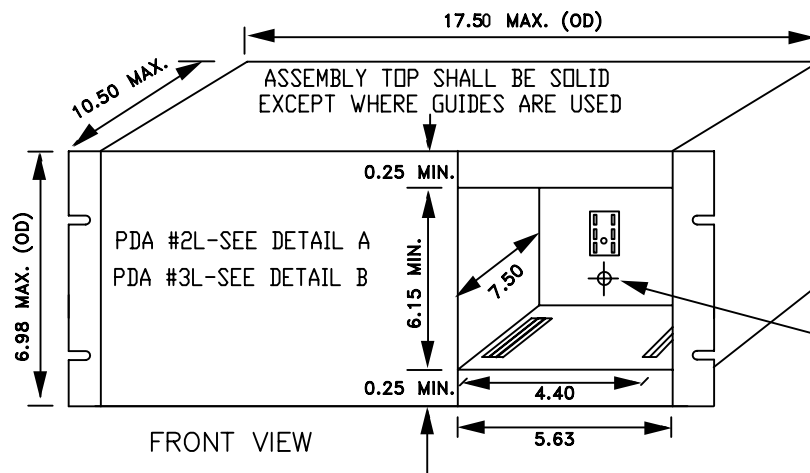
A6-7



NOTE:

All dimensions shown are in inches.

TITLE:	
SERVICE PANEL ASSEMBLY (SPA) DETAILS SHEET 1 OF 3	
1-21-2010, ERRATA 1	NO SCALE
TEES 2009	A6-10



NOTE:

All dimensions shown are in inches.

TITLE:

PDA #2L & #3L DETAILS
SHEET 1 OF 3

1-21-2010, ERRATA 1

NO SCALE

TEES 2009

A6-13

POWER DISTRIBUTION ASSEMBLY TERMINAL BLOCK ASSIGNMENT DETAIL

BLOCK	T1	T2		T3	T4	
PDA's POS	2L A B	2L A B	3L A B	2L & 3L A B	2L A B	3L A B
1.	EG BUS / EG	* / ER AC-	EG BUS / EQ GND	24VDC BUS / PS-7	NA / NA	FL1 / SP 3-3
2.	AC- BUS / AC-	01-5 / FU1-7	AC- BUS / AC-	24VDC (CONTROLLED) / PS-7	NA / NA	FL2 / SP 3-5
3.	CR AC- / AC- CLEAN	01-6 / FU1-8	* / AC+ CLEAN	DC GND BUS / PS 8	NA / NA	FL3 / SP 3-7
4.	* / SCB CKT 5	01-7 / FU2-7	* / AC+ RAW	DC GND BUS / PS-8	NA / NA	FL4 / SP 2-3
5.	* / AC+ RAW	01-8 / FU2-8	* / MU		NA / NA	FL5 / SP 2-5
6.	CR AC+ / AC+ CLEAN	* / FTR DRIVE	* / TR COIL		NA / NA	FL6 / SP 2-7
7.	* / SSR	01-1 / SCB CKT 1	NA / TRC2ND		NA / NA	FL7 / SP 1-3
8.	* / SCB CKT 6	01-2 / SCB CKT 2	NA / TRC2NC		NA / NA	FL8 / SP 1-5
9.	* / FCB1 (SEC)	01-3 / SCB CKT 3	03-5 / FLD2		NA / NA	FL9 / SP 1-7
10.	* / ER AC+	01-4 / SCB CKT 4	SPA AC- / AC- CLEAN / CLEAN		NA / NA	NA / NA

A = EXTERNAL SIDE B = INTERNAL SIDE * = WIRE PER ONE LINE DIAGRAM

NOTES: (FOR DETAILS A6-13 TO A6-15)

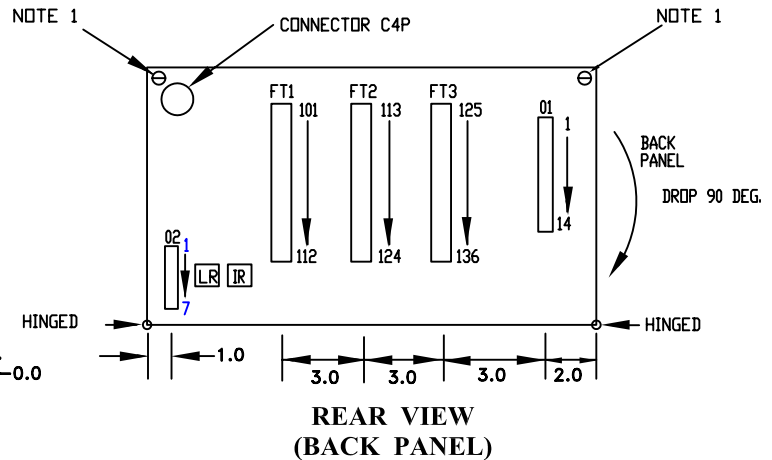
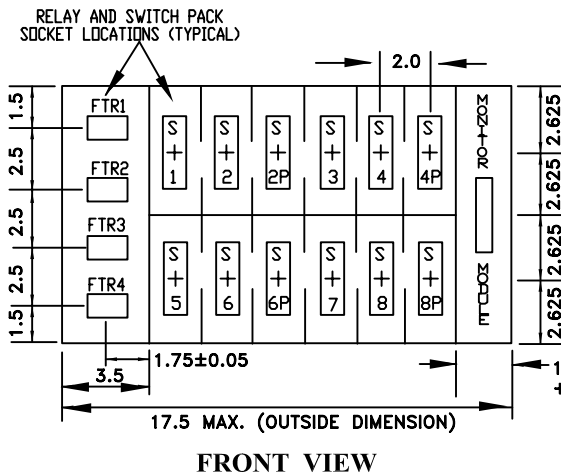
- All dimensions shown are in inches.
- SHEET DEFINITIONS:

CKT = CIRCUIT	EG = EQUIPMENT GROUND
FLD1 = FIELD 1 CIRCUIT BREAKER	FL1 = FIELD LOAD 1
FU1-7 = FLASHER UNIT #1, PIN 7	ER = EQUIPMENT RECEPTACLE
L = LAMP	LD CKT#1 = LOAD CIRCUIT 1
SSR = SOLID STATE RELAY	CR = CONTROL RECEPTACLE
MN = MAIN	MU-22 = MONITOR UNIT - PIN 22
OD = OUTSIDE DIMENSION	PDS = POSITION
PS-7 = POWER SUPPLY PIN 7	SCB = SIGNAL CIRCUIT BREAKER
SP 3-3 = SWITCH PACK 3, PIN 3	TR = TRANSFER RELAY
01-8 = OUTPUT FILE TB 01, POSITION 8	FCB1 = FIELD CIRCUIT BREAKER 1

- Thumb screw device.
- Transfer relay in PDA #2L & 3L shall extend no more than 1.0 inch out from the assembly front face.
- Slack shall be provided in the wiring for the circuit breakers and GFI receptacle to allow for the removal and repair. Excess bends and stress on the wiring shall be minimized.
- See Output File plan sheet for heavy duty relay and switch pack wiring assignments and connector mounting location.
- Wiring shall be routed (with extra length) to minimize movement when front panel door is opened. The wiring going to the front panel shall be routed such that it does not cause undue twisting or bending of the wires.
- No ventilation hole shall be large enough to place a 0.375 inch diameter object through.
- The C5P support connector and support bracket shall be installed (wiring NA) in the PDA #2L. If PDA #2L is used, the input panel C5P connector is not required and harness #2L - C5S connector shall be connected to PDA #2L C5P. If PDA #3L is used, harness #2 - C5S connector shall be connected to input panel C5P and C6P connector, support bracket and wiring shall be installed.

TITLE:	
PDA #2L & #3L DETAILS SHEET 3 OF 3	
1-21-2010, ERRATA 1	NO SCALE
TEES 2009	A6-15

OUTPUT FILE #1L DETAIL



OUTPUT FILE #1L TERMINAL ASSIGNMENT DETAIL

01 TERM	FUNCTION
1	PDA CKT1/SWPKS 1,2,2P-1
2	PDA CKT2/SWPKS 3,4,4P-1
3	PDA CKT3/SWPKS 5,6,6P-1
4	PDA CKT4/SWPKS 7,8,8P-1
5	PDA FU1 CKT1/FTR1
6	PDA FU1 CKT2/FTR2
7	PDA FU2 CKT1/FTR3
8	PDA FU2 CKT2/FTR4
9	EQUIP. GROUND
10	AC-
11	AC+ (FROM PDA)
12	SSR (TO PDA)
13	DOOR SW. (FROM POL PAN)
14	FTR COILS (TO)

02 TERM	FUNCTION
1	+24VDC TO LOGIC RELAY COIL (LR)
2	DC GROUND
3	IFI-14J, STOP TIME (FROM M.U)
4	IFI-14D, FLASH SENSE (FROM I.R)
5	EXTERNAL (M.U) RESET
6	N/A
7	+24VDC (CONTROLLED) TO SWITCHPACKS (1-12) POSITION 9

FT1 TERM	FUNCTION	FT2 TERM	FUNCTION	FT3 TERM	FUNCTION
101	SWPK 4-RED	113	SWPK 2P-RED	125	SWPK 1-RED
102	SWPK 4-YEL	114	SWPK 2P-YEL	126	SWPK 1-YEL
103	SWPK 4-GRN	115	SWPK 2P-GRN	127	SWPK 1-GRN
104	SWPK 4P-RED	116	SWPK 3-RED	128	SWPK 2-RED
105	SWPK 4P-YEL	117	SWPK 3-YEL	129	SWPK 2-YEL
106	SWPK 4P-GRN	118	SWPK 3-GRN	130	SWPK 2-GRN
107	SWPK 8-RED	119	SWPK 6P-RED	131	SWPK 5-RED
108	SWPK 8-YEL	120	SWPK 6P-YEL	132	SWPK 5-YEL
109	SWPK 8-GRN	121	SWPK 6P-GRN	133	SWPK 5-GRN
110	SWPK 8P-RED	122	SWPK 7-RED	134	SWPK 6-RED
111	SWPK 8P-YEL	123	SWPK 7-YEL	135	SWPK 6-YEL
112	SWPK 8P-GRN	124	SWPK 7-GRN	136	SWPK 6-GRN

NOTE:

1. Thumb screws device
2. All dimensions shown are in inches

TITLE:

INPUT/OUTPUT FILE DETAILS
SHEET 2 OF 5

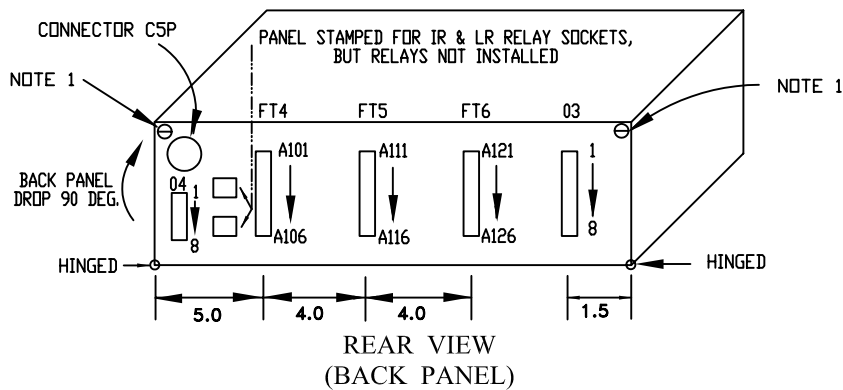
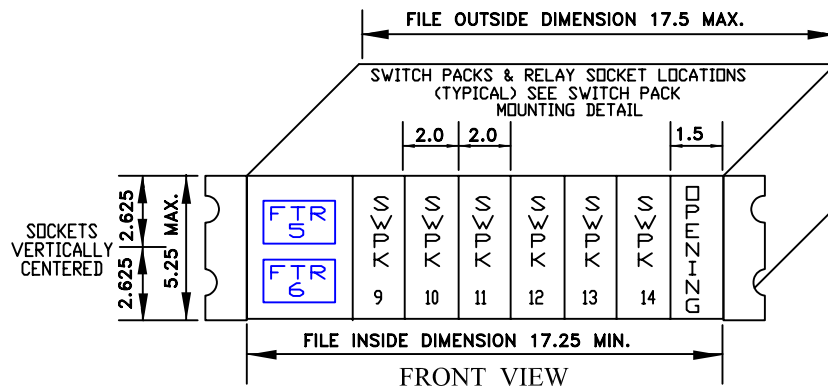
1-21-2010, ERRATA 1

NO SCALE

TEES 2009

A6-17

OUTPUT FILE #2L DETAIL



OUTPUT FILE #2L TERMINAL ASSIGNMENT DETAIL

O3 TERM	FUNCTION
1	PDA FU1 CKT1/FTR5
2	PDA FU2 CKT2/FTR6
3	FTR COILS (TO)
4	AC-
5	PDA CKT5/SWPKS 9,10,11-1
6	PDA CKT6/SWPKS 12,13,14-1
7	EQUIP. GROUND
8	AC+ (FROM PDA)

O4 TERM	FUNCTION
1	+24 VDC
2	DC GROUND
3	STOPTIME
4	FLASH SENSE
5	EXTERNAL RESET
6	WDT INPUT
7	LR COIL (UNIT IN)
8	SSR (PDA)

FT4 TERM	FUNCTION	FT5 TERM	FUNCTION	FT6 TERM	FUNCTION
A101	SWPK 13-RED	A111	SWPK 11-RED	A121	SWPK 9-RED
A102	SWPK 13-YEL	A112	SWPK 11-YEL	A122	SWPK 9-YEL
A103	SWPK 13-GRN	A113	SWPK 11-GRN	A123	SWPK 9-GRN
A104	SWPK 14-RED	A114	SWPK 12-RED	A124	SWPK 10-RED
A105	SWPK 14-YEL	A115	SWPK 12-YEL	A125	SWPK 10-YEL
A106	SWPK 14-GRN	A116	SWPK 12-GRN	A126	SWPK 10-GRN

NOTE:

1. Thumb screws device.
2. All dimensions shown are in inches.

TITLE:

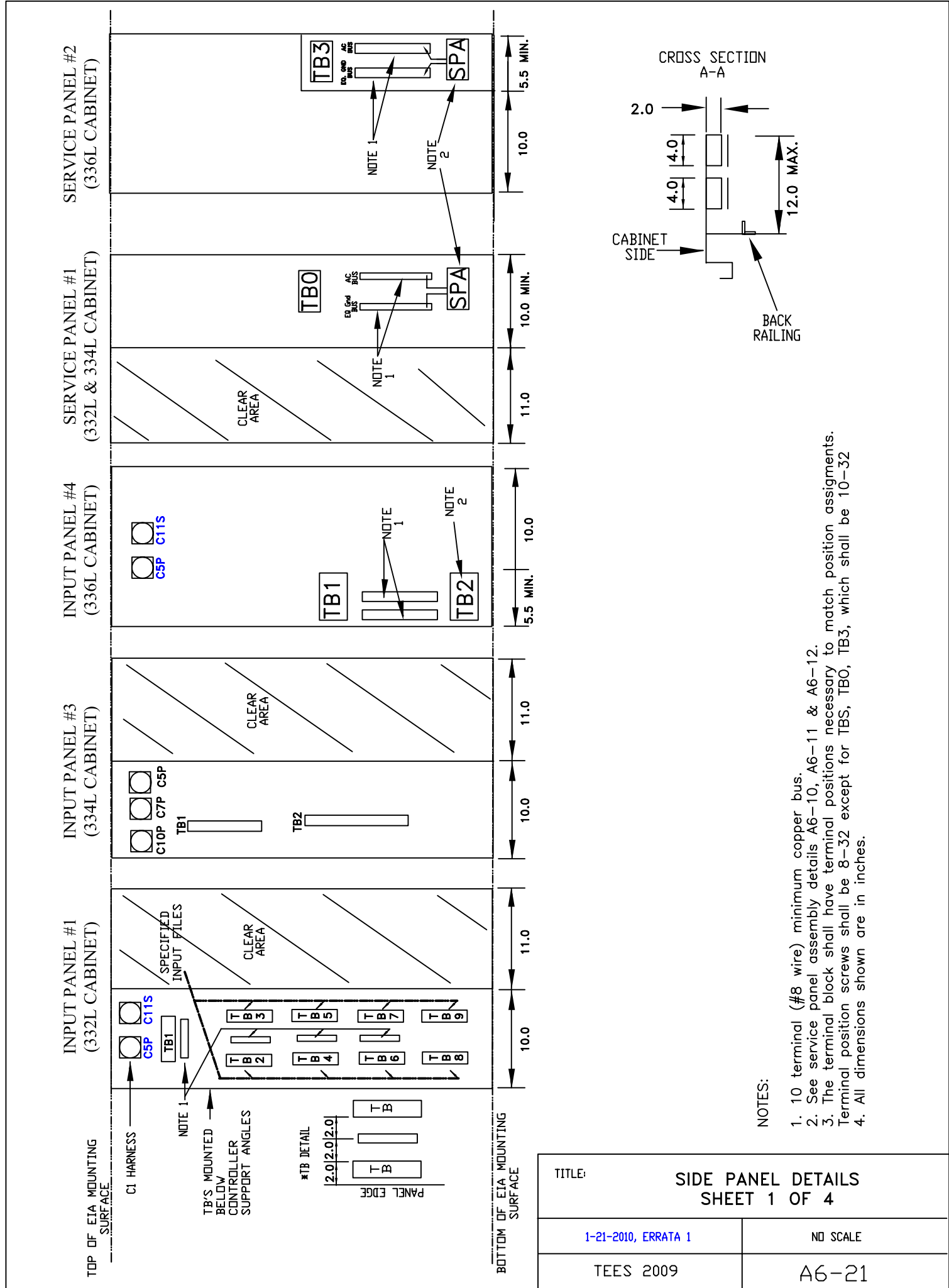
OUTPUT FILE #2L DETAILS

1-21-2010, ERRATA 1

NO SCALE

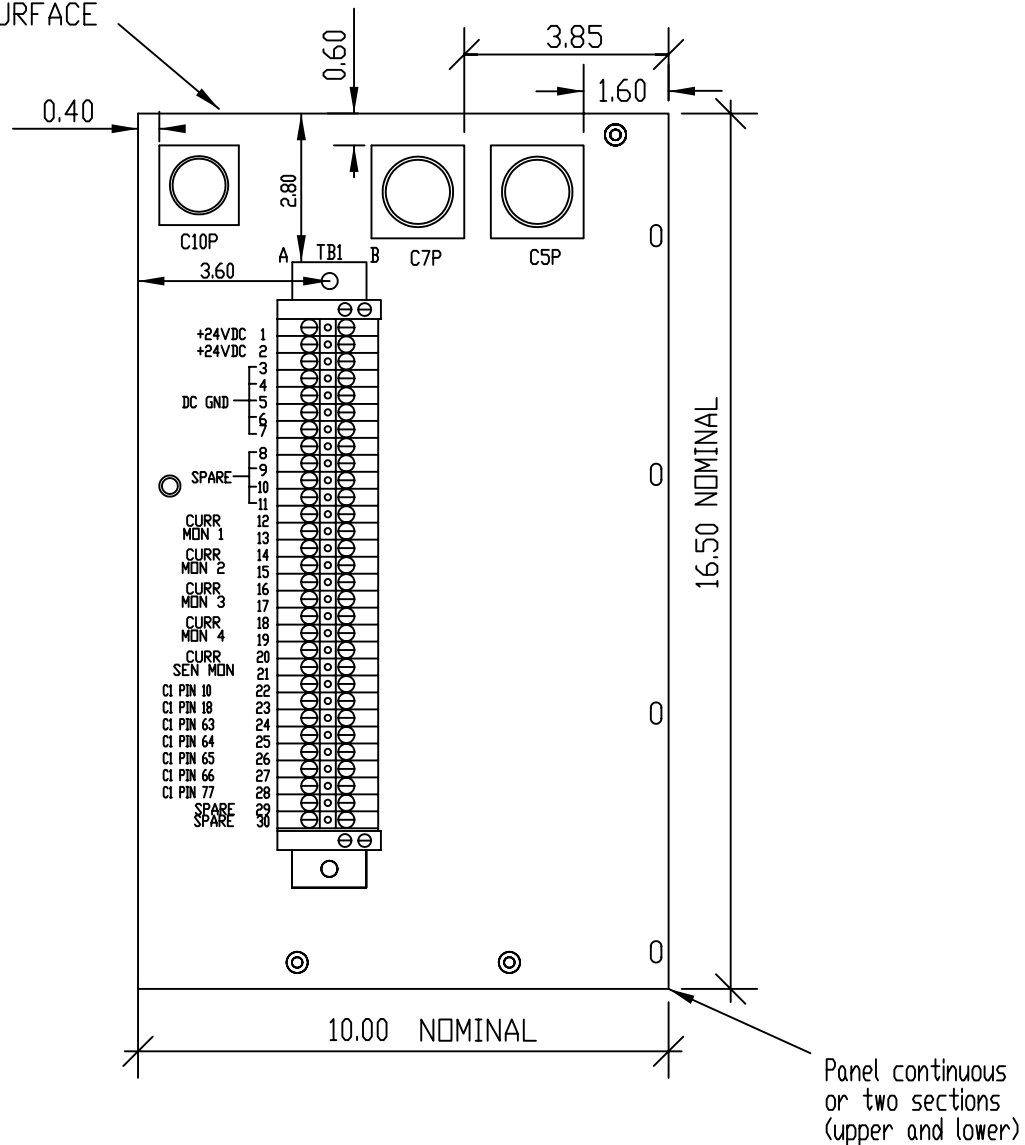
TEES

A6-18



TITLE: SIDE PANEL DETAILS SHEET 1 OF 4	
1-21-2010, ERRATA 1	NO SCALE
TEES 2009	A6-21

TOP OF EIA
MOUNTING SURFACE



NOTES:

1. Provide and install a 30 position TB1 Terminal Block & three circular connectors, C5P, C7P & C10P (no contacts), TB1 shall be a USK 10 Open Construct Phoenix Contact Terminal Block (or equal) mounted on DIN Railing (supported every 6 inches with position function label tabs and positions commoned and end locks).
2. A 4 foot length "CMS" Harness of 14 #20 (or larger) Conductors shall be furnished and installed in the cabinet. One end of the harness shall be the C10S Connector resting in C10P (mounted on the Input Panel #3) when not in used. The other end shall be stripped (according to manufacturers requirements) and connected to the "B Side" of TB1. The conductor bundle shall have external protection.
3. All dimensions shown are in inches.

TITLE:

SIDE PANEL DETAILS SHEET 2 OF 4

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No Scale

TEES 2009

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**INPUT PANEL #1
TERMINAL BLOCK ASSIGNMENT DETAIL**

POS	A	B	POS	A	B	POS	A	B
TB1 - * SEE INPUT PANEL #4 TB1 ASSIGNMENTS			TB4-1		I-4D	TB7-1		J-7D
			TB4-2	DET 7	I-4E	TB7-2	DET 33	J-7E
			TB4-3		I-4J	TB7-3		J-7J
			TB4-4	DET 8	I-4K	TB7-4	DET 34	J-7K
			TB4-5		I-5D	TB7-5		J-8D
			TB4-6	DET 9	I-5E	TB7-6	DET 35	J-8E
			TB4-7		I-5J	TB7-7		J-8J
			TB4-8	DET 10	I-5K	TB7-8	DET 36	J-8K
			TB4-9		I-6D	TB7-9		J-9D
			TB4-10	DET 11	I-6E	TB7-10	DET 37	J-9E
			TB4-11		I-6J	TB7-11		J-9J
			TB4-12	DET 12	I-6K	TB7-12	DET 38	J-9K
TB2-1		I-1D	TB5-1		J-4D	TB8-1	MANUAL	I-11D
TB2-2	DET 1	I-1E	TB5-2	DET 25	J-4E	TB8-2	SPARE	I-11J
TB2-3		I-1J	TB5-3		J-4J	TB8-3	11 COM	I-11K
TB2-4	DET 2	I-1K	TB5-4	DET 26	J-4K	TB8-4	PED Ø2	I-12D
TB2-5		I-2D	TB5-5		J-5D	TB8-5	PED Ø4	I-12J
TB2-6	DET 3	I-2E	TB5-6	DET 29	J-5E	TB8-6	12 COM	I-12K
TB2-7		I-2J	TB5-7		J-5J	TB8-7	PED Ø6	I-13D
TB2-8	DET 4	I-2K	TB5-8	DET 30	J-5K	TB8-8	PED Ø8	I-13J
TB2-9		I-3D	TB5-9		J-6D	TB8-9	13 COM	I-13K
TB2-10	DET 5	I-3E	TB5-10	DET 31	J-6E	TB8-10	FLH SENSE	I-14D
TB2-11		I-3J	TB5-11		J-6J	TB8-11	STOP TIME	I-14J
TB2-12	DET 6	I-3K	TB5-12	DET 32	J-6K	TB8-12	14 COM	I-14K
TB3-1		J-1D	TB6-1		I-7D	TB9-1	SPARE 2	J-11D
TB3-2	DET 19	J-1E	TB6-2	DET 13	I-7E	TB9-2	SPARE 3	J-11J
TB3-3		J-1J	TB6-3		I-7J	TB9-3	11 COM	J-11K
TB3-4	DET 20	J-1K	TB6-4	DET 14	I-7K	TB9-4	EVA	J-12D
TB3-5		J-2D	TB6-5		I-8D	TB9-5	EVC	J-12J
TB3-6	DET 21	J-2E	TB6-6	DET 15	I-8E	TB9-6	12 COM	J-12K
TB3-7		J-2J	TB6-7		I-8J	TB9-7	EV8	J-13D
TB3-8	DET 22	J-2K	TB6-8	DET 16	I-8K	TB9-8	EVD	J-13J
TB3-9		J-3D	TB6-9		I-9D	TB9-9	13 COM	J-13K
TB3-10	DET 23	J-3E	TB6-10	DET 17	I-9E	TB9-10	RR1	J-14D
TB3-11		J-3J	TB6-11		I-9J	TB9-11	RR2	J-14J
TB3-12	DET 24	J-3K	TB6-12	DET 18	I-9K	TB9-12	14 COM	J-14K

**INPUT PANEL #4
TERMINAL BLOCK ASSIGNMENT DETAIL**

TERM	A	B
TB1-1	(+24 VDC) 02-1/T3-1	I15-1, J15-1
TB1-2	M RESET	02-5
TB1-3	02-7/T3-2	C5-24
TB1-4	RESERVED	RESERVED (COMM IN)
TB1-5	RESERVED	RESERVED (COMM IN)
TB1-6	RESERVED	RESERVED (COMM OUT)
TB1-7	RESERVED	RESERVED (COMM OUT)
TB1-8	RESERVED	RESERVED
TB2-1 TO 6	NA	NA

**SERVICE PANELS 1 & 2
TERMINAL BLOCK ASSIGNMENT DETAIL**

TERM	A	B
TBS-1	AC+	TO PDA (without BBS) TO BBS-1 (with BBS)
TBS-2	AC-	AC- BUS
TBS-3	NA	TO EQ.GND BUS
BBS-1	AC+ IN	MBPS AC+ IN
BBS-2	MBPS AC+ OUT	TO PDA
TB0-1 TO 12	NA	NA
TB3-1 TO 6	NA	NA

(See Service Panel Assembly (SPA) details A6-10 & A6-11

NOTES:

1. Sheet definitions:

- 11 COM = DC COMMON
- COMM = COMMUNICATION
- DET1 = DETECTOR #1
- EVA = EMERGENCY VEHICLE PREEMPTION A
- IFI-1D = INPUT FILE 1, SLOT 1, CONNECTOR PIN D
- OF = OUTPUT FILE
- M = MONITOR MODULE
- NA = NOT ASSIGNED
- RR1 = RAILROAD PREEMPTION 1
- MBPS = MANUAL BYPASS SWITCH
- BBS = BATTERY BACK-UP SYSTEM
- PDA = POWER DISTRIBUTION ASSEMBLY

2. All dimensions shown are in inches.

**INPUT PANEL #3
TERMINAL BLOCK (TB #1) ASSIGNMENT DETAIL**

POS	A	B
TB1-1	+24 VDC	I/O FILES
TB1-2	+24 VDC	CAB. HARNESS #5 C1 PINS 1 & 104 I/O FILES & CAB. HARNESS #5
TB1-3	DC GND	
TB1-4	DC GND	
TB1-5	DC GND	
TB1-6	DC GND	
TB1-7	DC GND	
TB1-8	SPARE	NA
TB1-9	SPARE	NA
TB1-10	SPARE	NA
TB1-11	SPARE	NA
TB1-12	CURR. MONITOR 1	CAB. HARNESS #5
TB1-13	CURR. MONITOR 1	CAB. HARNESS #5
TB1-14	CURR. MONITOR 2	CAB. HARNESS #5
TB1-15	CURR. MONITOR 2	CAB. HARNESS #5
TB1-16	CURR. MONITOR 3	CAB. HARNESS #5
TB1-17	CURR. MONITOR 3	CAB. HARNESS #5
TB1-18	CURR. MONITOR 4	CAB. HARNESS #5
TB1-19	CURR. MONITOR 4	CAB. HARNESS #5
TB1-20	CURR. SEN. MON.	CAB. HARNESS #5
TB1-21	CURR. SEN. MON.	CAB. HARNESS #5
TB1-22	C1 PIN 10	CIA CONTROL 4
TB1-23	C1 PIN 18	NA
TB1-24	C1 PIN 63	NA
TB1-25	C1 PIN 64	NA
TB1-26	C1 PIN 65	POL. CONTROL SW.
TB1-27	C1 PIN 66	POL. LIGHTS SW.
TB1-28	C1 PIN 77	NA
TB1-29	SPARE	CAB. HARNESS #5
TB1-30	SPARE	CAB. HARNESS #5

**INPUT PANEL #3
TERMINAL BLOCK (TB #2) ASSIGNMENT DETAIL**

POS	A	B	POS	A	B
TB2-1	1-1D		TB2-38	EQ. GND	
TB2-2	1-1E		TB2-39	1-8J	
TB2-3	EQ. GND		TB2-40	1-8K	
TB2-4	1-1J		TB2-41	1-9D	
TB2-5	1-1K		TB2-42	1-9E	
TB2-6	1-2D		TB2-43	EQ. GND	
TB2-7	1-2E		TB2-44	1-9J	
TB2-8	EQ. GND		TB2-45	1-9K	
TB2-9	1-2J		TB2-46	1-10D	
TB2-10	1-2K		TB2-47	1-10E	
TB2-11	1-3D		TB2-48	EQ. GND	
TB2-12	1-3E		TB2-49	1-10J	
TB2-13	EQ. GND		TB2-50	1-10K	
TB2-14	1-3J		TB2-51	1-11D	
TB2-15	1-3K		TB2-52	1-11E	
TB2-16	1-4D		TB2-53	EQ. GND	
TB2-17	1-4E		TB2-54	1-11J	
TB2-18	EQ. GND		TB2-55	1-11K	
TB2-19	1-4J		TB2-56	1-12D	
TB2-20	1-4K		TB2-57	1-12E	
TB2-21	1-5D		TB2-58	EQ. GND	
TB2-22	1-5E		TB2-59	1-12J	
TB2-23	EQ. GND		TB2-60	1-12K	
TB2-24	1-5J		TB2-61	1-13D	
TB2-25	1-5K		TB2-62	1-13E	
TB2-26	1-6D		TB2-63	EQ. GND	
TB2-27	1-6E		TB2-64	1-13J	
TB2-28	EQ. GND		TB2-65	1-13K	
TB2-29	1-6J		TB2-66	1-14D	
TB2-30	1-6K		TB2-67	1-14E	
TB2-31	1-7D		TB2-68	EQ. GND	
TB2-32	1-7E		TB2-69	1-14J	
TB2-33	EQ. GND		TB2-70	1-14K	
TB2-34	1-7J		TB2-71	SPARE	
TB1-35	1-7K		TB1-72	SPARE	
TB1-36	1-8D		TB1-73	EQ. GND	
TB2-37	1-8E				

TITLE:

**SIDE PANEL DETAILS
SHEET 4 OF 4**

1-21-2010, ERRATA 1

NO SCALE

TEES 2009

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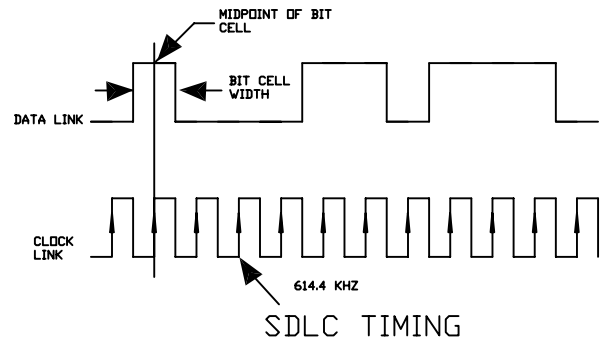
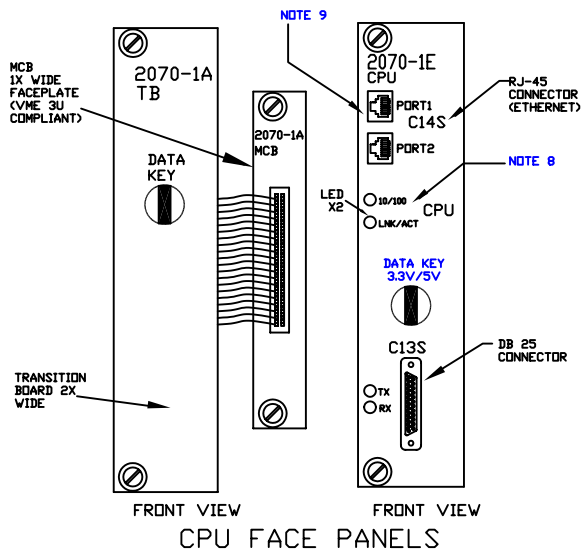
APPENDIX A9

CHAPTER 9 DETAILS

Model 2070 - Chassis Front View	A9-1
Model 2070 - Chassis Rear View	A9-2
Model 2070 - Chassis Top View	A9-3
Model 2070 - Chassis Motherboard	A9-4
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Model 2070 – Serial Port Descriptors Defaults	A9-16
Model 2070 – Power Failure Reaction	A9-17

SERIAL PORT REQUIREMENTS			
LOGICAL PORT		RATE KBITS	PROTOCOL
SP1		1.2, NOTE 1	ASYNC
SP1S		19.2, NOTE 2	SYNC, HDLC, SDLC
SP2		1.2, NOTE 1	ASYNC
SP2S		19.2, NOTE 2	SYNC, HDLC, SDLC
SP3		1.2, NOTE 1	ASYNC
SP3S		614.4, NOTE 3	SYNC, HDLC, SDLC
SP4		9.6, NOTE 1	ASYNC
SP5		1.2, NOTE 1	ASYNC
SP5S		614.4	SYNC, HDLC, SDLC
SP6		38.4, NOTE 1	ASYNC
SP8**	NOTE 4	9.6, NOTE 1	ASYNC
SP8S**	NOTE 4	153.6	SYNC, HDLC, SDLC

SDLC FRAME LAYOUT					
OPENNING FLAG	ADDR	CONTROL	INFORMATION	CRC	CLOSING FLAG
0111 1110	8 BITS	1000 0011	VARIABLE LENGTH	16 BITS	0111 1110



C13S PIN ASSIGNMENT			
PIN	FUNCTION	PIN	FUNCTION
1	SP8TXD+	14	SP8TXD-
2	SP8RXD+	15	SP8RXD-
3	SP8TXC+	16	SP8TXC-
4	SP8RXC+	17	SP8RXC-
5	SP8RTS+	18	SP8RTS-
6	SP8CTS+	19	SP8CTS-
7	SP8DCD+	20	SP8DCD-
8	NA	21	NA
9	LINESYNC+	22	LINESYNC-
10	NRESET+	23	NRESET-
11	POWERDOWN+	24	POWERDOWN-
12	BIAS +5 VDC	25	EG
13	DCG #2		

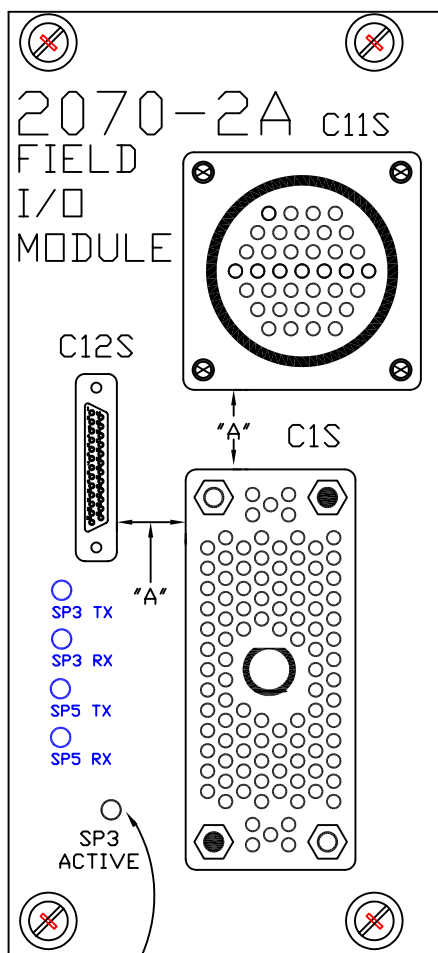
C14S PIN ASSIGNMENT			
PIN	FUNCTION	PIN	FUNCTION
1	TX +	5	NA
2	TX -	6	RX -
3	RX +	7	NA
4	NA	8	NA

NOTES: (FOR THIS DETAIL)

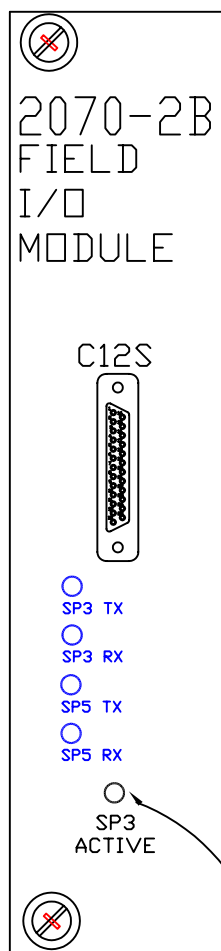
- Additional rates 1.2, 2.4, 4.8, 9.6, 19.2, 38.4.
- Additional descriptors for other rates:
SPxSa = 19.2, SPxSb = 38.4, SPxSc = 57.6
SPxSd = 76.8, SPxSg = 64.0, SPxSe = 153.6.
- Additional descriptors for other rates:
SPxSe = 153.6, SPxSf = 614.4.
- On 2070-1A, SP1 is assigned to 68360 SCC1.
On 2070-1E, SP1 and SP8 are assigned to the dual SCC, and ETHERNET is assigned to 68EN360 SCC1.
- A Post Header (ROBINSON NUGENT IDA-XX OR EQUAL) Connector with strain relief shall be provided on the MCB Front Plate and the Transition Board for mating with the interface harness. The harness shall be shielded and straight through wired.
- BIAS +5VDC (50mA maximum) refers to voltage required for a Line Terminator device and is derived from the ISO +12VDC Power Supply.
- EG (Equipment Ground) pin is electrically connected to the faceplate.
- LED indicators between switch & CPU
- All RJ-45 connectors shall contain LED indicators 10/100 & LNK/ACT

** 2070-1E only.

TITLE: MODEL 2070-1E CPU MODULES AND SERIAL PORT/SDLC PROTOCOL	
1-21-2010, ERRATA 1	NO SCALE
TEES 2009	A9-7



FRONT VIEW



FRONT VIEW

C12S PIN ASSIGNMENT			
PIN	FUNCTION	PIN	FUNCTION
1	SP5TXD+	14	SP5TXD-
2	SP5RXD+	15	SP5RXD-
3	SP5TXC+	16	SP5TXC-
4	SP5RXC+	17	SP5RXC-
5	SP3TXD+	18	SP3TXD-
6	SP3RXD+	19	SP3RXD-
7	SP3TXC+	20	SP3TXC-
8	SP3RXC+	21	SP3RXC-
9	LINE SYNC+	22	LINE SYNC-
10	NRESET+	23	NRESET-
11	POWERDOWN+	24	POWERDOWN-
12	BIAS +5 VDC	25	EG
13	DCG #2		

FIELD I/O FACE PANELS

NOTES: (FOR THIS DETAIL)

- 2070-2A Faceplate shall be 4X wide. 2070-2B Faceplate shall be 2X wide.
(SEE SYSTEM PCB MODULE, GENERAL DETAILS.)
- Dark Circles in the C1S Connector denote guide pin locations and opencircles denote guide socket locations.
- Dimension "A" shall be a minimum of 0.5in.
- C1S - M104 Type. C11S - 37-Pin Circular Plastic Type.
C12S - 25-Pin DB Socket Type
- C12S pin 12 (BIAS +5VDC) at 50mA maximum is derived from the ISO +12 VDC Power Supply.
BIAS +5VDC refers to voltage required for a Line Terminator device.
- EG (Equipment Ground) pin is electrically connected to the faceplate.
- LED indicators Tx & Rx for SP3 (field site) and SP5 shall be provided.
- C1 connector shall be bolted to the front plate.

TITLE:

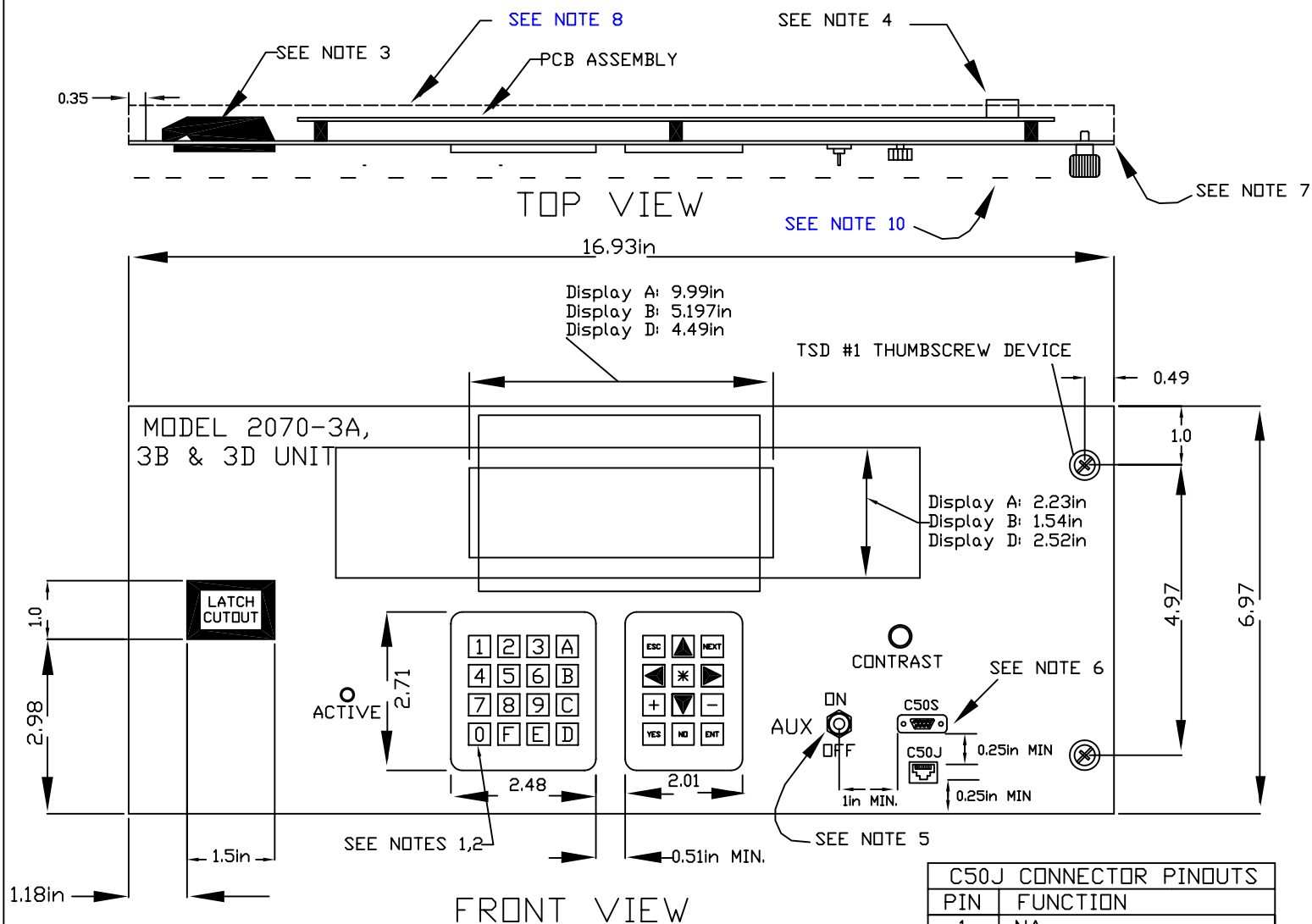
MODEL 2070-2
FIELD I/O MODULES

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TEES 2009

A9-8



NOTES: (FOR THIS DETAIL)

1. Key size shall be (0.3x0.3)in.
2. Key center to center spacing shall be 0.5in.
3. Slide latch shall be a SOUTHCO flush style A3-40-625-12 (OR EQUAL).
4. The 40 contact connector shall be similar to AMP 102160-9 or equal & compatible to the FP harness in type and pin assignments.
Center of the FP harness connector shall be vertically positioned (3.54+/-0.197)in as measured from the top of the FPA.
The connector shall be a right angle connector with pin 1 located on the lower right hand corner.
5. Two position LOGIC switch mounted vertically.
6. "C50S" connector shall be a DE-9 socket contact connector. "C50J" shall be a RJ-45 8-position jack. "C60P" connector shall be a DE-9 plug contact connector.
7. Front panel sheet metal thickness shall be (0.06±0.005) in.
8. The FPA shall be provided with a continuous top and bottom 0.63in (inside dimension) lip bent 90 degrees to the front plate and shall extend the full length of the FPA.
9. C60P B Box Power is +5VDC, 350mA max. All signals on C60 P are referenced to isolated interface ground DCG#3.
10. Components shall not protrude beyond the height of the thumbscrews when tightened.
11. See 9.4.1 for components required.
12. All dimensions shown are in inches.

C50S CONNECTOR PINOUTS	
PIN	C50S FUNCTION
1	C50 ENABLE
2	SP4RXD
3	SP4TXD
4	NA
5	DCG #1
6	NA
7	NA
8	NA
9	NA

C50J CONNECTOR PINOUTS	
PIN	FUNCTION
1	NA
2	SP4RXD
3	C50 ENABLE
4	NA
5	SP4TXD
6	DCG #1
7	NA
8	NA

C60P CONNECTOR PINOUTS	
PIN	FUNCTION
1	B Box Power, Note 9
2	SP6RXD
3	SP6TXD
4	NA
5	DCG #3
6	NA
7	CPURESET
8	NA
9	CPU LED

TITLE:

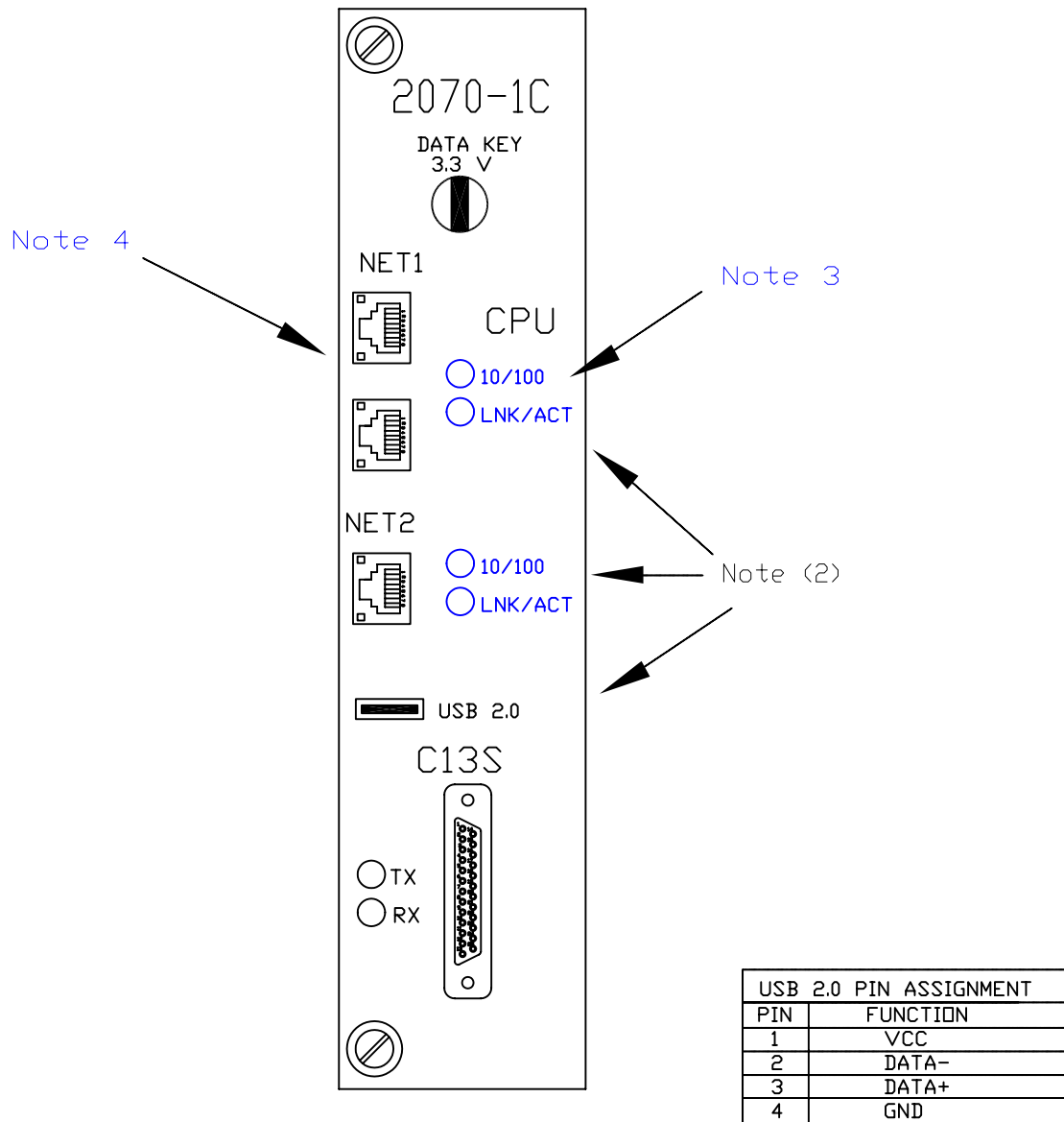
MODEL 2070-3A, 3B & 3D
FRONT PANEL ASSEMBLY

1-21-2010, ERRATA 1

NO SCALE

TEES 2009

A9-10



NET1 PIN ASSIGNMENT			
PIN	FUNCTION	PIN	FUNCTION
1	TX +	5	NA
2	TX -	6	RX -
3	RX +	7	NA
4	NA	8	NA

NET2 PIN ASSIGNMENT			
PIN	FUNCTION	PIN	FUNCTION
1	TX +	5	NA
2	TX -	6	RX -
3	RX +	7	NA
4	NA	8	NA

C13S PIN ASSIGNMENT			
PIN	FUNCTION	PIN	FUNCTION
1	SP8 TX +	14	SP8 TX -
2	SP8 RX +	15	SP8 RX -
3	SP8 TXC +	16	SP8 TXC -
4	SP8 RXC +	17	SP8 RXC -
5	SP8 RTS +	18	SP8 RTS -
6	SP8 CTS +	19	SP8 CTS -
7	SP8 DCD +	20	SP8 DCD -
8	NA	21	NA
9	LINESYNC +	22	LINESYNC -
10	NRESET +	23	NRESET -
11	PWRDWN +	24	PWRDWN -
12	BIAS +5 VDC	25	EQUIP GND
13	DC GND #2		

NOTES: (FOR THIS DETAIL)

- BIAS +5VDC refers to voltage required for a Line Terminator device.
- NET1, NET2, USB & C13S should be placed within the area as shown.
- LED indicators between switch & CPU.
- All RJ-45 connectors shall contain LED indicators 10/100 & LNK/ACT.

TITLE:

MODEL 2070-1C CPU

1-21-2010, ERRATA 1

NO SCALE

TEES 2009

A9-15

SERIAL PORT DESCRIPTORS DEFAULTS			
SP1, SP2, SP3 and SP5	SP4	SP 6	SP 8
noupc	noupc	noupc	noupc
bsb	bsb	bsb	bsb
bsl	bsl	bsl	bsl
noecho	echo	echo	noecho
lf	lf	lf	lf
null=0	null=0	null=0	null=0
nopause	nopause	nopause	nopause
pag=24	pag=24	pag=24	pag=24
bsp=08	bsp=08	bsp=08	bsp=08
del=18	del=18	del=18	del=18
eor=0D	eor=0D	eor=0D	eor=0D
eof= 1B	eof= 1B	eof= 1B	eof= 1B
reprint=04	reprint=04	reprint=04	reprint=04
dup=01	dup=01	dup=01	dup=01
psc=17	psc=17	psc=17	psc=17
abort=03	abort=03	abort=03	abort=03
quit=05	quit=05	quit=05	quit=05
bse=08	bse=08	bse=08	bse=08
bell=07	bell=07	bell=07	bell=07
type=00	type=00	type=00	type=00
baud=1200	baud=9600	baud=38400	baud=9600
xon=11	xon=00	xon=11	xon=11
xoff=13	xoff=00	xoff=13	xoff=13
tabc=09	tabc=09	tabc=09	tabc=09
tabs=4	tabs=4	tabs=04	tabs=04

NOTES: (FOR THIS DETAIL)

1. All serial port descriptors shall be set with 8 Bit Word,
1 Stop & no Parity.
2. Model 2070-1C sp4 shall be set to 38.4 Kbps.
3. sp3s & sp5s shall be set to 614.4 Kbps.

TITLE: SERIAL PORT DESCRIPTORS DEFAULTS	
1-21-2010, ERRATA 1	NO SCALE
TEES 2009	A9- 16

APPENDIX A10

CHAPTER DETAILS

Model 2070-6 ASYNC / Modem Serial Communication Module	A10-1
Model 2070-7 ASYNC / SYNC Serial Communication Module	A10-2
Model 2070-6D Fiber Optics Communication Module	A10-3
Model 2070-Fx Fiber Optics Network Communication Module	A10-4
Model 2070-6W Wireless Modem Communication Module	A10-5
Model 2070-9 FSK / Dial Up Modem Communication Module	A10-6
Model 2070 - 6E Serial 2 Network Communication Module	A10-7
Model 2070 - 9D Dial-Up Modem Communication Module	A10-8
Model 2070 -7G Universal Time Base Module	A10-9

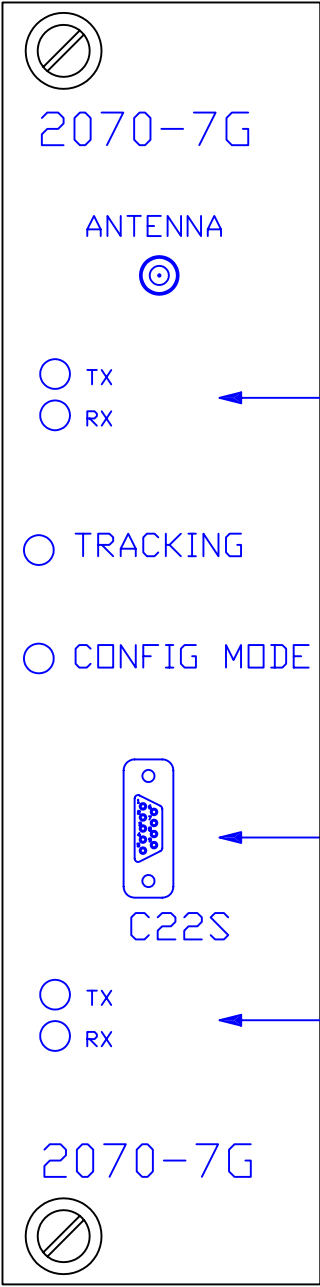
GENERAL NOTES

The 2070-6x and 2070-7x modules shall provide circuitry to disable its Channel 2 and EIA 232 control lines when a ground-true state is presented at Connector A1 Pin B21 (C50 Enable). C50 Enable shall disable channel 2 via disabling the RS-485 signals to and from the motherboard. The Disable line shall be pulled up on the module.

Line drivers/receivers shall be socket or surface mounted.

Isolation circuitry shall be opto- or capacitive-coupled isolation technologies. Each module's circuit shall be capable of reliably passing a minimum of 1.0 Mbps.

The Comm modules shall be "Hot" swappable without damage to circuitry or operations.



COM 1

DB-9

COM 2

DB9 - PIN ASSIGNMENT	
PIN	FUNCTION
1	DCD
2	RXD
3	TXD
4	NA
5	GND
6	NA
7	RTS
8	CTS
9	NA

TITLE:

MODEL 2070-7G
UNIVERSAL TIME BASE MODULE

1-21-2010, ERRATA 1

NO SCALE

TEES 2009

A10-9



TRANSPORTATION ELECTRICAL EQUIPMENT SPECIFICATIONS

TEES 2009 ERRATA No.2



December 5th, 2014

**STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION**



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The TEES dated March 12th, 2009, Chapter 4 (BBS) dated July 7, 2009 and Errata No. 1 dated January 21st, 2010 shall be modified as specified in this Errata No. 2.

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1.4.8 Thumb Screw Devices

Thumb Screw Devices (TSDs) shall be of the following type: retractable screw fastener with projecting stainless steel screw, spring and natural aluminum knob finish. (TSD No. 2 shall be flat black.)

TSD No.1 - 8-32 SOUTHCO #47-62-301-20 or equal.

TSD No.2 - 8-32 SOUTHCO #47-62-301-60 or equal.

TSD No.3 - M3 SOUTHCO #47-81-181-10 or equal.

1.4.9 PCB Modules

All PCB Modules shall be mounted vertically in their corresponding host assembly.

2.5.3 Functional Requirements

The Model 400N Ethernet Module shall interface to the 170 controller using controller's Main Port EIA-232.

The Main and User Serial Ports shall operate EIA-232 Asynchronous communications and shall support data rates of 1.2, 2.4, 9.6, 19.2, 38.4, 57.5 and 115.2Kbps.
The Model 400N Ethernet Module Network Interface shall meet IEEE 802.3 and ANSI 8802-3 Standards and support 10/100 Mbps.

The Auxiliary Port shall be configurable to operate as a DCE or DTE.

The Model 400N shall have an option to enable or disable Dynamic DCD.

4.1.2 Battery Backup System Configuration

The Battery Backup System (BBS) shall include **(See A4-1 – BBS Block Diagram)**, but not be limited to the following:

Inverter /Charger	Installation Wiring Kit
Power Transfer Relay	Hardware Kit
Manual Bypass Switch	Battery Cable Harness
EIA mounting Brackets	Manuals

The Installation Wiring Kit shall include all necessary 10 AWG color-coded wiring for all required 18 AWG wiring for relays contacts, and a minimum of twenty (20), cable ties and/or adhesive backed panel mount style cable tie holders.

The Hardware Kit shall include all necessary bolts and washers for mounting all BBS components.

The Manuals shall include (2 each per BBS Unit) Operational and Maintenance Manuals.

4.3.4 Display

The BBS shall have a backlit LCD type display that is easily seen in both bright sunlight and in darkness. **The screen shall be a minimum of a 4 line display. The following information shall be displayed on a continuous basis; operating mode (STANDBY, Buck/Boost), utility input voltage, BBS output voltage, charger status, percent battery**

charge, battery voltage, BBS status (Standby, Backup, Buck, Boost), any alarms and faults, and relay status information.

4.3.13 System Configuration Mode

The BBS shall provide the user with a system configuration mode that would allow the user to view system configuration parameters on the front panel display. As a minimum, network settings shall be displayed under the systems configuration mode.

CHAPTER 5-SECTION 1 GENERAL REQUIREMENTS

Delete Chapter 5-Section 1, Paragraph 5.1.4

CHAPTER 5-SECTION 4 MODEL **242L TWO-CHANNEL DC ISOLATOR REQUIREMENTS**

5.4.1 Model 242 DC Isolator Channel

The Model 242 DC Isolator Channel shall provide isolation between a VDC input circuit (external electrical switch closure) and the controller unit input. The minimum isolation shall be 1000 MegaOhms and 2,500 VDC measured between the input and the output of the same channel.

5.4.2 Test Switch

Each isolation channel shall have a front panel mounted test switch to simulate valid input. The test switch shall be a single-pole double-throw, three position CONTROL test switch: The position assignment shall be UP – constant ON; MIDDLE – OFF; and DOWN – momentary ON.

5.4.3 Power Source

The DC Isolator operating voltage shall be obtained from the cabinet's 24 VDC power supply. The isolator shall have an internal isolated dc-dc power supply supplying 20 +/- 4 VDC to the field input side of the isolation channels. This internal isolated power supply shall provide at least 1500 Vrms of isolation from the cabinet 24 VDC power supply. The isolator shall not draw more than 2.0 watts of DC power. PCB should be two layer design minimum, using plated-thru vias, and Gold Plated Fingers on Both Sides of PCB.

5.4.4 Onboard Jumper

An onboard two-post shunt jumper shall be provided to allow for minimized output durations of less than 100 ms when the jumper is in the OPEN position.

5.4.5 Channel Contact Closure Input

A valid channel input shall cause a channel Ground True Output to the controller unit of a minimum 100 ms in duration. A channel contact closure input of 5 ms or less shall not cause an output (ground true) to the controller. A contact closure between 5 and 10 ms may or may not cause an output to the controller. A contact closure input of 10 ms or greater shall cause an output to the controller. The output pulse width shall be a minimum of 100ms upon a valid input, unless onboard jumper is in the OPEN position, in which

case the output pulse width shall be minimized, and return to a false state immediately following completion of valid input.

5.4.6 Field Input

Each isolation channel field input shall be turned on (true) when a contact closure causes an input voltage of less than 8 VDC, and shall be turned off (false) when the contact opening causes the input voltage to exceed 12 VDC. Each input shall deliver no less than 15 mA nor more than 40 mA to an electrical contact closure or short from the power supply. Each input shall be provided with electrical transient protection.

5.4.7 Outputs

Each isolation channel output shall be an opt-isolated NPN open collector capable of sinking 50 mA at 30 Volts. The outputs shall be compatible with Model 2070 controller.

CHAPTER 5-SECTION 5

MODEL 252 TWO-CHANNEL AC ISOLATOR

5.5.1 Model 252 Two-Channel AC Isolator

The Model 252 Two-Channel AC Isolator shall contain 2 isolation channels which provide isolation between external 120 VAC input circuits and the controller unit input circuits.

5.5.2 Channel Input Voltage “Von”

A channel input voltage “Von” of 80 +/- 5 VAC applied for a minimum duration of 110 ms $\pm$ 10 ms shall cause an output (Ground True) to the controller unit.

5.5.3 Channel Input Voltage “Voff”

A channel input voltage “Voff” (Von minus 10 VAC) applied for a minimum duration of 110 ms $\pm$ 10ms shall cause an output (Ground False) to the controller unit.

5.5.4 Post Jumper

A two post jumper shall be provided to select inverted output states for Von and Voff. When in CLOSED position (Grounded) Von shall cause a Ground False output. An indicator shall be provided on the front panel labeled ‘RR’ which shall indicate a Voff input, Ground True output.

5.5.5 Input Impedance

The input impedance of each channel shall be between 6,000 - 15,000 Ohms at 60 Hz.

5.5.6 Minimum Isolation

The minimum isolation shall be 1000 MegaOhms between the input and output terminals at 500 AC applied voltage.

5.5.7 Power Source

The AC Isolator operating voltage shall be obtained from the cabinet’s 24 VDC power supply. The isolator shall not draw more than 2.0 watts of DC power. PCB should be two layer design minimum, using plated-thru vias, and Gold Plated Fingers on Both Sides of PCB.

5.5.8 Outputs

Each isolation channel output shall be an opt-isolated NPN open collector capable of sinking 50 mA at 30 Volts. The outputs shall be compatible with Model 2070 controller.

5.5.9 Input Transient Protection

Each isolation channel shall be provided with electrical transient protection.

CHAPTER 6
CABINET SPECIFICATIONS
MODELS 332L, 334L, 336L, 342LX, 344LX & 346LX

CHAPTER 6-SECTION 1 GENERAL REQUIREMENTS AND CABINET MODEL COMPOSITION

6.1.1 Composition

Unless otherwise specified the model shall be furnished, ready for operation with the following composition.

6.1.2 Model 332L Cabinet

Model 332L Cabinet shall consist of:

Housing 1 B	Output File #1 ~~L~~
Mounting Cage 1	C1 Harness #1
Power Distribution Assembly #2 ~~L~~	Service Panel #1
Input Files I & J	Input Panel #1
C11 Harness	

6.1.1.1 Model 334L Cabinet

Model 334L Cabinet shall consist of:

Housing 1 B	PDA Assembly #3 ~~L~~
Mounting Cage 1	C1 Harness #2
Input File I	Service Panel #1
Input Panel #3	

6.1.1.2 Model 336L Cabinet

MODEL 336L CABINET shall consist of:

Housing 2	Output File #1 ~~L~~
Mounting Cage 2	C1 Harness #3
Power distribution Assembly #2L	Service Panel #2
Input File I	Input Panel #4
C11 Harness	

6.1.1.3 Model 342LX Cabinet

Model 342LX Cabinet shall consist of Housing 3 and two ITS Mounting Cages.
First Mounting Cage shall consist of:

Power Distribution Assembly #2LX	C1 Harness #1
Input Files LX I & J	Service Panel #1
Output File #1LX	Input Panel #1

C11 Harness

Second Mounting Cage shall consist of:

(2) Blank Side Panels	(2) Shelves
Service / PDA Assembly	

6.1.1.4 Model 344LX Cabinet

Model 344L Cabinet shall consist of Housing 3 and two ITS Mounting Cages.

First Mounting Cage shall consist of:

Input File LX I	C1 Harness #2
Input Panel #3	Service Panel #1
PDA Assembly #3LX	

Second Mounting Cage shall consist of:

(2) Blank Side Panels	(2) Shelves
Service / PDA Assembly	

6.1.1.5 Model 346LX Cabinet

Model 346LX Cabinet shall consist of Housing 4 and two ITS Mounting Cages.

First Mounting Cage shall consist of:

Power Distribution Assembly #2LS	C1 Harness #3
Input Files LX I	Service Panel #2
Output File #1LX	Input Panel #4
C11 Harness	

6.1.1.6 Assemblies and Files

All assemblies and files shall be mounted on the cage mounting rails per cabinet model detail. Cabinet model interface wiring shall be per specified C1 Harness, detailed wiring lists and required One Line Wiring.

6.1.3 Cabinet Shipping Requirements

The cabinet shall be delivered mounted on a plywood shipping pallet. The pallet shall be bolted to the cabinet base. The cabinet shall be enclosed in a slipcover cardboard packing shell. The housing doors shall be blocked to prevent movement during transportation.

6.1.4 Cabinet Adaptors

When specified, adaptors shall be provided. The adaptor shall be fabricated of the same material and finish as the cabinet housing.

6.1.5 Stainless Steel

All bolts, nuts, washers, screws (size 8 or larger), hinges and hinge pins shall be stainless steel unless otherwise specified.

6.1.6 Cage Mounting

A cage mounting clear area for the controller unit shall be provided. The area shall extend 1.5 inches in front of and 16 inches behind the front EIA mounting angles.

6.1.7 Protection

All conductors, terminals and parts which could be hazardous to maintenance personnel shall be protected with suitable insulating material.

CHAPTER 6-SECTION 2 HOUSING REQUIREMENTS

6.2.1 Housing

The housing shall include, but not be limited to, the following:

Enclosure	Police Panel
Doors	Ventilization
Latches/Locks	Gasketing
Hinges and Door Catches	Cage Supports and Mounting

6.2.2 Housing Construction

6.2.2.1 Waterproof

The housing shall be rainproof with the top of the enclosure crowned to prevent standing water. It shall have single front and rear doors, each equipped with a lock.

6.2.2.2 Fabricating

The enclosure, doors, lifting eyes, gasket channels, police panel, and all supports welded to the enclosure and doors shall be fabricated of 0.125 in minimum thickness aluminum sheet. Bolted on supports shall be either the same material and thickness as the enclosure or 0.105 in minimum steel. **The side panels and filter shell shall be fabricated of 0.125 in minimum thickness aluminum sheet.**

6.2.2.3 Exterior

All exterior seams for enclosure and doors shall be continuously welded and shall be smooth. All edges shall be filed to a radius of 0.03125 in minimum. Exterior cabinet welds shall be done by gas Tungston arc TIG process only. ER5356 aluminum alloy bare welding electrodes conforming to AWS A5.10 requirements shall be used for welding on aluminum. Procedures, welders and welding operators shall conform to the requirements and practices in AWS B3.0 and C5.6 for aluminum. Internal cabinet welds shall be done by either gas metal arc MIG or gas Tungston arc TIG Process.

6.2.2.4 Aluminum surfaces

Aluminum surfaces shall conform to the following:

6.2.2.4.1 Anodic Coating

An anodic coating shall be applied to the aluminum surface after the surface has been cleaned and etched. The cleaning and etching procedure shall be to immerse in inhibited alkaline cleaner at 159.8 °F for 5 minutes (Oakite 61A, Diversey 909 or equivalent in mix of 6 ounces to 8 ounces per gallon to distilled water). Rinse in cold water. Etch in a sodium solution at 150.8 °F for 5 minutes 0.5 ounce sodium fluoride plus 5 ounces of sodium hydroxide mix per gallon to distilled water. Rinse in cold water. Desmut in a 50% by volume nitric acid solution at 68 °F for 2 minutes. Rinse in cold water.

6.2.2.4.2 Conforming

The anodic coating shall conform to MIL-A-8625F (Anodic Coatings for Aluminum and Aluminum Alloys) for Type II, Class I Coating except the outer housing surface coating shall have a 0.0007 inch minimum thickness and a 0.952 ounces per square inch minimum coating weight. The anodic coating shall be sealed in a 5% aqueous solution of nickel acetate (PH 5.0 to 6.5) for 15 minutes at 210.2 °F.

6.2.2.4.3 Powder Coating

The Model 342LX, 344LX and 346LX Cabinets shall be Powder Coated with a coating that is at least 2 mils thick. The color shall be an Aluminum finish, Federal Standard 595C, # 17178.

6.2.2.5 Enclosure Doorframes

The enclosure doorframes shall be double flanged out on all 4 sides and shall have strikers to hold tension on and form a firm seal between the door gasketing and the frame. The dimension between the door edge and the enclosure external surface when the door is closed and locked shall be 0.156 (+/- 0.08) in.

6.2.2.6 Gasketing

Gasketing shall be provided on all door openings and shall be dust-tight. Gaskets shall be 0.25 inch minimum thickness closed cell neoprene or silicone (BOYD R-10480 or equal) and shall be permanently bonded to the metal. If neoprene is used the mating surface of the gasketing shall be covered with a silicone lubricant to prevent sticking to the mating metal surface. A Gasket Top Channel shall be provided to support the top gasket on the door (prevent gasket gravitational fatigue).

6.2.2.7 Cage Bottom Support Mounting Angles

The Model 332L, 334L & 336L

Cage bottom support mounting angles shall be provided on either side, level with the bottom edge of the door opening, for horizontal support and bolt attachment; side cage supports shall be provided for the bracket cage supports; and bracket cage support attachments.

Model 342LX , 344LX and 346LX

Cage bottom supports shall be provided on either side, level with the bottom edge of the door opening, for horizontal support and bolt attachment. In addition, side cage supports shall be provided for the upper cage bolt attachments. Spacer brackets between the side cage supports and the cage shall be a minimum thickness of either 0.188 in aluminum or 0.105 in steel.

6.2.2.8 Lifting Eyes

The housing shall be provided with 2 lifting eyes for placing the cabinet on its foundation. Each eye opening shall have a minimum diameter of 0.75 in. Each eye shall be able to support a weight load of 1000 pounds.

6.2.2.9 Exterior Bolt Heads

All exterior bolt heads shall be tamperproof type.

6.2.3 Door Latches & Locks

6.2.3.1 Latching Handles

The latching handles shall have provision for padlocking in the closed position. Each handle shall be 0.75 in minimum diameter stainless steel with a minimum 0.5 in shank. The padlocking attachment shall be placed at 4.0 in from the handle shank center to clear the lock and key. An additional 4.0 in minimum gripping length shall be provided.

6.2.3.2 Latching Mechanism

The latching mechanism shall be a three-point draw roller type. The pushrods shall be turned edgewise at the outward supports and have a cross section of 0.25 in thick by 0.75 in wide, minimum.

6.2.3.3 Locks and Handles for Model 332L, 334L and 336L

When the door is closed and latched, the door shall be locked. The locks and handles shall be on the right side of the front door and left side of the rear door. The lock and lock support shall be rigidly mounted on the door. In the locked position, the bolt throw shall extend a minimum of 0.25 ± 0.03125 in into the latch Cam area. A seal shall be provided to prevent dust or water entry through the lock opening.

6.2.3.4 Locks

The locks shall be Corbin 2 type, or equal. **Two keys shall be supplied with each cabinet.** The keys shall be removable in the locked position only.

6.2.3.5 Bolts

The locks shall have rectangular, spring-loaded bolts. The bolts shall have a 0.281 in throw and shall be 0.75 in wide by 0.75 in thick (tolerance is ± 0.035 in).

6.2.3.6 Center Latch Cam

The center latch cam shall be fabricated of a minimum thickness 0.1875 in steel or aluminum. The bolt surface shall horizontally cover the cam thickness. The cam shall be structured to only allow the door to open when the handle is moved toward the center of the door.

6.2.3.7 Rollers

Rollers shall have a minimum diameter of 0.875 in with nylon wheels and steel ball bearings.

6.2.4 Ventilation

The housing ventilation including intake, exhaust, filtration, fan assembly and environmental control are as follows:

6.2.4.1 Front Door

The **Model 332L, 334L and 336L** front door shall be provided with louvered vents. The louvered vent depth shall be a maximum of 0.25 in. A removable and reusable air filter shall be housed behind the door vents. The filter filtration area shall cover the vent opening area. A filter shell shall be provided that fits over the filter providing mechanical

support for the filter. The shell shall be louvered to direct the incoming air downward. The shell sides and top shall be bent over a minimum of 0.25 in to house the filter. The filter resident in its shell shall be held firmly in place with a bottom bracket and a spring loaded upper clamp. No incoming air shall bypass the filter. The bottom filter bracket shall be formed into a waterproof sump with drain holes to the outside housing. **The Model 342LX, 344LX and 346LX left front door and right rear door shall be provided with louver vents.**

6.2.4.2 Intake and Exhaust Areas

The intake (including filter with shell) and exhaust areas shall pass a minimum of 60 cubic feet of air per minute for housing #1, 26 cubic feet of air per minute for housing #2 **and 120 cubic feet of air per minute for housing #3.**

6.2.4.3 Electric Fan

The **Model 332L, 334L and 336L** housing shall be equipped with an AC powered electric fan with ball or roller bearings and a capacity of at least 100 cubic feet of free air delivery per minute. The fan shall be mounted within the housing and vented. **The Model 342LX, 344LX and 346LX housing shall be equipped with two AC powered electric fans.**

6.2.4.4 Temperature Controlling

Each fan shall be thermostatically controlled and shall be manually adjustable to turn on between 32 °F and 140 °F with a differential of not more than 20 °F between automatic turn on and off. The fan circuit shall be protected at 125% of the fan motor ampacity. The manual adjustment shall be graded in 20 °F increment scale. The Thermostat shall be an Omega KT01101141900 or equal.

6.2.4.5 Filter

The filter shall be 16 in wide by 12 in high by 0.875 in thick. The filter shall be an ECO-AIR Products E35S or equal.

6.2.5 Hinges & Door Catches

6.2.5.1 Leave Hinges

Two-bolt per leave hinges shall be provided to bolt the enclosure to the door. Housing **1B and 3** shall have 4 hinges and Housing 2 three hinges. Each hinge shall be 3.5 in minimum length and have a fixed pin. The pin ends shall be welded to the hinge and ground smooth. The pins and bolts shall be covered by the door edge and not accessible when the door is closed.

6.2.5.2 Front and Rear Doors

Front and rear doors shall be provided with catches to hold the door open at both 90 and 180 ±10 degrees. The catch minimum diameter shall be either 0.375 in for plated steel or aluminum rods or 0.25 in for Stainless steel. The catches shall be capable of holding the door open at 90 degrees in a 60 mph wind acting at an angle perpendicular to the plane of the door.

6.2.6 Police Panel

6.2.6.1 Police Panel Assembly

A police panel assembly shall be provided to allow the police officers limited access to intersection control. **The police panel assembly including switches shall not extend into the cabinet more than 2.5 in.**

6.2.6.2 Police Panel Door

The police panel door shall be equipped with a lock. The lock shall be keyed for a master police key. One key shall be furnished with each police lock. Each police key shall have a shaft at least 1.75 inches in length.

6.2.6.3 Toggle Power Switches

The police panel shall contain 2 DPST Toggle Power Switches.

6.2.6.3.1 Model 334L** and 344**LX****

One switch shall be labeled "ON-OFF LIGHTS" and the other "POLICE CONTROL ON-OFF".

6.2.6.3.2 Models 332L**, 336**L**, 342**LX** and 346**LX****

One switch shall be labeled "ON-OFF" and the other "FLASH/AUTOMATIC".

6.2.6.3.3 Front and Back of the Panel

The front and back of the panel shall be enclosed with a rigid metal covering so that no parts having line voltage are exposed.

6.2.6.3.4 Panel Assembly

The panel assembly shall have a drain to prevent water collecting within the assembly. The drain shall be channeled to the outside.

CHAPTER 6-SECTION 3

CABINET CAGE REQUIREMENTS

6.3.1 EIA 19-inch Rack Cage

A standard EIA 19-in rack cage shall be installed inside the **Model 332L, 334L, and 336L** housing for mounting of the controller unit and cabinet assemblies. Two standard EIA 19-in rack cages shall be installed inside the **Model 342LX, 344LX and 346LX** housing for mounting of the controller unit and cabinet assemblies.

6.3.2 EIA Cage Rack Portion

The EIA rack portion of the cage shall consist of 2 pairs of continuous, adjustable equipment mounting angles. The angles nominal thickness shall be either 0.1345 in plated steel or 0.105 Stainless Steel. The angles shall be tapped with 10-32 threads with EIA universal spacing. The angles shall comply with Standard EIA RS-310-D and shall be supported at the top and bottom by either welded or bolted support angles to form a cage.

6.3.3 Clearance

Clearance between rails for mounting assemblies shall be 17.75 in.

6.3.4 Angles

Two steel supporting angles extending from the front to the back rails shall be supplied to support the controller unit. The angles shall be designed to support a minimum of 50 pounds each. The horizontal side of each angle shall be a minimum of 3 in. The angles shall be vertically adjustable.

6.3.5 Cage

The cage shall be bolted to the cabinet at 4 points, via the housing cage supports and associated spacer brackets, 2 at the top and 2 at the bottom of the rails.

6.3.6 Cage Position

The cage(s) shall be centered within the cabinet(s).

CHAPTER 6-SECTION 4 CABINET ASSEMBLIES

6.4.1 General

6.4.1.1 Equipment

The following equipment shall be completely removable from the cabinet without removing any other equipment and using only a slotted or Phillips screwdriver:

- Power Supply Assembly
- Power Distribution Assembly
- Input File
- Output File
- Monitor Unit Assembly

6.4.1.2 Fuses, Circuit Breakers, Switches and Indicators

All fuses, circuit breakers, switches (except Police Panel Switches and Fan Fuse) and indicators shall be readily visible and accessible when the cabinet front door is open.

6.4.1.3 Equipment in the Cabinet

All equipment in the cabinet, when required shall be clearly and permanently labeled. The marker strips shall be made of material that can be easily and legibly written on using a pencil or ballpoint pen. Marker strips shall be located immediately below the item they are to identify and must be clearly visible with the items installed.

6.4.1.4 Resistor-Capacitor Transient Suppression

Resistor-capacitor transient suppression shall be provided at all AC relay sockets (across relay coil) except for the Flash Transfer Relays (FTR) in the output files where one suppression device may be common for all.

6.4.1.5 Leakage Resistor

A leakage resistor, which permits a small amount of current to pass through the heavy duty relay coil, shall be installed across the terminals of a relay socket to overcome the residual magnetism.

6.4.1.6 Assembly

Assembly or file depth dimension shall include terminal blocks.

6.4.1.7 Air Circulation

All assemblies and files shall allow air circulation through its top and bottom unless specifically called out otherwise.

6.4.1.8 Socket Types

Socket types for the following equipment shall be

Switch Pack	BEAU S-5412-XX (or equal)
Heavy Duty Relay	BEAU S-5408-XX (or equal)
Flasher Unit & Power Sup Mod	BEAU S-5406-XX (or equal)
208 Monitor Unit	PCB 22/44S
210 Monitor Unit	PCB 28/56S

6.4.1.9 Mounting

Connector sockets for Flasher Unit, Power Supply, and Switch Pack modules shall be mounted with their front face 7.5 in deep from assembly or file front panel (Note: Output File Exception).

6.4.1.10 Guides

Guides (Top and Bottom) shall be provided for Switch Pack Modules, Flasher Units, Monitor Unit, Watchdog Timer Module, Detector & Isolator Modules, and Power Supply Module (Bottom only). The guides shall begin 1.0±0.5 inches in from the front panel surface and extend to within 0.5 inches from the connector socket face.

6.4.1.11 Fabricating

Assemblies and Files shall be fabricated of 0.060 in minimum thickness aluminum or stainless steel sheet. The metal surface shall be treated with clear chromate.

6.4.2 Power Supply Assembly

6.4.2.1 Power Supply

A power supply shall be provided to supply +24 VDC to the Input and Output Files for use by their associated devices. The power supply shall be compliant with Chapter 3, Section 4 under Model 206L Power Supply Unit of these specifications.

6.4.3 Power Distribution Assembly (PDA)

6.4.3.1 Equipment

The following equipment shall be provided with the power distribution assemblies:

6.4.3.1.1 PDA #1L

- 1 -- Duplex NEMA 5-15R Controller Receptacle
- 2 -- Duplex NEMA 5-15R Equipment Receptacle (one with GFCI)
- 1 -- 1 Pole 15 Amperes minimum, 120 VAC Clean Power Circuit Breaker
- 1 -- 1 Pole 15 Amperes, 120 VAC Equipment Circuit Breaker
- 1 -- 6 Pole Ganged, 10 Amperes, 120 VAC Signal Bus Circuit Breaker
- 1 -- 2 Pole Ganged, 10 Amperes, 120 VAC Flash Bus Circuit Breaker
- 1 -- Solid State Relay (Normally Closed) - rated minimum 50 Amperes, 120 VAC, Crydom A2450-B or equal.
- 2 -- Model 204 Flasher Unit and Socket
- 1 -- AUTO/FLASH Control Switch

- 1 -- FLASH Indicator Light
- 1 -- Model 430 Heavy Duty Relay (Transfer Relay) & Socket
- 2 -- 10 Position Terminal Blocks (TBK) T1 & T2

6.4.3.1.2 PDA #2L/2LX

- 1 -- Duplex NEMA 5-15R Controller Receptacle
- 2 -- Duplex NEMA 5-15R Equipment Receptacle (one with GFCI)
- 1 -- 1 Pole 15 Amperes minimum, 120 VAC Signal Bus Circuit Breaker
- 1 -- 1 Pole 15 Amperes minimum, 120 VAC Clean Power Circuit Breaker
- 6 -- 1 Pole Ganged, 10 Amperes, 120 VAC Signal Bus Circuit Breaker with Auxiliary Switch
- 1 -- 1 Pole 15 Amperes, 120 VAC Equipment Circuit Breaker
- 1 -- 2 Pole Ganged, 10 Amperes, 120 VAC Flash Bus Circuit Breaker
- 1 -- Solid State Relay (Normally Closed) - rated minimum 50 Amperes, 120 VAC, A2450-B or equal.
- 2 -- Model 204 Flasher Unit and Socket
- 1 -- Model 206L Power Supply Module and Socket
- 1 -- AUTO/FLASH Control Switch
- 1 -- Flash On Indicator Light
- 3 -- 10 Position TBK T1, T2 & T4
- 1 -- 4 Position TBK T3
- 1 -- SSR Fault Indicator Light
- 1 -- HI Health Indicator Relay
- 1 -- K24 VDC Controlled Relay

6.4.3.1.3 PDA #2LS

- 1 -- Duplex NEMA 5-15R Controller Receptacle
- 2 -- Duplex NEMA 5-15R Equipment Receptacle (one with GFCI)
- 1 -- 1 Pole 15 Amperes minimum, 120 VAC Signal Bus Circuit Breaker
- 1 -- 1 Pole 15 Amperes minimum, 120 VAC Clean Power Circuit Breaker
- 6 -- 1 Pole Ganged, 10 Amperes, 120 VAC Signal Bus Circuit Breaker with Auxiliary Switch
- 1 -- 1 Pole 15 Amperes, 120 VAC Equipment Circuit Breaker
- 1 -- 2 Pole Ganged, 10 Amperes, 120 VAC Flash Bus Circuit Breaker
- 1 -- Solid State Relay (Normally Closed) - rated minimum 50 Amperes, 120 VAC, A2450-B or equal.
- 2 -- Model 204 Flasher Unit and Socket
- 1 -- Model 206LS Power Supply Module and Socket
- 1 -- AUTO/FLASH Control Switch
- 1 -- Flash On Indicator Light
- 3 -- 10 Position TBK T1, T2 & T4
- 1 -- 4 Position TBK T3
- 1 -- SSR Fault Indicator Light
- 1 -- HI Health Indicator Relay

1 --K24 VDC Controlled Relay

6.4.3.1.4 PDA #3L/3LX

- 1 -- Duplex NEMA 5-15R Controller Receptacle
- 2 -- Duplex NEMA 5-15R Equipment Receptacle
- 1 -- 1 Pole 15 Amperes, 120 VAC Equip. Circuit Breaker
- 2 -- 1 Pole 10 Amperes, 120 VAC Field Circuit Breakers
- 1 -- 1 Pole 15 Amperes, 120 VAC Clean Power CB
- 1 -- Model 206L Power Supply Module and Socket
- 1 -- Model 208 Monitor Unit and Socket
- 1 -- Model 430 Heavy Duty Relay and Socket
(Transfer Relay)
- 1 -- Watchdog Timer ON/OFF-RESET Control Switch
- 3 -- Model 200 Switch Pack Sockets
- 3 -- 10 Position TBK T1, T2 & T4
- 1 -- 4 Position TBK T3

6.4.3.2 Rating of Breakers

Rating of breakers shall be shown on face of breaker or handle. Breaker function shall be labeled below breakers on front panel.

6.4.3.3 Equipment Receptacle

The first equipment receptacle in the circuit shall have ground-fault circuit interruption as defined in the National Electrical Code. Circuit interruption shall occur on 6 mA of ground-fault current and shall not occur on less than 4 mA of ground-fault current.

6.4.3.4 AUTO/FLASH Switch

The AUTO/FLASH Switch when placed in FLASH position (down) shall energize the Solid State Relay (SSR). When the switch is placed in the AUTO Position (up) the switch packs shall control the signal indications. The switch shall be a SPST Toggle Control Switch.

6.4.3.5 FLASH Indicator Light

The FLASH Indicator Light labeled "Flash On" shall be mounted on the PDA Front Panel. The lamp shall be driven by Flasher Unit/Output through Flash Relay Circuit No. 1 or per Circuit Breaker.

6.4.3.6 SSR Fault Indicator Light

The SSR Fault Indicator Light labeled “SSR Fault” shall be mounted on the PDA Front Panel. The lamp shall be driven by the SSR output when the Health Indicator Relay is energized.

6.4.3.7 Conductors

All conductors from the power distribution assembly routed to the cabinet wiring shall be connected to the terminal block on the common side, except for the AC power conductor between the service terminal block and main circuit breaker. All internal conductors terminating at the blocks shall be connected to the other side of the blocks.

6.4.3.8 Ganged Circuit Breakers

Ganged Circuit Breakers shall be certified by the circuit breaker manufacturer that their circuit breakers shall gang trip.

6.4.3.9 Monitor Unit

The Monitor Unit ON/OFF-RESET Switch shall be a DPST Toggle Control mounted on the PDA #3L's front panel. When placed in DOWN Position (OFF-RESET) a grounded input shall be presented at the Monitor Unit Pin 22 (resetting the WDT Circuitry) and the other side switch circuit closes by passing the Monitor Unit.

6.4.3.10 Circuit Breaker with Auxiliary Switch

6.4.3.10.1 Single Pole

Six Single Pole 10 Ampere Circuit Breakers with Auxiliary Switch Feature and Medium Trip Delay Characteristic shall be provided.

6.4.3.10.2 Breakers

The six breakers shall be wired and routed per the Option One Line Diagram. The breaker auxiliary switch circuit shall be open when the breaker is in ON Position. The auxiliary circuits shall be wired in parallel so that any tripped breaker shall energize the Solid State Relay input, Flash Transfer Relay Coils and the "FLASH ON" Indicator. The Auxiliary Contacts shall be rated at 5 Amperes, 120 VAC Minimum (fast on type connection).

6.4.3.10.3 Terminals

Breaker switches shall be bussed using straight solid non-insulated bus wire which is soldered directly to the “fast-on” terminals.

6.4.3.11 Model 206L/LS Power Supply Module

6.4.3.11.1 Requirements

The module shall meet the requirements specified in 6.4.2.1.

6.4.3.11.2 Module Chassis

The module chassis shall be vented. Its top and sides shall be open except for unit supports

6.4.3.11.3 PDA Assembly

When resident in the PDA assembly, the module shall be held firmly in place by its stud screw, assembly connector support panel and a wing nut.

6.4.3.11.4 Wire-Wound Power Resistors

Two 0.5 Ohm, 10 watt minimum wire-wound power resistors with a 0.2uH inductance shall be provided (1 on the AC+ power line and 1 on the AC- line). Three MOV surge arrestors rated for 20 Joules minimum shall be supplied between AC+ and EG, AC- and EG, and between AC+ and AC-. A 0.68uF capacitor shall be placed across AC+ and AC- between the two power resistors and the MOV's.

6.4.3.12 Terminal Screw Sizes

Terminal screw size shall be 10-32 for TBK T1, T2 & T4 and 6-32 for TBK T3.

6.4.4 Input File

6.4.4.1 Depth

The file shall have a maximum depth of 8.5 in and shall intermit with and support 14 two-channel detector sensor or isolator units.

6.4.4.2 Connectors

The file shall provide a PCB 22/44S connector centered vertically for each two-channel detector. The associated number and letter side connectors shall be shorted internally. Pins D, E, F, J, K, L and W shall be brought out to a 8 position terminal block on the back of the file. The output emitters shall be common grounded with the ground terminating at TB 15, Position 4. Position 8 of the terminal block is assigned to Equipment Ground and is used to terminate lead in shields.

6.4.4.3 Marker Strips

The input file shall be provided with marker strips to identify isolators and detectors in the file.

6.4.4.4 Screw Size

Terminal Block (TB) terminal screw size shall be 8-32.

6.4.5 Output File

6.4.5.1 General Requirements

6.4.5.1.1 Marker Strips

The Output File shall be provided with marker strips to identify switch packs when mounted in the file.

6.4.5.1.2 Connectors

Switch pack connectors, monitor unit connectors, flash transfer relay sockets and flash programming connectors shall be accessible from the back of the Output File without the use of tools or removal of any other equipment.

6.4.5.1.3 Terminal Positions

TBK O1 and O3 terminal positions shall be labeled functionally. A permanent label reading "Channels 9 & 10 Separated" placed on the right Output File mounting flange.

6.4.5.1.4 Field Wire

Field wire terminal blocks shall be mounted vertically on the back of the assembly. Output File #1 shall have 3 terminal blocks with 12 positions and Output File #2 shall have 3 terminal blocks with 6 positions. Terminal position screw size shall be 10-32.

6.4.5.1.5 Flash Transfer Relays

The Flash Transfer Relays shall be Heavy Duty Type. The coil of the relay shall be energized only when the signals are in flashing operation and the police panel ON/OFF switch is ON. The relay shall transfer the field outputs from switch pack output to flash control. The transfer shall not interrupt the controller unit operation.

6.4.5.1.6 Depth

The depth of the file shall not exceed 14.5 in.

6.4.5.1.7 Flash Programming Connectors

The flash programming connectors shall be Molex Type 1375 or equal. The receptacle shall be mounted on the file with a programmable plug connected. The plug connector, with programming jumpers, shall be furnished for each circuit to allow red or yellow flash programming. Plug pins shall be crimped and soldered.

6.4.5.1.8 TB O1,O2,O3& O4 Terminal Screw Sizes

Terminal Block (TB) O1 and O3 terminal screw size shall be 8-32 and TBK O2 & O4 shall be 6-32.

6.4.5.2 Output File #1L

6.4.5.2.1 Containing

The output file shall be capable of containing 12 Model 200 Switch Packs, 4 Flash Transfer Relays, and the Model 210 Monitor Unit. Four Flash Transfer Relays and 1 Model 210 Monitor Unit shall be furnished with each output file.

6.4.5.2.2 Output Circuits

The red and yellow output circuits of switch packs 1, 2, 3, 4, 5, 6, 7 and 8 shall be made available at individual pack Molex receptacle /plug connection for flash select-ability. Eight red & 4 yellow Molex Plugs shall be provided.

6.4.5.2.3 Model 210 Monitor Unit

It shall be possible to remove the Model 210 Monitor Unit without causing the intersection to go into flashing operation. The cabinet shall be wired so that with the front cabinet door closed and with the monitor unit removed, the intersection shall go into flashing operation (See One Line Diagram). The cabinet shall contain a conspicuous warning against operation with the Model 210 Monitor Unit removed.

6.4.5.2.4 Monitor Unit Compartment

The monitor unit compartment including the housed Model 210 Monitor Unit exclusive of handle shall extend no farther than 1.25 in front of the 19-in rack front surface. The switch pack socket connector front surface shall be no more than 8.5 inches in depth from the front surface of the output file.

6.4.5.3 Output File #2L (Model 420)

6.4.5.3.1 Switch Packs and Flash Transfer Relays

The Output File #2 shall be capable of containing 6 Model 200 Switch Packs and 2 Flash Transfer Relays. Two Flash Transfer Relays shall be provided with the file.

6.4.5.3.2 Output Circuits

The red and yellow output circuits of Switch Packs No. 1, 2, 4 and 5 shall be made available at a Molex receptacle/plug connection for flash select ability.

6.4.5.4 Output File #1LX

The Output File #1LX shall meet the requirements as specified in Section 6.4.5.2 except that it shall be touch safe as indicated in the plan details.

6.4.5.5 Output File #2LX

The Output File #2LX shall meet the requirements as specified in Section 6.4.5.3 except that it shall be touch safe as indicated in the plan details.

6.4.6 Heavy Duty Relay (Model 430)

6.4.6.1 Electromechanical Type

Heavy duty relays shall be the electromechanical type designed for continuous duty.

6.4.6.2 Enclosing

Each relay shall be enclosed in a removable, clear plastic cover. The manufacturer's name, electrical rating and part number shall be placed on the cover. They shall be permanent, durable and readily visible.

6.4.6.3 DPDT Contacts

Each relay shall be provided with DPDT contacts. Contact points shall be of fine silver, silver alloy or superior alternative material. Contact points and arms shall be capable of switching a 20 Amperes at 120 VAC tungsten load per contact once every 2 seconds with

a 50% duty cycle for at least 250,000 operations without contact welding or excessive burning, pitting or cavitation.

6.4.6.4 Relay Coil

The relay coil shall have a power consumption of 10 Volt-Amperes maximum.

6.4.6.5 Potential & Surge Rating

Each relay shall withstand a potential of 1500 VAC at 60 Hz between insulated parts and between current carrying or non-carrying parts. Each relay shall have a 1 cycle surge rating of 175 Amperes RMS.

6.4.7 Side Panels

6.4.7.1 Viewing

Two panels shall be provided and mounted on the cage parallel to the cabinet sides. In viewing from the back door, the left side panel shall be designated as the "Input Panel" and the right side panel shall be designated as the "Service Panel".

6.4.8 Cabinet Harnesses

6.4.8.1 C1 Harness

The C1 Harness shall be a minimum of 4 ft in length. The harness wire bundle shall be provided with external protection and routed on the Input Panel Side of the cabinet. Adequate length shall be provided to allow the C1P Connector to properly connect any State Approved **Model 2070** Controller Unit mounted in the cabinet.

6.4.8.2 Ends

One end of the C1 Harness shall be the C1P Connector with pin contacts wired per the detail assignment. The other ends of the harnesses shall terminate as follows:

Harness #1 - C4S Connector (connected to C4P on Output File #1)
C5S Connector (connected to C5P on either the Input Panel or Output File #2)
Assigned Input Files I & J Positions and Logic Ground Bus

Harness #2 - C5S Connector (same as Harness #1)
C6S Connector (connected to C6P on the Output/PDA Assembly)
Assigned Input File I Positions and Logic Ground Bus

Harness #3 - C4S Connector (same as Harness #1)
Assigned Input File I Positions
Input Panel Terminal Block and Logic Ground Bus

6.4.8.3 C1 Harness #3/Output File #2 Adaptor

C1 Harness #3/Output File #2 Adaptor shall be comprised of a C4P Connector on one end and a C5S on the other. The adaptor shall interface the first 24 pins of C4 Connector to the 24 pins of C5.

6.4.8.4 Conductors

Conductors between the C1 Connector and the Input File(s) shall be of adequate length to allow any conductor to be connected to any detector output terminal (Positions S, F, or W).

CHAPTER 6-SECTION 5

CABINET WIRING

6.5.1 Cabinet Wiring Diagram

6.5.1.1 Diagrams/Drawings Supply

Four sets of nonfading (comparable to Xerox 2080) cabinet wiring diagram and drawing sheets shall be supplied with each cabinet. The diagrams shall be nonproprietary. They shall identify all circuits in such a manner as to be readily interpreted. The cabinet drawing sheets shall show the equipment layout in an elevation view as viewed from the rear of the cabinet with the left and right cabinet walls shown in their relative positions. The diagram and drawing sheets shall be placed in a heavy duty side opening clear plastic pouch and attached to the front cabinet door.

6.5.1.2 Pouch

A pouch that would hold the Cabinet Manuals, Cabinet Wiring and Drawing Sheets, and Cabinet Keys shall be provided as part of the Cabinet.

The pouch shall be of such design and material that it provides adequate storage and access to the wiring diagram sheets and cabinet manuals. The pouch shall be of size and strength to easily hold the documents and keys without tearing.

6.5.1.3 Manuals

Two cabinet manuals shall be provided in the pouch together with the wiring diagram and drawing sheets.

6.5.2 Conductors

6.5.2.1 General

All conductors used in cabinet wiring shall terminate with properly sized non-insulated (if used, for DC Logic Only) or clear insulated spring-spade type terminals except when soldered to a through-panel solder lug on the rear side of the terminal block or as specified otherwise. All crimp-style connectors shall be applied with a power tool which prevents opening of the handles until the crimp is completed.

6.5.2.2 Sizes

Conductors between the service terminal AC- and Equipment Ground and their associated bus, the equipment ground bus conductor to Power Distribution Assembly and cage rail, AC- Bus to Power Distribution Assembly shall be No. 8 or larger.

6.5.2.3 Types

All conductors unless otherwise specified shall be No. 22, or larger, with a minimum of 19 copper strands. Conductors shall conform to Military Specification: MIL-W-16878D, Type B, or better. The insulation shall have a minimum thickness of 10 mils and shall be

nylon jacketed polyvinyl chloride except that Conductors No. 14 and larger may have Type THHN insulation (without Nylon Jacket), and shall be stranded with a minimum of 7 copper strands.

6.5.2.4 Labels

All conductors, except those which can be readily traced, shall be labeled. Labels attached to each end of the conductor shall identify the destination of the other end of the conductor.

6.5.2.5 Color-Code Requirements

All conductors shall conform to the following color-code requirements:

6.5.2.5.1 Grounded Conductors

The grounded conductors of AC circuits shall be identified by a solid white or solid gray color.

6.5.2.5.2 Equipment Grounding

The equipment grounding conductors shall be identified by a solid green color or by a continuous green color with 1 or more yellow stripes.

6.5.2.5.3 DC Logic Ground

The DC logic ground conductors shall be identified by a continuous white color with a red stripe.

6.5.2.5.4 Ungrounded AC+ Conductors

The ungrounded AC+ conductors shall be identified by a solid black or continuous black with colored stripe.

6.5.2.5.5 Logic Ungrounded Conductors

The logic ungrounded conductors shall be identified by any color not specified above.

6.5.2.6 DC Logic Ground and Equipment Ground

Within the cabinet, the DC logic ground and equipment ground shall be electrically isolated from the AC grounded conductor and each other by 500 Mega Ohms when tested at 250 VDC.

6.5.2.7 AC- Copper Terminal Bus

The AC- copper terminal bus shall not be grounded to the cabinet or connected to logic ground. Nylon screws with a minimum diameter of 0.25 in shall be used for securing the bus to the service panel.

6.5.2.8 Power Supply DC Ground

The cabinet power supply DC Ground shall be connected to the DC logic ground bus using a No. 14, or larger, stranded copper wire.

6.5.2.9 Input Terminal

Each detector lead-in pair, from the field terminals in the cabinet to the sensor unit rack connector, shall be a cable of UL Type 2092 or better. The stranded tinned copper drain wire shall be connected to a terminal on the input file terminal block. This input terminal shall be connected to the equipment grounding bus through a single conductor.

6.5.3 Terminal Blocks

6.5.3.1 Terminal Screws

The terminal blocks shall be barrier type rated at 20 Amperes, 600 volts RMS minimum. The terminal screws shall be 0.3125 in minimum length nickel plated brass binder head type with screw inserts of same material. Screw size is called out under associated cabinet assembly, file or side panel.

CHAPTER 6-SECTION 6

SERVICE PANEL ASSEMBLY

6.6.1 General Requirements

A Service Panel Assembly shall be provided. The assembly shall function as the entry point for AC Power to the cabinet including main and secondary circuit breakers, cabinet transient and voltage surge protection, clean power filtering, and Raw and Clean AC Power Sources.

6.6.2 Location

The assembly shall be located on the lower right Cage when viewed from the back door.

6.6.3 Service Terminal Block

The terminals of the Block shall be labeled AC+, AC-, AC+ In , AC+ Out and EQ GND and shall be covered with a clear insulating material to prevent inadvertent contact. The Terminating Lugs shall be large enough to accommodate # 2 conductors. A AWG #8 Jumper Conductor shall be provided between AC+ In and AC+ Out.

6.6.4 Surge Protector

The surge protector shall be the EDCO Model SHA-1250 **ITS** or equal.

6.6.4.1 Impulse Breakdown

Less than 1,000 volts in less than 0.1 us at 10 kilovolts/us.

6.6.4.2 Standby Current

Less than 1 mA.

6.6.4.3 Striking Voltage

Greater than 212 VDC.

6.6.4.4 Ranges

Capable of withstanding 15 pulses of peak current each of which will rise in 8 us and fall in 20 us to 0.5 of the peak voltage at 3-minute intervals. Peak current rating shall be 20,000 Amperes.

CHAPTER 6-SECTION 7

SERVICE POWER DISTRIBUTION ASSEMBLY

6.7.1 General Requirements

A Service Power Distribution Assembly (Service PDA) shall be provided. The assembly shall function as the entry point for AC Power to the LX cabinets including main and secondary circuit breakers, cabinet transient and voltage surge protection, clean power filtering, and Raw and Clean AC Power Sources.

6.7.2 Location

The Service PDA shall be located on the lower left rack when viewed from the back door.

6.7.3 Service Terminal Block

The terminals of the Block shall be labeled AC+, AC-, EQ GND , AC+ , AC- and EQ GND and shall be covered with a clear insulating material to prevent inadvertent contact. The Terminating Lugs shall be large enough to accommodate # 2 conductors.

6.7.4 Surge Protector

The surge protector shall be the EDCO Model SHA-1250 **ITS** or equal.

6.7.4.1 Impulse Breakdown

Less than 1,000 volts in less than 0.1 us at 10 kilovolts/us.

6.7.4.2 Standby Current

Less than 1 mA.

6.7.4.3 Striking Voltage

Greater than 212 VDC.

6.7.4.4 Ranges

Capable of withstanding 15 pulses of peak current each of which will rise in 8 us and fall in 20 us to 0.5 of the peak voltage at 3-minute intervals. Peak current rating shall be 20,000 Amperes.

CHAPTER 6-SECTION 8

332L, 334L, 336L, **342LX, 344LX & 346LX** CABINET DETAILS

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CHAPTER 9-SECTIONS 1, 2, 3, 4 & 5

9.1.1 Controller Unit

The Controller Unit shall be composed of the Unit Chassis, modules and assemblies per their version. The following is a list of 2070 Versions, their interface rolls and composition:

UNIT VERSION	DESCRIPTION
2070V UNIT	Provides directly driven VME and mates to 170 & ITS cabinets. It consists of: UNIT CHASSIS, 2070-1A TB, 2070-1A MCB, 2070-2E+ FI/O, 2070-3A FRONT PANEL, 2070-4A POWER SUPPLY, and 2070-5 VME CAGE ASSEMBLY.
2070E UNIT	LITE Unit mates to the 170 & ITS cabinets. It consists of: UNIT CHASSIS, 2070-1E CPU, 2070-2E+ (2C if ITS CABINET), FI/O, 2070-3B FRONT PANEL and 2070- 4A POWER SUPPLY
2070EC UNIT	LITE unit mates to ITS cabinets only. It consists of: UNIT CHASSIS, 2070-1E CPU, 2070-2E+ FI/O, 2070-3C FRONT PANEL and 2070-4A POWER SUPPLY
2070LX UNIT	LX Unit mates to the 170 & ITS cabinets. It consists of: UNIT CHASSIS, 2070-1C CPU, 2070-2E+ (2C if ITS CABINET), FI/O, 2070-3B FRONT PANEL and 2070- 4A POWER SUPPLY
Note: See Chapter 11 for 2070 NEMA Versions	

9.1.6 EIA-485 Communications Links

All circuitry associated with the EIA-485 Communications links shall be capable of reliably passing a minimum of 1.0 Mbps. Isolation circuitry shall be by **optical/digital isolator technologies**.

9.2.4.3 Ram Memory

A minimum of **32 MB of DRAM/pseudo SRAM** memory, organized in 32-bit words, shall be provided. A minimum of 512 KB of SRAM will be available for agency use, organized in 16 or 32-bit words shall be provided. The time from the presentation of valid RAM address, select lines, and data lines to the RAM device to the acceptance of data by the RAM device shall not exceed 80 ns and shall be less as required to fulfill zero wait state RAM device write access under all operational conditions.

9.2.4.6 CPU_Reset

A software-driven CPU_Reset signal (Active LOW) shall be provided to reset other controller systems, such as the FCU and FPA. The signal output shall be driver capable of sinking 30 mA at 30 VDC. Execution of the program module “cpureset” in the boot image shall assert the CPU_Reset signal once. **The assertion of the CPU_Reset signal shall cause the FCU firmware to reset. The FCU shall become operational and respond to the Modules Status Request with the P bit set, within 33ms after a firmware reset. The cpureset shall be executed when the controller starts up or is rebooted using the OS-9 break command.**

9.2.4.10 Network Switch, Model 2070 -1E

The Model 2070-1E CPU Module shall be provided with an integrated Store-and-Forward Network Switch per the IEEE 802.3, 802.3u and 802.3 x specifications. The switch shall be configured with two ports connected to the front panel RJ-45 connectors (C14S) and a third port shall be connected to the CPU. A fourth Port on the Network Switch shall be used to route, **via magnetics**, to Ethernet across the Motherboard to the “A” Connector’s Network Lines. DC Grounding around the network connectors and lines shall be provided. The Network Lines shall be assigned as: NetP5 TX+, TX-, RX+ and RX- respectively.

9.2.6 Datakey

When programmed, Byte 3 of the header shall contain the Key Type value as defined in the following table:

Key	Model No.	Memory Size	Sector Size	Part Number	Color

Type

	DK1000	1Kb	2 Byte	611-0006-002A	Black
	LCK16000	16Kb	2 Byte	611-0070-008A	Gray
	SFK2Mb	2Mb	64KBytes	611-0089-004A	Yellow
	SFK4Mb	4Mb	64KBytes	611-0104-002A	Red
	SFK8Mb	8Mb	64KBytes	611-0132-006A	Blue
	SFK32Mb	32Mb	64KBytes	611-0164-005A	Green

9.2.7.1 Operating System

The CPU Module shall be supplied with Microware Embedded OS-9 Release 1.3.1 or later with kernel edition #380 or later. The following modules shall be included:

Embedded OS-9 Real Time Kernel
Sequential Character File Manager (SCF)
Stacked Protocol File Manager (SPF)
Pipe File Manager (PEMAN)
Random Block File Manager (RBF)
C Shared Library (CSL)

Boot Image shall include the following utility modules:

Break	Date	Deiniz	Devs	Free	Copy
Dir	Tmode	Edt	List	Load	Deldir
Dump	Del	Ident	Iniz	Irqs	Events
Echo	Format	Dcheck	Login	Link	Kermit
Tsmon	Mdir	Mfree	Pd	Makdir	Save
Attr	Rename	Procs	Unlink	Sleep	Xmode
Shell	Build	Setime	Merge	Grep	Mat
Tee	Printenv	Chown	Cudo	Mkdatmod	

The Boot Image with the above utilities and including the network driver and descriptor shall be loaded into RAM as part of OS-9 initialization as defined in Section 9.2.7.3.2.

9.2.7.2.2 Memory Drivers

Drivers shall be provided to access the FLASH, SRAM, and DRAM memories. The following descriptors shall apply:

/f0	FLASH drive	non-volatile, writeable
/dd	FLASH drive	OS-9 default device for /f0
/f0wp	FLASH Drive	as /f0 except write protected
/f0fmt	FLASH Drive	as /f0 except format enabled
/r0	SRAM Drive	non-volatile ramdisk
/r0fmt	SRAM Drive	as /r0 except format enabled
/r2	DRAM Drive	volatile 2 MB ramdisk, not automatically initialized

/r4	DRAM Drive	volatile 4 MB ramdisk, not automatically initialized
/r8	DRAM Drive	volatile 8 MB ramdisk, not automatically initialized

9.2.7.5.3 Multi-user functionality

The boot image init module shall be configured with a “default directory name” as /f0wp. This will allow login and tsmon to provide the user with login prompt from the terminal port or from the network via a telnet session.

The login and tsmon OS-9 modules should be included in the operating system boot image for the implementation of multi-user mode. A “.login” file with an entry of date shall be included in the /f0 directory. The attributes of the .login file shall be set using the command “attr -pwprwr .login “ and the ownership shall be set to group.user ID of “0.0”

The following startup file shall be provided resident in the /f0 directory. The startup file shall have the ownership group.user ID of “20.70”.

Include the following startup file:

```
*
*-t -np
*
* Startup File
*/f0/sys/startspf
*/f0/sys/startnfs
ex tsmon /sp4
*
*
```

9.2.7.5.4 Network Configuration

The modules inetdb, inetdb2 and rpcdb shall be generated by the make utility via the use of a makefile and the network configuration files residing the /f0/ETC directory. The generated inetdb, inetdb2 and rpcdb modules should be re-located to the /f0/CMDS/BOOTOBJS directory where they will be pick-up by the network configuration shell scripts located at /f0/SYS. The modules shall be configured with the network default values as defined in Section 9.2.6 (Data Key) or via the interfaces.conf shell script and all services shall be comment out in the Internet Daemon Services List inetd.conf located in the /f0/ETC directory.

9.2.7.5.6 ETC

A set of example configuration files consistent with the above networking modules shall be provided in the /f0/ETC directory. This directory shall contain following standard of OS-9 files: hosts, hosts.equiv, networks, protocols, services, inetd.conf, resolv.conf, hosts.conf, rpc, interfaces.conf, routes.conf., nfs.map, nfsd.map in addition to the following makefile:

Include the following makefile:

```
#####
###                               Model 2070 Controller
#
#                               Makefile
#####
# This makefile will make the inetdb,inetdb2 and rpcdb data modules
#
#
#####

-b
-bo

TRGTS      =      inetdb rpcdb
DEL        =      del -qf
COPY       =      copy
RPCDBGGEN  =      rpcdbgen
ATTR       =      attr -rweprpwpe
IDBGEN     =      idbgen
OS         =      OSK
CPU        =      68k

ODIR       =      /f0/CMD5/BOOTOBJS
SDIR       =      /f0/ETC

SFILES     =      $(SDIR)/hosts $(SDIR)/hosts.equiv
$(SDIR)/protocols \
            $(SDIR)/networks $(SDIR)/services $(SDIR)/inetd.conf
\
            $(SDIR)/resolv.conf $(SDIR)/host.conf \
            $(SDIR)/interfaces.conf $(SDIR)/routes.conf

$(SDIR)/rpc
RFILES     =      $(SDIR)/nfs.map $(SDIR)/nfsd.map
RPCOPT     =      # -s -c -d

all: $(TRGTS)
      $(COPY) -f $? -w=$(ODIR)
      $(COPY) -f inetdb2 -w=$(ODIR)

rpcdb: $(RFILES)
      $(DEL)  $@
      $(RPCDBGGEN) -to=$(OS) -tp=$(CPU) -w=$(SDIR) -o=$@ $(RPCOPT)
      $(ATTR)  $@
```

```

inetdb:  $(SFILES)
         $(DEL)  $@
         $(DEL)  $@2
         $(IDBGEN) -to=$(OS) -tp=$(CPU) -d=$(SDIR) $@
         $(ATTR)  $@
         $(ATTR)  $@2
clean:
         $(DEL)  $(ODIR)/inetdb
         $(DEL)  $(ODIR)/inetdb2
         $(DEL)  $(ODIR)/rpcdb

#####

```

9.2.7.6.1 Directories

The 2070 shall follow Standard Microware File System Configuration. A /f0/CMDS, /f0/CMDS/BOOTOBJS, /f0/ETC and /f0/SYS directories shall be implemented. Execute permission shall be included in the attributes of files in the /f0/CMDS directory. Sysgo should set its execution directory to /f0wp/CMDS prior to spawning opexec or other processes. The /f0/CMDS/BOOTOBJS shall contain the modules as identified above and other customizable descriptors and modules. **The /f0/SYS shall contain the files named “motd” and “errmsg” as defined elsewhere in this section and the following four standard OS-9 network configuration shell script files: startspf, startnfs, loadspf and loadnfs.**

Include the following startspf file:

```

*-t -np
*
* startspf
* Shell Script to Start SPF System
*
* Set default directories before starting daemon programs
*
* chd /h0
* chx /h0/cmds
*
* Load SPF modules
*
/f0/sys/loadspf
*
* Load and start mbuf handler (May be done via p2 list in init module)
* Allow for error returned in case sysmbuf is already initialized.
*
*-nx
* mbininstall
*-X
*
* Start SPF system using ipstart
*
ipstart

```

```

*
* Add interfaces not specified in inetdb2
*
*ifconfig enet0 <my_address> binding /<dev>/enet
*ifconfig ppp0 binding /ipcp0
*
* Add any static routes. Even if running routed it may be useful
*   to add multicast routes.
*
*route add -net 224.0.0.0 <my_address>
*
* Start service daemons
*   routed: Dynamic routing server
*   inetd: FTP/Telnet and other protocols server
*   telnetd: Remote terminal server
*   ftpd: Remote file-transfer server (FTP)
*   bootpd: Network boot protocol server
*   tftpd: Trivial file transfer protocol server
*
*routed <>>>/nil&
inetd <>>>/nil&
*telnetd <>>>/nil &
*ftpd <>>>/nil &
*bootpd /h0/TFTPBOOT/bootptab <>>>/nil&
*tftpd /h0/TFTPBOOT <>>>/nil &
*
*   spfndpd: Hawk User state debugging daemon
*   spfnppd: Hawk Profiling daemon
*
*spfndpd <>>>/nil &
*spfnppd <>>>/nil &
*
* End
*
```

Include the following loadspf file:

```

*-t -np
*
* loadspf for SPF LAN Communication Package
* Load SPF System Modules
*
load -d /f0wp/cmds/bootobjs/inetdb
load -d /f0wp/cmds/bootobjs/inetdb2
*load -d sysmbuf * System Mbuf module
load -d /f0wp/cmds/bootobjs/pkman
load -d /f0wp/cmds/bootobjs/pkdvr
load -d /f0wp/cmds/bootobjs/pk
load -d /f0wp/cmds/bootobjs/pks
*load -d spf * SPF file manager
load -d /f0wp/cmds/bootobjs/spip
load -d /f0wp/cmds/bootobjs/ip0
load -d /f0wp/cmds/bootobjs/sptcp
load -d /f0wp/cmds/bootobjs/tcp0
load -d /f0wp/cmds/bootobjs/spudp
load -d /f0wp/cmds/bootobjs/udp0
```

```

load -d /f0wp/cmds/bootobjs/spraw
load -d /f0wp/cmds/bootobjs/raw0
load -d /f0wp/cmds/bootobjs/sproute
load -d /f0wp/cmds/bootobjs/route0
*
* Load LAN Trap library and Commands
* Load one of the following Netdb name resolution trap handlers
*
*load -d /f0wp/cmds/bootobjs/netdb_local
*
* Load trap handler for DNS name resolution
*
load -d /f0wp/cmds/bootobjs/netdb_dns
*
* Load SPF Ethernet Drivers and Descriptors
*
load -d /f0wp/cmds/bootobjs/spenet
load -d /f0wp/cmds/bootobjs/enet

* Serial Drivers and Descriptors
*
*load -d spslip      spsl0          * Slip /t1
*load -d spipcp      ipcp0          * PPP IPCP
*load -d splcp       lcp0           * PPP LCP
*load -d sphdlc      hdlc0          * PPP HDLC
*chd ../..
*load -d chat pppd ppplog pppauth; chd BOOTOBS/SPF * PPP Utilities
*
*
* Chd up to CMDS directory
*
*load -d mbinstall          * Load mbinstall memory handler
                             * (or can be done within init)
*
load -d /f0wp/cmds/ipstart
*
*
*load -d /f0wp/cmds/routed
*load -d telnet telnetd telnetdc ;* Telnet support modules
*load -d ftp ftpd ftpdc          ;* FTP support modules
*load -d tftpd tftpd bootpd      ;* Bootp/TFTP support modules
load -d /f0wp/cmds/inetd

*load -d idbgen idbdump ndbmod   ;* Development tools
load -d /f0wp/cmds/ifconfig
load -d /f0wp/cmds/route
*load -d route hostname ifconfig arp ;* Runtime tools
load -d /f0/cmds/ping
load -d /f0/cmds/netstat
*
* Loads the Hawk Daemons.
*
*load -d /f0/cmds/spfndpd
*load -d /f0/cmds/ndpio
*load -d /f0/cmds/spfndpd
*
```

```
* End
*
```

Include the following startnfs file:

```
*-t -np
*
* startnfs for NFS provided with LAN Communication Package
*
*
* Shell Script to Start NFS Client System and mount file systems
*
* NOTE: NFS client modules may be loaded into memory using loadnfs
*
chd /f0                      ;* Set default directories for NFS mounts
chx /f0/cmds                 ;* Programs are located in CMDS directory
SYS/loadnfs
*
* Start NFS client and mount remote file systems
*
iniz nfs_devices             ;* attach NFS client devices
*
* Example mount commands to connect to server systems remote device
*
*mount -m peer:/ /peer       ;* mount remote file systems
*mount alpha:/h0 /alpha <>>>/nil&
*mount electron:/home/joe/dat/Modules /h0 <>>>/nil&
*
* Start NFS Server System
*
*
* Specify file systems to export (Necessary if acting as a NFS Server)
*
*exportfs -s /f0              ;* specify remote mountable devices
*exportfs -s /r0              ;* specify remote mountable devices
*
* start rpc services daemons
* Uncomment portmap, mountd and nfsd if acting as a NFS Server
*
*portmap<>>>/nil&              ;* start portmap server          (rpcinfo)
*mountd<>>>/nil&               ;* mount server              (mount, showmount)
*nfsd<>>>/nil&                 ;* nfs server                (..)
*
* End
*
```

Include the following loadnfs file:

```
*-t -np
*
* loadnfs for NFS modules provided with LAN Communication Package
*
* Load NFS Client Modules
*
* chd /f0/cmds/bootobjs
```



```

* NFS file manager, driver and descriptor
load -d /f0wp/cmds/bootobjs/nfs
load -d /f0wp/cmds/bootobjs/nfsnul
load -d /f0wp/cmds/bootobjs/nfs_devices
load -d /f0wp/cmds/bootobjs/rpcdb
*
* Load NFS Client Commands
*
* chd /f0wp
*
*load -d nfsc          mount          * Client connection handler
*load -d rpcdbgen rpcdump nfsstat    * RPC data module utilities
*load -d rpcinfo
*
* Load NFS Server Modules
*
*load -d exportfs portmap * NFS server required utilities/daemons
*load -d nfsd mountd      * NFS server required utilities/daemons
*load -d showmount
*
* Load RPC Client Modules
*
*load -d rcopy rload rpr on rup rusers spray
*
* Load RPC Server Modules
*
*load -d rldd rexdc rexd rstatd rusersd sprayd
*
*
* End
*
```

The motd file shall contain the Manufacturer's Name and TEES and Erratas Release information. The attributes of the motd file shall be set using the command `attr -pwprwr motd` and the ownership shall be set to group.user ID of "0.0"

Include the following motd file:

```

*****
*****      Manufacturer's Name      *****      **
**      TEES Release 2009, Errata No.1 and Errata No. 2
*****
```

The errmsg file shall be the standard OS-9 errormsg file which defines OS-9 error codes 000:001 through 010:068. The attributes of the errormsg file shall be set using the command `attr -pwprwr errormsg` and the ownership shall be set to group.user ID of "0.0"

9.2.7.6.2 Password

The /f0/SYS shall contain a "password" file with one entry, `reg user`. The password file should follow Microware's password file format for the addition and configuration of

multiuser functionality and password protection. A user account with the name “reg”, the password as “user” shall be defined as listed in the password file. The attributes of all files in the /f0/sys directory, except for those files as mentioned elsewhere in these specifications, shall be set using the following command:

```
$ attr -nprnpwnpenewr *  
and the ownership shall be group.user ID of “0.0”.
```

Include the following password file:

```
*  
* Password File  
* Model 2070 Controller*  
*  
reg,user,20.70,128,/f0wp/cmds,/f0,shell -p="Reg:"  
*  
*
```

A Termcap text file shall be include in the /f0/SYS directory. This Termcap file shall contain description fields defining the capability names and values of the front panel DISPLAY.

9.3.8.3 Outputs

Simultaneous assertion of all outputs shall occur within 100 μ s. Each output shall be capable of being individually configured in state to ON, OFF (Cases A and D), or an optional state synchronized with either phase of LINESYNC (Cases B and C). The condition of the outputs shall only be "ON" if the FI/O continues to receive active communications from the CPU Module. If there is no valid communications with the CPU Module for 2.0 seconds, all outputs shall revert to the OFF condition, and the Module Status Byte shall be updated to reflect the loss of communication from the CPU Module.

9.3.8.4 Standard Function

Each output shall be controlled by the data and control bits in the CPU Module Field I/O frame protocol as follows:

Output Bit Translation

Case	Output Data Bit	Output Control Bit	Function
A	0	0	Output in the OFF state
B	1	1	Output is a square wave, synchronized to the LINESYNC signal. When LINESYNC is ON (1), the output is OFF, and when LINESYNC is OFF (0), the output is ON.
C	0	1	Output is a square wave, synchronized to the LINESYNC signal. When LINESYNC is ON (1), the output is ON, and when LINESYNC is OFF (0), the output is OFF
D	1	0	Output is in the ON state.

9.3.8.4.1 Case A

In Case A above, the corresponding output shall be turned OFF if previously ON and if previously OFF remain OFF until otherwise configured. For **optional** half-cycle switching (Cases B and C), all outputs to be changed shall be changed within 50 μ s after the corresponding LINESYNC transition and shall remain in the same state during the entire half cycle. In Case D above, the corresponding output shall be turned ON if previously OFF and if previously ON **should** remain ON until otherwise configured. All outputs shall neither glitch nor change state unless configured to do so.

9.3.8.7 Communication Processing

This task shall be to process the command messages received from the CPU Module, prepare, and start the response transmission. **The response message transmission shall begin within 4 ms of the receipt of the last byte of the command message for all command message types.**

Processing time for the Set Outputs command shall be less than 1.5ms. The FI/O shall be able to process 1000 Set Outputs command messages within 1.5 seconds, where each command toggles all outputs utilizing Case A and D as defined elsewhere in these specifications. Each output shall consist of a square wave with a 50% duty cycle and a time period of less than 3 ms.

9.4.5.16 C50 Enable Function

C50 ENABLE function when grounded by Connector C50 Pins 1 and 5 shall be brought to Connector A1 Pin B21 for the purpose of disabling the module Channel 2.

9.5.5.1 AC Fail/Power Down Output Lines

The AC Fail/Power Down Output Lines shall go Low (ground true) immediately upon Power Failure. The Lines shall transition to High within 50 ms after both Power Restoration and supply is fully recovered. The Lines shall be driven separately. The Sysreset/Powerup Output Lines shall transition to Low 525 +/-25 ms after AC Fail/Power Down transition to Low. The Lines shall transition to HIGH 225 +/- 25 ms after both Power Restoration and the supply is fully recovered **(e.g. after +5 VDC is within the range specified in section 9.5.6).** The Lines shall be driven separately.

CHAPTER 10-SECTION 2

MODEL 2070-7A & 7B ASYNC / SYNC

SERIAL COMM MODULE

10.2.1 Circuits

Two opto-isolated independent circuits designated circuits #1 (Channel 1) and circuits #2 (Channel 2), shall be provided. Their functions are identical, except for the CPU Serial Communications Port and external connector (circuits #1 to SP1 [or SP3] and Connector C21S and circuits #2 to SP2 [or SP4] and Connector C22S). Line drivers/receivers shall be socket or surface mounted.

The 2070-7x module's isolation circuitry shall be capable of reliably passing a minimum of 1.0 Mbps. The EIA-485 drivers to the external connectors must be capable of supporting either two times the maximum applicable baud rate for the port or 1Mbps, which ever is less. The EIA-232 drivers to the external connectors must be capable of supporting a minimum of 115,200 bits per second.

10.2.2 2070 -7A

Each circuit shall convert its EIA-485 signal lines (RX, TX, RTS, CTS and DCD) to/from board TTL Level Signals; isolate both signal and ground; and drive / receive external EIA-232 devices via C21 / C22 Connectors. Connectors shall be DB-9S type.

2070-7A (DB-9S)	
C21S & C22S CONNECTOR PINOUT	
PIN	FUNCTION
1	DCD
2	RXD
3	TXD
4	NA
5	IFC GND
6	NA
7	RTS
8	CTS
9	NA

IFC GND is isolated from the internal ground system & is the voltage reference for the EIA-232 & EIA-485 signals.

10.2.3 2070 - 7B

Each circuit's drivers/receivers and associated signal ground shall be matched with an associated EIA-485 receiver/driver; isolating both signal and ground, and driver/receiver

from external EIA-485 devices via C21/C22 Connectors. Connectors shall be DB-15S type.

Each circuit EIA -485 signal lines, (RX, TX, TXC (I), TXC (O) and RXC) and associated signal ground shall be board terminated to matching drivers/receivers; isolating both signal and ground, and drive/receiver external EIA-485 devices via C21/C22 Connectors. Connectors shall be DB-15S type.

2070-7B (DB-15S)			
C21S & C22S CONNECTOR PINOUT			
PIN	FUNCTION	PIN	FUNCTION
1	TXD +	9	TXD -
2	IFC GND	10	IFC GND
3	TXC +	11	TXC -
4	IFC GND	12	IFC GND
5	RXD +	13	RXD -
6	IFC GND	14	IFC GND
7	RXC +	15	RXC -
8	NA		

10.2.4 EIA-485 Termination Requirements

The EIA-485 Line Drivers/Receivers shall be socket mounted or Surface mounted and shall not draw more than 35 mA in active state and 20 mA in inactive state. A 100-Ohm Termination Resistor shall be provided across each Differential Line Receiver Input.

10.2.5 LED Indicator

Each circuit signal TX and RX line shall have an LED Indicator mounted on the front plate and labeled according to function.

10.2.6 Enable/Disable Features

The 2070-7x modules shall provide circuitry to disable their Channel 2 and EIA 232 control lines when a ground-true state is presented at Connector A1 Pin B21 (C50 Enable). C50 Enable shall disable Channel 2 via disabling the RS-485 signals to and from the motherboard. The Disable line shall be pulled up on these modules.

The 2070-7x modules shall provide circuitry to manually disable Channel 1. When Channel 1 is manually disable, the "Ch. A Disable" LED indicator shall be turn ON.

The Enable/Disable function shall be controlled from an option switch or jumper located on the PCB. Channel A denotes C21S and Channel B denotes C22S.

10.2.7 Hot Swappable

The 2070-7x module shall be “Hot” swappable without damage to its circuitry or operations. A communication “glitch” occurring during insertion/removal is acceptable since the application program should be able to recover/retry. Power-on and hot-swap current surges shall not exceed a 10 ms surge at three times (3x) the maximum rating of each voltage supply used by the module.

10.2.8 Power Requirements

The power requirements of the 2070-7x Module shall be within the power limitations of the Model 2070 Unit as described in Section 9.2.5 of these specifications.

Models	+5 VDC	+12 VDC iso	+12 VDC ser	-12 VDC ser
2070-7 All Comm	250mA		50 mA	50 mA

CHAPTER 10-SECTION 9

MODEL 2070-7G UNIVERSAL TIME BASE MODULE

10.9.1 Model 2070-7G Universal Time Base Module

The Model 2070-7G Universal Time Base Module shall consist of a GPS receiver with antenna and a microprocessor-based circuit. It shall read raw GPS time data and accept user commands via Com 2 as defined elsewhere in these specifications. The Model 2070-7G Universal Time Base Module shall be a Plug-in Style Card version for the Model 2070 Controller. The Model 2070-7G shall be provided with two communications channels Com 1 and Com 2. Com 1 shall be use to establish serial communications between the Model 2070 Controller and a GPS receiver resident in the Model 2070-7G Universal Time Base Module. Com 2 shall be switch selectable between a Config Mode to the GPS receiver and a straight serial port for the Model 2070 Controller.

10.9.2 GPS Receiver/Antenna

The Model 2070-7G shall be provided with a Land-Based L1, C/A code GPS Receiver operating at a frequency of 1575.42MHz. The GPS Receiver shall contain a **minimum of 16 Channels**. The receiver shall have a tracking sensitivity level greater than **-141dBm** at the receiver input.

The Model 2070-7G shall be provided with an active permanently mount GPS Antenna. The Antenna mount shall consist of GPS roof-mount antenna with double threaded bolt, through hole, wing nut fastener, and locking nuts. The mounting shall consist of a Bulkhead mount with 0.8 inch threaded wing nut.

The Antenna System shall be comprised of an Antenna Element, Cable and Connector, and Low Noise Amplifier (LNA).

The Cable and Connector shall consist of a 2 Meter RG174/U Coaxial cable terminated at the non-antenna end with a **BNC male/SMA female** straight connector.

The Antenna Element shall use Right Handed Circular Polarization (R.H.C.P) and shall have a minimum Gain of +5 dBi. The antenna shall have a VSWR of 1.5:1 max. and an output impedance of 50 Ohms.

The Low Noise Amplifier shall operate from a 3.3 to 5.5 V DC source and shall provide an Outer Band Attenuation of 20 dB min. at $F_o \pm 50$ MHz and a Gain of 31 dB min.

The Overall Performance of the Antenna System including Antenna Element, LNA and Coax Cable shall be as follows:

Center Frequency: 1575	1575.42 MHz
Gain	26 dB min.
Noise Figure	2.0 dB max.
Axial Ratio	3.0 dB max.
Bandwidth	2 MHz min.
VSWR	2.0:1 max.
Output Impedance	50 Ohms

10.9.3 Default Configurations

The Model 2070-7G Universal Time Base Module shall have the following default configuration parameters:

Baud Rate	1200 bps
Time Zone	8, Pacific Time Zone
New Line Character	ASCII Carriage Return, Except QC, which CR+LF
Hour Format	24 hour (Military Time)
Daylight Savings Time	Enabled
Begin DST Clock Correction	March, Second Sunday at 02:00AM
End DST Clock Correction	November, First Sunday at 2:00 AM

These parameters shall be configurable using the Q & S Command Set as defined in Section 10.9.4 of these specifications.

10.9.4 Q & S Command Set

The “Q” Commands

“Q” commands shall be used to request information from the Model 2070-7G, such as global position, date and time. The Model 207-7G shall support the “Q” commands as listed in the following table.

Model 2070-7G "Q" COMMANDS			
COMMAND	RETURNS	FORMAT	EXAMPLES
QA n1 n2 0 0	Status, DOY, time	13 byte Binary string	See detail comments below
QD	Date and Day of year	YY/MM/DD/day {newline}	02/02/05/036
QT	TIME	mHH:MM:SS:Thtd {newline}	A10:51:21:697 _17:45:05:489D
QC	Date, time status and day of week	YYMMDDHHmmSSThtLW {cr+lf}	020821231706945Y6
QD, QT, QL & QC	Message	ASCII string “NOT LOCKED ON”	NOT LOCKED ON
QM	Data stored in ROM	Bw:Dx:My:Ncr:Oz Baud: DST: 12/24: new line: TimeZone	B7:D0:M1:Ncr:O6 {newline}
QV	Firmware version	ASCII version number	v1.2
QI	Get Daylight saving time configuration	bMbsbhbmeMesehem{newline}	0302020011010200 {newline}
QL	Get Position (latitude and longitude)	DD.MM.SS.THTA ddd.mm.ss.thtO	38.53.23.123N 077.00.27.123W

“Q” Commands

QD When the “QD” command is received by the Model 2070-7G it shall respond with either the ASCII message “NOT LOCKED ON” or with the date in the format YY/MM/DD/day followed by the new line character. “doy” is the day of the year in a 3 digit format, January 1 being 001. If the Model 2070-7G has not yet found at least one satellite to insure correct data, the response shall be “NOT LOCKED ON”.

An example of a normal response from the Model 2070-7G to a “QD” command sent to it would be “02/02/05/036(new line character)”. This sample data stream would represent February 5, 2002 and that date would be the 36th day of the year 2002.

Note: If the device is configured for a time zone other than the local time zone, the date and “doy” shown could differ from the local date, depending on the time of day.

QT When the “QT” command is received by the Model 2070-7G it shall respond with either the ASCII message “NOT LOCKED ON” or with the time of day in the format of an A or a P or an ASCII space (to signify A.M. or P.M. or 24 hour time format) immediately followed by “HH:MM:SS:Tht” and a “D”, if Daylight Savings Time function is “Enabled” and ending with the new line character.

Two sample “QT” responses are:

“A10:51:21:697{NEW LINE}”, which could be interpreted as 10:51 A.M. plus 21.697 seconds and not corrected for daylight savings time.

“_17:45:05:489D{new line}”, which could be interpreted as 1745 plus 5.489 seconds (using the 24 hour format), with Daylight Savings Time Enabled. The “_” represents an ASCII “space” character and signifies that the output is in 24 hour format.

As with the “QD” command, if the Model 2070-7G is not receiving a valid signal from at least one satellite, the response to a “QT” command shall be the ASCII message “NOT LOCKED ON”.

QC This command reply shall provide a combination of the information found in the “QT” and “QD” commands but in slightly different format and with some additional information.

As with the “QT”, “QL” and “QD” commands, the message “NOT LOCKED ON” shall be the reply if the Model 2070-7G does not have at least one satellite in view to determine the precise time and date.

A special synchronization character in the data stream (either Y or N) shall signify whether or not the date and time data are synchronized with UTC (Universal Coordinated Time).

In order for the Model 2070-7G to report fully synchronized data with the special character changed to “Y”, the unit must be tracking at least 4 satellites. If the synchronization character is “N” the time reported will be less precise but still within a few milliseconds of the UTC synchronized time. The “QC” command hour format is always 24 hour (military time) since there is no character in the data stream to indicate A.M. or P.M. An additional bit of information included in the “QC” data stream is a “day of the week” number. The number 0 (zero) indicates Sunday, 1 indicates Monday and so on through 6, which indicates Saturday. Unlike the “QT” and “QD” commands, the “new line” character shall not be changed. It shall always be ASCII “carriage return

+ line feed”. The format of the “QC” data stream shall be YYMMDDHHmmSSThLW followed by an ASCII carriage return and line feed.

A sample “QC” data stream generated by the Model 2070-7G would be:

“02032123176945Y6{cr+lf}”. This data stream would be interpreted as March 21, 2002, the time, in 24 hour format, would be 2317 plus 6.945 seconds, the time is synchronized to UTC (Y) and the day of the week is Saturday (6). Note that the data stream does not indicate whether or not Daylight savings time is “Enabled or Disabled”.

QM The “QM” command shall reply with the parameters stored in non-volatile memory, which shall be the baud rate, daylight savings time enable-disable, time format, new line character and time zone. Parameters shall be separated by a colon and the data stream shall be terminated with the new line character. The data stream

B7:DO:M1:Ncr:O6{newline} would represent a baud rate = 19200 bps, Daylight savings time = disabled, 12 hour time reporting format, new line character = carriage return and Time Zone = Central. This command shall be used to determine the current configuration.

QV When the “QV” command is received by the Model 2070-7G it shall reply with the firmware version number. The format for the firmware version shall be as VX.X where X.X shall digits from 0 to9. An example of a response to the QV command would be “V1.2” without the quotation marks. The “NOT LOCKED ON” message shall never reply to this query command.

QI The “QI” command shall replay the currently loaded Daylight saving time parameters; these shall be stored in the non-volatile memory. A total of 8 parameters are shall be sent. The data stream is bMbshbmeMesehem{newline} and the parameters are as follow:

Begin Month (bM). The month when starts to observe the DST changes. This value shall be a two digits number. 01 means January, 02 February, 03 March and so on.

Begin Sunday (bs). The Sunday number of “begin month (bM)”. This value shall be a two digits number.

Begin Hour (bh) and Begin Minutes (bm). The time when starts to observe the DST. This time shall be expressed in a 24 hour format.

End Month (eM). The month when ends the DST changes. This value shall be a two digits number. 01 means January, 02 February, 03 March and so on.

End Sunday (es). The Sunday number of “end month (eM)”. This value shall be a two digits number.

End Hour (eh) and End Minutes (em). The time when the DST observation ends. This time shall be expressed in a 24 hour format.

An example data stream 0302020011010200{newline} would represent DST clock adjust will begin at second Sunday of March at 02:00 AM and DST will end at first Sunday of November at 02:00 AM.

When the Model 2070-7G module detects any of both DST conditions, either Begin or End, it corrects the time by adding or subtracting one hour to local time. Once “begin DST” conditions met (Month, Sunday and time) it adds one hour to local time. When “end DST” conditions met (Month, Sunday and time) it subtracts one hour to local time. The Model 2070-7G shall always respond to this command.

QL The “QL” command will replay the latitude and longitude of the current Global Position expressed in degrees, minutes, seconds and milliseconds, north (N) or south(S) for Latitude, east (E) or west (W) for longitude. The data stream shall be expressed as follows, DD.MM.SS.THTA_ddd.mm.ss.thtO{newline}.

DD = latitude degrees
MM = latitude minutes
SS = latitude seconds
THT = latitude milliseconds
A = latitude, North or South
ddd = longitude degrees
mm = longitude minutes
ss = longitude seconds
tht = longitude milliseconds
O = longitude, East or West

An example data stream 38.53.23.123N_077.00.27.123W{newline} would represent 38 degrees latitude north, with 53 minutes, 23 seconds and 123 milliseconds and 077 degrees longitude west with 00 minutes, 27 seconds and 123 milliseconds. As with the “QT”, “QC” and “QD” commands, the message “NOT LOCKED ON” shall be the response if the Model 2070-7G does not have at least one satellite in view to determine the precise position.

Please note: the “_” represent an ASCII space.

QA The “QA” command differs from the other Q commands in that it must include two additional user selected variables n1 and n2, and two fixed variables n3 and n4, which are always zero. The output from the QA command depends on the variables sent with the command. It also differs from the other Q commands in that the information returned is not ASCII but rather binary. A list of the user defined variables and the information returned follows.

User defined variables

n1– Time zone. The variable entered must be the sum of an ASCII 0 + (0 – 11) depending on the time zone desired. For example ASCII 38 signifies time zone 8, Pacific.
n2 – Daylight savings time correction, 0 = disabled, 1 = enabled.

Possible replies from the Model 2070-7G to a QA command

Byte 0

Bits 1-3 are not used.

Bit 4 is 0 if valid time is not currently available and 1 if time is valid.

Bit 5 is 1 during the initialization phase only (before first lock on, i.e. LED changes to green for the first time. This bit changes to 0 at the first lock on and never changes even in subsequent amber conditions.

Bit 6 is 1 if GPS detects internal fault that could affect time reporting, otherwise is 0.

Bit 7 is normally 0 but if no satellite information is received for 24 hours, this bit will be 1.

Bit 8 is not used.

Byte 1

Bits 1-4 are not used, always zero.

Bits 5-6 are always 0 indicating that the time is in 24-hour format.

Bit 7, Daylight Savings Time indicator is 1 when DST is enabled and the date is within the DST period. This bit is 0 if DST correction is disabled or the date is outside of the DST period.

Bit 8 is not used, always zero.

Bytes 2 and 3

Milliseconds portion of current time, the Hex equivalent of BCD.

Byte 4

Seconds portion of current time, the Hex equivalent of BCD.

Byte 5

Minutes portion of current time, the Hex equivalent of BCD.

Byte 6

Hours portion of current time, the Hex equivalent of BCD.

Bytes 7 and 8

Day of Year, the Hex equivalent of BCD.

Byte 9

Year (this byte is actually the offset from 1986) i.e. 18 = 2004, the Hex equivalent of BCD.

Bytes 10 and 11

Always zero.

Byte 12

Always a new line character (CR).

The “S” Commands

The Model 2070-7G shall accept instructions from the user in the form of “S” (Set) commands. The “S” commands, their variables, and their meanings that shall be supported shall consist of the following:

Model 2070-7G "S" COMMANDS				
COMMAND	NAME OF COMMAND	"n" variable	SETTING (default)	(Notes)
SB_n	SET BAUD RATE	0	Reserved	
		1	Reserved	
		2	Reserved	
		3	(1200)	
		4	2400	
		5	4800	
		6	9600	
		7	19200	
		8	38400	
SD_n	SET DAYLIGHT SAVINGS TIME	0	Disabled	
		1	(Enabled)	
SM_n	SET 12 OR 24 HOUR TIME FORMAT	0	(24 Hour)	
		1	12 Hour (AM/PM)	
SN_n	SET NEW LINE CHARACTER	ASCII characters except colon and /	(carriage return)	
SO_n	SET TIME ZONE	0	Time zone 0	UTC
		1	Time zone 1	
		2	Time zone 2	
		3	Time zone 3	
		4	Time zone 4	
		5	Time zone 5	Eastern
		6	Time zone 6	Central
		7	Time zone 7	Mountain
		8	(Time zone 8)	Pacific
		9	Time zone 9	Alaska
		: (colon)	Time zone 10	Hawaii
		; (semi-colon)	Time zone 11	
SI1bMbsbhbmeMesehem	SET DAYLIGHT SAVING TIME	bM (Begin	03	

	CONFIGURATION	month)		
		bs (Begin Sunday)	02	
		bh (Begin hour)	02	
		bm (Begin minutes)	00	
		eM (End month)	11	
		es (end Sunday)	01	
		eh (end hour)	02	
		em (End minutes)	00	

“S” Commands

“S” Commands shall be sent to the Model 2070-7G without an “end of line” character.

The Model 2070-7G shall not send any acknowledgement when it receives an “S” command however the QM command can be used to confirm the change was made. All setting changes shall be stored in non-volatile memory and used in place of the factory default settings.

The following describes the “S” commands that shall be supported by Model 2070-7G:

SBn (Set Baud Rate). This command shall be used to change the Model 2070-7G’s serial communication speed. The baud rate of the controller and the Model 2070-7G must be the same. When the unit is first powered up it shall be configured with the factory default baud rate of 1200.

When communications between the Model 2070-7G and the controller is established, the SB command can be used to change the baud rate to the preferred speed. The available baud rates are shown in "S" Commands table. Generally the highest baud rate, that provides reliable communication, should be used. For example, to change the unit’s default baud rate to 4800 baud, the proper “S” command to send would be “SB5” (without quotation marks). Any baud rate changes will go onto effect immediately.

SDn (Enable/Disable Daylight Savings Time). This command shall be used to enable or disable the device's one hour offset to accommodate Daylight Savings Time rules. If the unit is to be used to output local time in an area that observes Daylight Savings Time rules, the "SD1" command should be used. The factory default setting is "Enabled", which means the Model 2070-7G will automatically adjust the local time output by one hour at the beginning and end of the Daylight Savings Time period. Users can change the configuration when these changes must occur with the SI1 command. If the unit will be used in areas that do not observe Daylight Savings Time, the appropriate "S" command to use would be "SD0".

SMn (Set time output format). This command shall be used to specify how the time of day data will be formatted. The factory default setting is the 24 hour, Military Time, format. If the user prefers to have the data output in a 12 hour format, (with A.M. or P.M. noted) the "SM1" (without the quotation marks) command must be sent once to change the format setting.

SNn (Set new line character). The Model 2070-7G's response to a valid "Q" command shall be a data stream that ends with a "new line" character. The default new line character is an ASCII carriage return. If the user prefers to have the data stream end in different ASCII character it can be changed using the "SN" command. Any ASCII character except the "/" (slash) and the ":" (colon) characters may be used as the variable. For example to use "#" as the new line character the proper command to send would be "SN#" (without the quotation marks). Only one "new line character" is permitted.

SO n (Set time zone). This command allows the user to set the Model 2070-7G's output to reflect the local time. Each time zone is assigned a number or ASCII character that is used as the variable for the "SO" command. The Model 2070-7G firmware shall accommodate time zones 0 through 11. Time zone 0 shall be used to output UTC (Universal Coordinated Time) or GMT (Greenwich Mean Time) if the user prefers that reference instead of local time. The default factory value shall be 8, as listed under default configurations, which shall represent Pacific Standard Time in the United States.

SI1bMbsbhbmeMesehem (Set daylight saving time parameters). This command shall allow the user to set the Model 2070-7G's daylight saving time settings. The modification of these parameters will determine when DST begin & end:

Begin Month(bM). The month when starts to observe the DST changes. This value shall be a two digits number. 01 means January, 02 February, 03 March and so on.

Begin Sunday(bs). The Sunday number of "begin month (bM)". This value shall be a two digits number.

Begin Hour(bh) and Begin Minutes(bm). The time when starts to observe the DST. This time shall be expressed in a 24 hour format.

End Month(eM). The month when ends the DST changes. This value shall be a two digits number. 01 means January, 02 February, 03 March and so on.

End Sunday(es). The Sunday number of “end month(eM)”. This value shall be a two digits number.

End Hour(eh) and End Minutes(em). The time when the DST observation ends. This time shall be expressed in a 24 hour format.

These parameters shall be set in the Non-Volatile memory.

10.9.5 Config Mode

The Model 2070-7G Module shall be provided with a switch allowing the user to switch Com 2 into Config Mode. In Config Mode, Com 2 loops back to the GPS Receiver and provides the user with a communications port to run Q and S Commands to configure the GPS receiver or query it for data. During Config Mode, the Config Mode LED indicator shall be turn ON to indicate configuration mode. When the Config Model is OFF, Com 2 shall consist of a serial port (serial pass through) to the Model 2070 Controller.

10.9.6 Connectors

The Model 2070-7G Universal Time Base Module shall contain the following connectors in the Faceplate:

Antenna	SMA Connector
Com 2 Port (C22S)	DB9 Female Connector

10.9.7 Data Output

When communicating to the GPS Receiver, the Date, Time, Day of Week, Signal Status, and Global Position shall be available. Data format shall be as defined in Section 10.9.4 of these specifications and the NMEA 0183 Standard. Serial Communications shall be software selectable at 1200, 2400, 4800, 9600, 19200 or 38400 bps.

10.9.8 Protocols

The Model 2070-7G shall support the NMEA 0183 Standard, Version 2.1 or later, as defined by the National Marine Electronics Association and the QC Command Set as defined in Section 10.9.4 of these specifications. A dipswitch marked "CMode" shall be provided which allows for the selection of one of three modes. The communication modes shall consist of a "NORM" (Normal Mode), "NB" (Normal Broadcast Mode) and GPS. When the CMode is in the "NORM" (Normal Mode) ON position, the Model 2070-7G shall respond to the QS command set as defined elsewhere in these specifications. When the dipswitch CMode is in the "NB", (Normal Broadcast Mode) ON Position, and the Model 2070-7G shall operate in a broadcast mode and shall not

respond to the QS command set. When operating in the NB mode, the Model 2070-7G shall use the default settings as defined in section 10.9.2.

When the CMode is in the "GPS", (GPS pass through mode) ON position, the Model 2070-7G shall act like a standard NMEA 0183 compliant GPS receiver. As a minimum, when set on GPS mode, the Model 2070-7G shall support the following NMEA 2.0 Standard sentences: RMC, GGA, GSA, GSV, GLL and ZDA. The sentences shall be preceded by the standard generic Global Positioning System (GPS) talker ID "GP".

=== GLL - Geographic Position - Latitude/Longitude ===

	1	2	3	4	5	6	7	8
\$-- GLL	,lll.ll	,a	,yyyy.yy	,a	,hhmmss.ss	,a	,m	,*hh

\$-GLL,lll.ll,a,yyyy.yy,a,hhmmss.ss,a,m,*hh<CR><LF>

Field Number:

1. Latitude
2. N or S (North or South)
3. Longitude
4. E or W (East or West)
5. Universal Time Coordinated (UTC)
6. Status A - Data Valid, V - Data Invalid
7. FAA mode indicator (NMEA 2.3 and later)
8. Checksum

=== GGA - Global Positioning System Fix Data ===

Time, Position and fix related data for a GPS receiver.

	1	2	3	4	5	6	7	8	9	1	11	1	13	14	1

										0		2			5
\$-- GG A	,hhmmss .ss	,llll. ll	, a	,yyyyy. yy	, a	, x	,x x	,x. x	,x. x	, M	,x. x	, M	,x. x	,xxx x	*h h

\$--GGA,hhmmss.ss,llll.ll,a,yyyyy.yy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>

Field Number:

1. Universal Time Coordinated (UTC)
2. Latitude
3. N or S (North or South)
4. Longitude
5. E or W (East or West)
6. GPS Quality Indicator,
 - 0 - fix not available,
 - 1 - GPS fix,
 - 2 - Differential GPS fix
(values above 2 are 2.3 features)
 - 3 = PPS fix
 - 4 = Real Time Kinematic
 - 5 = Float RTK
 - 6 = estimated (dead reckoning)
 - 7 = Manual input mode
 - 8 = Simulation mode
7. Number of satellites in view, 00 - 12
8. Horizontal Dilution of precision (meters)
9. Antenna Altitude above/below mean-sea-level (geoid) (in meters)
10. Units of antenna altitude, meters
11. Geoidal separation, the difference between the WGS-84 earth ellipsoid and mean-sea-level (geoid), "-" means mean-sea-level below ellipsoid
12. Units of geoidal separation, meters
13. Age of differential GPS data, time in seconds since last SC104 type 1 or 9 update, null field when DGPS is not used
14. Differential reference station ID, 0000-1023
15. Checksum

Example:

\$GPGGA,180844.000,3211.10532,N,11055.20380,W,0,00,99.0,779.59,M,-27.7,M, ,*69

=== RMC - Recommended Minimum Navigation Information ===

	1	2	3	4	5	6	7	8	9	10	11	12	13
\$-- RMC	,hhmmss.ss	,A	,llll.ll	,a	,yyyyy.yy	,a	,x.x	,x.x	,xxxx	,x.x	,a	,m	*hh

\$--RMC,hhmmss.ss,A,llll.ll,a,yyyyy.yy,a,x.x,x.x,xxxx,x.x,a,m*hh<CR><LF>

Field Number:

1. UTC Time
2. Status, V=Navigation receiver warning A=Valid
3. Latitude
4. N or S
5. Longitude
6. E or W
7. Speed over ground, knots
8. Track made good, degrees true
9. Date, ddmmyy
10. Magnetic Variation, degrees
11. E or W
12. FAA mode indicator (NMEA 2.3 and later)
13. Checksum

A status of V means the GPS has a valid fix that is below an internal quality threshold, e.g. because the dilution of precision is too high or an elevation mask test failed.

Example:

\$GPRMC,180845.000,V,3211.105,N,11055.204,W,0.0,0.0,271009,9.4,E*6E

=== ZDA - Time & Date - UTC, day, month, year and local time zone ===

	1	2	3	4	5	6	7
\$-- ZDA	,hhmmss.ss	,xx	,xx	,xxxx	,xx	,xx	*hh

\$--ZDA,hhmmss.ss,xx,xx,xxxx,xx,xx*hh<CR><LF>

Field Number:

1. UTC time (hours, minutes, seconds, may have fractional subsecond)
2. Day, 01 to 31
3. Month, 01 to 12
4. Year (4 digits)
5. Local zone description, 00 to +- 13 hours
6. Local zone minutes description, apply same sign as local hours
7. Checksum

Example: \$GPZDA,160012.71,11,03,2004,-1,00*7D

10.9.9 LED Indicators

Function		LEDs
Com 1	TxD	Green or Red
	RxD	Green or Red
Com 2	TxD	Green or Red
	RxD	Green or Red
Config Mode		Green or Red
Tracking		Tri-Color

10.9.10 Model 2070-7G Tracking

The Model 2070-7G Universal Time Base Module shall be provided with the following tracking functionality:

The Model 2070-7G shall be equipped with a tri-color LED (Light Emitting Diode) to indicate the unit's status during operation; the LED shall be located at the faceplate and labeled as TRACKING as shown in detail A10-9.

The various states of the TRACKING LED indicator and their meanings shall be as described in the section below.

Power up phase: At power up, the 2070-7G's microprocessor shall read the five parameters stored in the unit's non-volatile memory. These parameters are Baud Rate, Daylight Savings Time mode and configuration, Time Zone, Military Time format and new line character. The default values shall be read from memory if they have not been modified. Next, the communications port shall be initialized and the speed set to the stored baud rate parameter. The remaining three communications parameters shall be fixed at 8 data bits, no parity and 1 stop bit.

The power up process shall take no more than 200 milliseconds. During this period the unit may not respond to any "S" or "Q" commands and the LED shall be **amber** for less than one second.

GPS initialization phase: After the power up phase is complete the unit will query the GPS receiver to see if it is already initialized. This is usually the case when the unit is powered up. If there is no data output, the GPS receiver will be initialized by the firmware program, using initialization commands and known variables. This process shall not take longer than 6 seconds. During this period, the Model 2070-7G reply to the commands "QA", "QD", "QT", and "QC" shall be the message "NOT LOCKED ON" and the LED shall **flash red**, once per second.

Signal acquisition phase: Once the GPS initialization phase is complete, it shall take from 3 to 180 seconds for the unit to acquire and process the first satellite's signal. When the Model 2070-7G has received and processed the first satellite's information, unsynchronized time/date information shall be available using the "QC" data stream and the synchronization character shall be "N". When the synchronization character is "N", the "QC", and "QT" and "QD" replies will be complete but time is not fully synchronized to UTC. When unsynchronized data is available, the LED shall **flash amber**, once per second.

Fully synchronized phase: When the 2070-7G has acquired information from 4 satellites its output will be synchronized to UTC (Universal Coordinated Time. When the unit is synchronized to UTC it is said to be "LOCKED ON". At this point the "QT", "QD", "QL" and "QC" replies will contain the most accurate information (time and location) possible. When the unit is fully synchronized (LOCKED ON); the synchronization character shall the letter "Y" in the "QC" data stream and the LED indicator shall **flash green**, once per second.

10.9.11 Power Requirements

The power requirements of the Model 2070-7G Universal Time Base Module shall be within the power limitations of the Model 2070 UNIT as describe elsewhere in this specifications.

10.9.12 Environmental

The Model 2070-7G Universal Time Base Module shall operate within the specifications listed in Chapter 1 Section 1.8.4.

10.9.13 Form Factor

See A10-9 for Details

CHAPTER 10-SECTION 10

MODEL 2070-EX NETWORK SWITCH MODULE

Model 2070-Ex Network Switch Module

The Model 2070-Ex Module shall provide 4 ports for Network Communications to and from the Model 2070 Controller.

An integrated Store-and-Forward Network Switch shall be used as the core for the Model 2070-Ex Module. A network port shall be used to route Ethernet Traffic across the Motherboard to the “A” Connector’s Network Lines. DC Grounding around the network connectors and lines shall be provided. The Network Lines shall be assigned as: NetP5 TX+, TX-, RX+ and RX- respectively. Three network ports shall be brought to RJ-45 Connectors on the Front Panel.

The Model 2070-Ex Module shall be a Plug-in Card style version for the 2070 Controller.

Mechanical/Electrical Requirements.

The Model 2070-Ex Modules card edge connector shall be fully compatible with the 2070 Controller’s Motherboard Ax Card Slots.

The Model 2070-Ex Module shall be powered direct from the 2070 Controller’s edge connector.

Model 2070-Ex Module Requirements

The Model 2070-Ex shall be provided with Network Magnetics for each port including the network port routed to the Controller's Motherboard.

Network Standards

The Model 2070-Ex Module shall meet the IEEE802.3 10Base-T, IEEE 802.3u, and IEEE 802.3x.

Modes of Operation

The Model 2070-Ex Module shall have auto-negotiation for 10/100 Mbps Connection speed and Half/Full-Duplex modes on all RJ-45 ports.

The Model 2070-Ex Module shall be provided with Auto-MDIX for all RJ-45 ports.

The network port routed to the Controller's Motherboard shall have Auto-negotiation for 10/100Mbps connection speed and the Half/Full-Duplex communications mode shall be manually settable.

Network Media Support

The Model 2070-Ex Module shall be configured as a Multiple Channel Media Converter to route network traffic between the Model 2070 CPU, Three RJ-45 Front Panel Connectors.

The Model 2070-Ex Module shall support the following Media:

100Base-TX: Cat. 5, EIA/TIA-568B, 100-Ohm UTP cables.

LED Indicators

The Model 2070-Ex Module shall be provided with RJ-45 Connectors containing Link/Activity and 10/100 Speed LED indicators. Network Link/Activity and 10/100 Speed indicators for the port routed to the Controller's Motherboard shall be provided on the Front Plate of the Model 2070-Ex Module.

Form Factor

See A10-10 for Details

Power Requirements

The power requirements of the 2070-Ex Module be within the power limitations of the Model 2070 Unit as describe in Section 9.2.5 of these specifications.

Models	5 VDC	+12 VDC iso	+12 VDC ser	-12 VDC ser
2070-6A & Others	900mA		300 mA	300 mA

Environmental

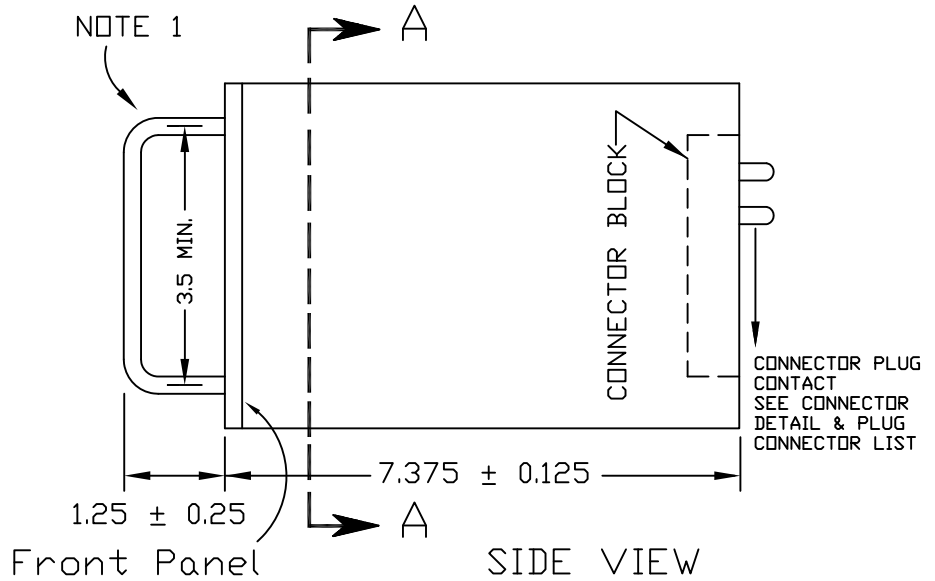
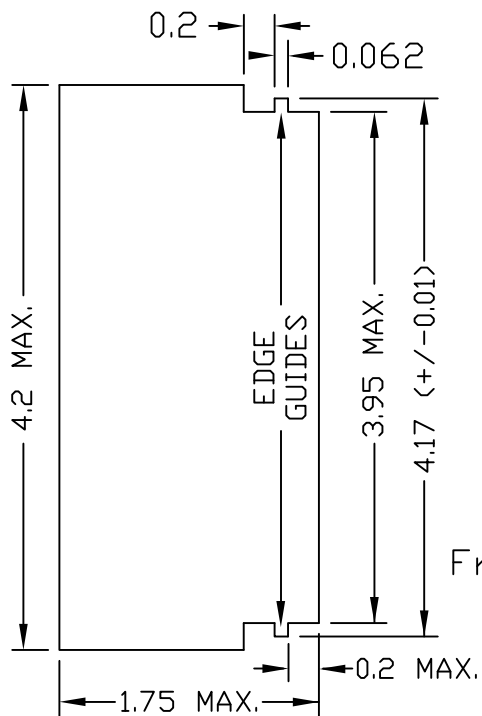
The 2070-Ex Module shall operate within the specifications listed in Chapter 1 Section 1.8.4.

APPENDIX A CHAPTER DETAILS

APPENDIX A3

CHAPTER 3 DETAILS

Model 200 Switch Pack, 204 & 205 CONNECTOR DETAILS	A3-1
Model 208 T170 Monitor Unit	A3-2
Model 210 T170 Monitor Unit Programming Card Connector &	A3-4
Wiring Assignments	
C2 Modem Harness	A3-5
C2 Serial Harness	A3-8
C1 Cable Harness	A3-9
Model 206LS Power Supply	A3-10



MODEL PLUG CONNECTORS LIST (OR EQUAL)

MODEL 200 - BEAU P-5412-LAB
 MODEL 204 - BEAU P-5406-LAB
 MODEL 205 - BEAU P-5408-LAB

MODEL 200 CONNECTOR DETAIL

PIN	FUNCTION
1	AC+
2	Equip. Ground
3	Red Output
4	Not Assigned
5	Yellow Output
6	Red Input
7	Green Output
8	Yellow Input
9	+24 VDC
10	Green Input
11	AC-
12	Not Assigned

MODEL 204 CONNECTOR DETAIL

PIN	FUNCTION
7	Load Circuit #1
8	Load Circuit #2
9	Equip. Ground
10	AC-
11	AC+
12	Not Assigned

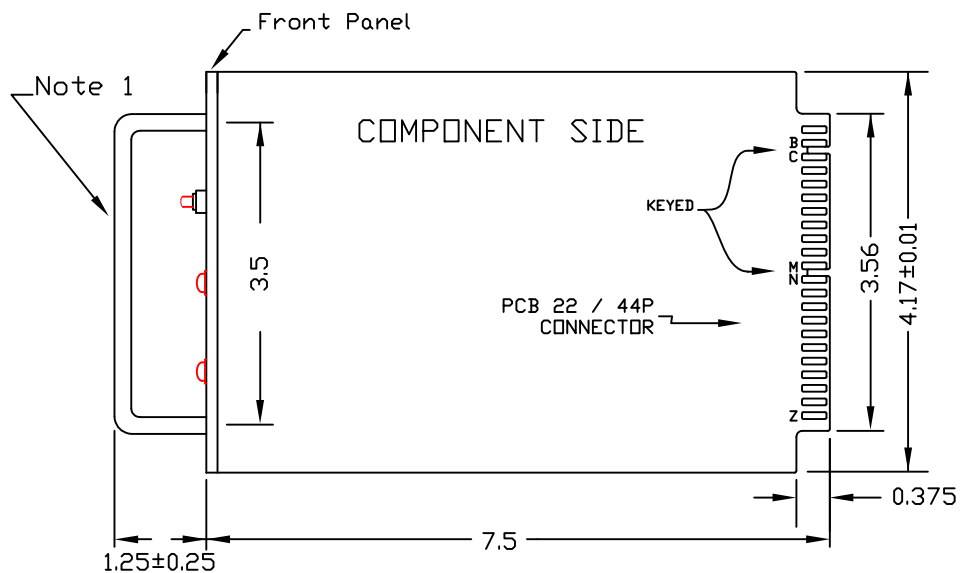
MODEL 205 CONNECTOR DETAIL

PIN	FUNCTION
1	Coil
2	Coil
3	NC CKT1
4	NC CKT2
5	Common CKT1
6	Common CKT2
7	NO CKT1
8	NO CKT2

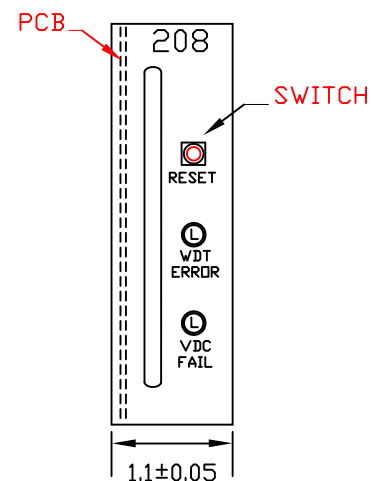
NOTES:

- "U" shape rod handle shall be fabricated of 0.18in to 0.26in diameter, **aluminum** stock to form a handle.
- All dimensions shown are in inches.

TITLE: MODEL 200 SWITCH PACK, 204 FLASHER & 205 TRANSFER RELAY CONNECTOR DETAILS	
ERRATA 2	NO SCALE
TEES 2009	A3-1



SIDE VIEW



FRONT VIEW

MODEL 208 MONITOR UNIT PIN ASSIGNMENT

PIN	FUNCTION
1 / A	DC GROUND
2 / B	WDT Ext. Reset
5 / E	WDT IN
10 / L	+24 VDC
15 / S	AC-
17 / U	Normally Open, Circ. #2
19 / W	AC+
20 / X	WDT Lamp (External)
21 / Y	Circ. Common #1 & #2
22 / Z	Normally Closed, Circ. #1

NOTES:

- "U" shape rod handle shall be fabricate of 0.18 to 0.26 in diameter, **aluminum** stock to form a handle.
- All dimensions shall be in inches.

TITLE:

MODEL 208 T170 MONITOR UNIT

ERRATA 2

NO SCALE

TEES 2009

A3-2

MODEL 210 MONITOR UNIT
CONNECTOR WIRING ASSIGNMENTS

PIN	FUNCTION	PIN	FUNCTION
1	Channel #2 Green	A	Channel #2 Yellow
2	Channel #13 Green	B	Channel #6 Green
3	Channel #6 Yellow	C	Channel #15 Green
4	Channel #4 Green	D	Channel #4 Yellow
5	Channel #14 Green	E	Channel #8 Green
6	Channel #8 Yellow	F	Channel #16 Green
7	Channel #5 Green	H	Channel #5 Yellow
8	Channel #13 Yellow	J	Channel #1 Green
9	Channel #1 Yellow	K	Channel #15 Yellow
10	Channel #7 Green	L	Channel #7 Yellow
11	Channel #14 Yellow	M	Channel #3 Green
12	Channel #3 Yellow	N	Channel #16 Yellow
13	Channel #9 Green	P	NA
14	NA	R	Channel #10 Green
15	Channel #11 Yellow	S	Channel #11 Green
16	Channel #9 Yellow	T	NA
17	NA	U	Channel #10 Yellow
18	Channel #12 Yellow	V	Channel #12 green
19	NA	W	NA
20	Equipment Ground	X	NA
21	AC— *	Y	DC Ground
22	Watchdog Timer	Z	External Reset
23	+24 VDC	AA	+24 VDC
24	(Pins 24 & 25 Tied together)	BB	Stop Time
25		CC	NA
26	NA	DD	NA
27	NA	EE	Output SW, Side #2
28	Output SW, Side #1	FF	AC+

MODEL 210 PROGRAMMING CARD
CONNECTOR WIRING ASSIGNMENTS

PIN	FUNCTION (Circuit Side)	PIN	FUNCTION (Component Side)
1	Channel #2 Green	A	Channel #1 Green
2	Channel #3 Green	B	Channel #2 Green
3	Channel #4 Green	C	Channel #3 Green
4	Channel #5 Green	D	Channel #4 Green
5	Channel #6 Green	E	Channel #5 Green
6	Channel #7 Green	F	Channel #6 Green
7	Channel #8 Green	H	Channel #7 Green
8	Channel #9 Green	J	Channel #8 Green
9	Channel #10 Green	K	Channel #9 Green
10	Channel #11 Green	L	Channel #10 Green
11	Channel #12 Green	M	Channel #11 Green
12	Channel #13 Green	N	Channel #12 Green
13	Channel #14 Green	P	Channel #13 Green
14	Channel #15 Green	R	Channel #14 Green
15	Channel #16 Green	S	Channel #15 Green
16	DC Ground	T	CONFLICT
17	Channel #1 Yellow	U	Channel #9 Yellow
18	Channel #2 Yellow	V	Channel #10 Yellow
19	Channel #3 Yellow	W	Channel #11 Yellow
20	Channel #4 Yellow	X	Channel #12 Yellow
21	Channel #5 Yellow	Y	Channel #13 Yellow
22	Channel #6 Yellow	Z	Channel #14 Yellow
23	Channel #7 Yellow	AA	Channel #15 Yellow
24	Channel #8 Yellow	BB	Channel #16 Yellow
25	NA	CC	NA
26	NA	DD	NA
27	NA	EE	Output SW, Side #2
28	Output SW, Side #1	FF	AC+

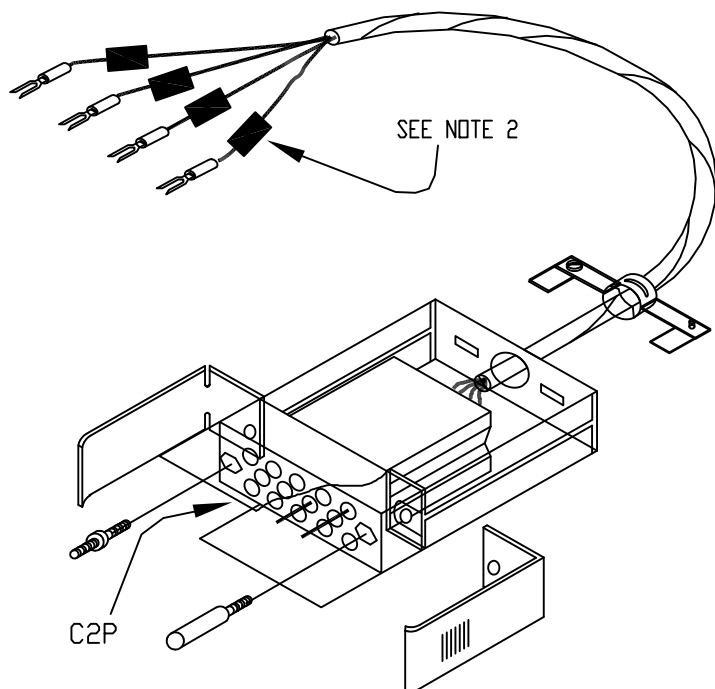
TITLE: MODEL 210 T170 MONITOR UNIT PROGRAMMING
CARD CONNECTOR & WIRING ASSIGNMENTS

ERRATA 2

NO SCALE

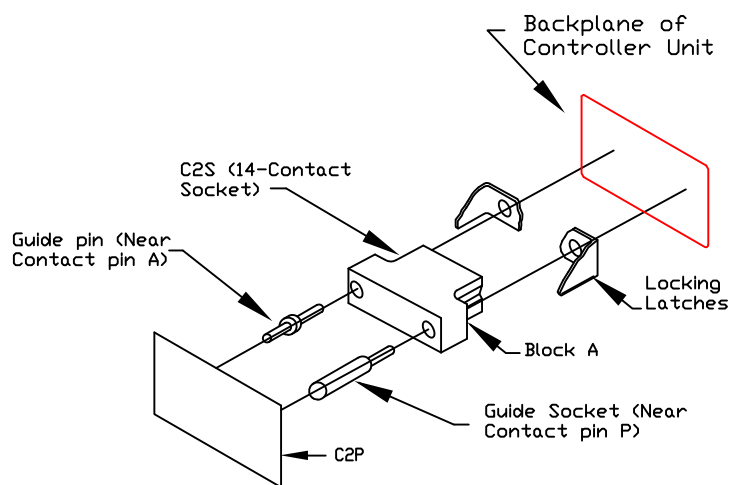
TEES 2009

A3-4

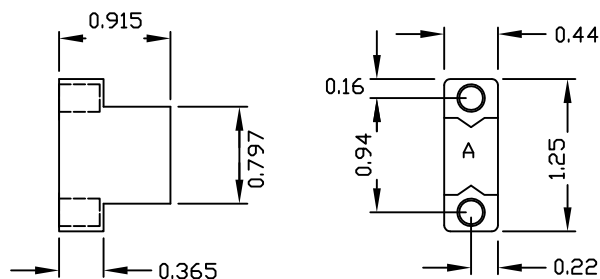


C2 MODEM HARNESS

C2P CONNECTOR ASSIGNMENT			
PIN	FUNCTION	PAIR	WIRE COLOR
A	AUDIO IN	PAIR 2	WHITE
B	AUDIO IN		GREEN
C	AUDIO OUT	PAIR 1	RED
E	AUDIO OUT		BLACK



CONNECTOR C2 DETAIL



CONNECTOR C2S

NOTES:

1. Cable length shall be 36.00in minimum. The cable shall be 2-pair #20 cable conductors, Belden 9402 or equal. The field end connections shall be #8 stud spring spade type.
2. Each conductor (AUDIO IN or AUDIO OUT) shall be labeled.
3. All dimensions shown are in inches.

TITLE:

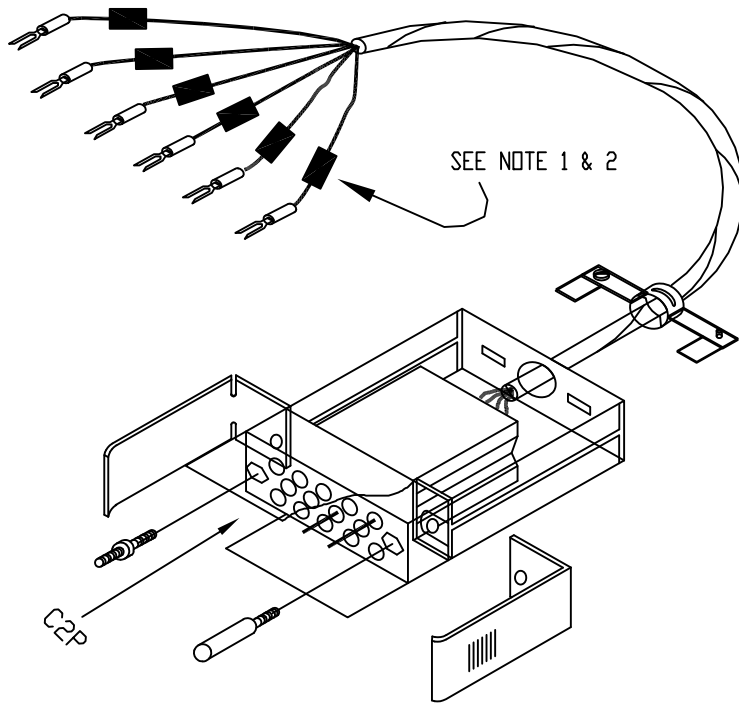
C2 MODEM HARNESS

ERRATA 2

NO SCALE

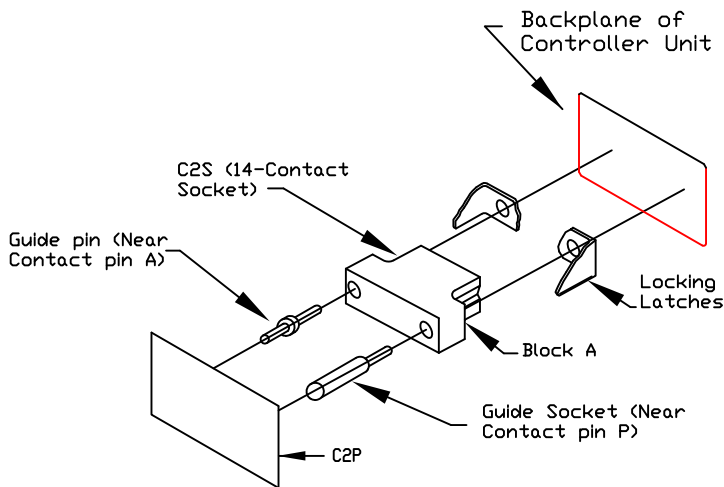
TEES 2009

A3-5

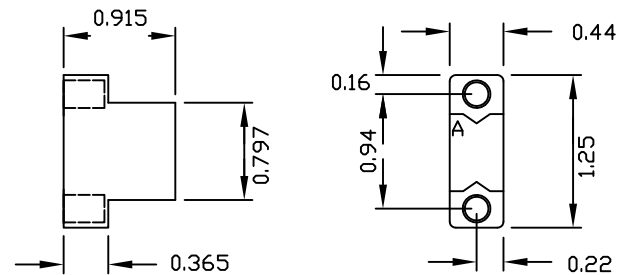


C2 SERIAL HARNESS

C2P CONNECTOR ASSIGNMENT			
PIN	FUNCTION	PIN	FUNCTION
A	NA	J	RTS
B	NA	K	RXD
C	NA	L	TXD
D	NA	M	CTS
E	NA	N	GND
F	NA	P	NA
H	DCD	R	NA



CONNECTOR C2 DETAIL

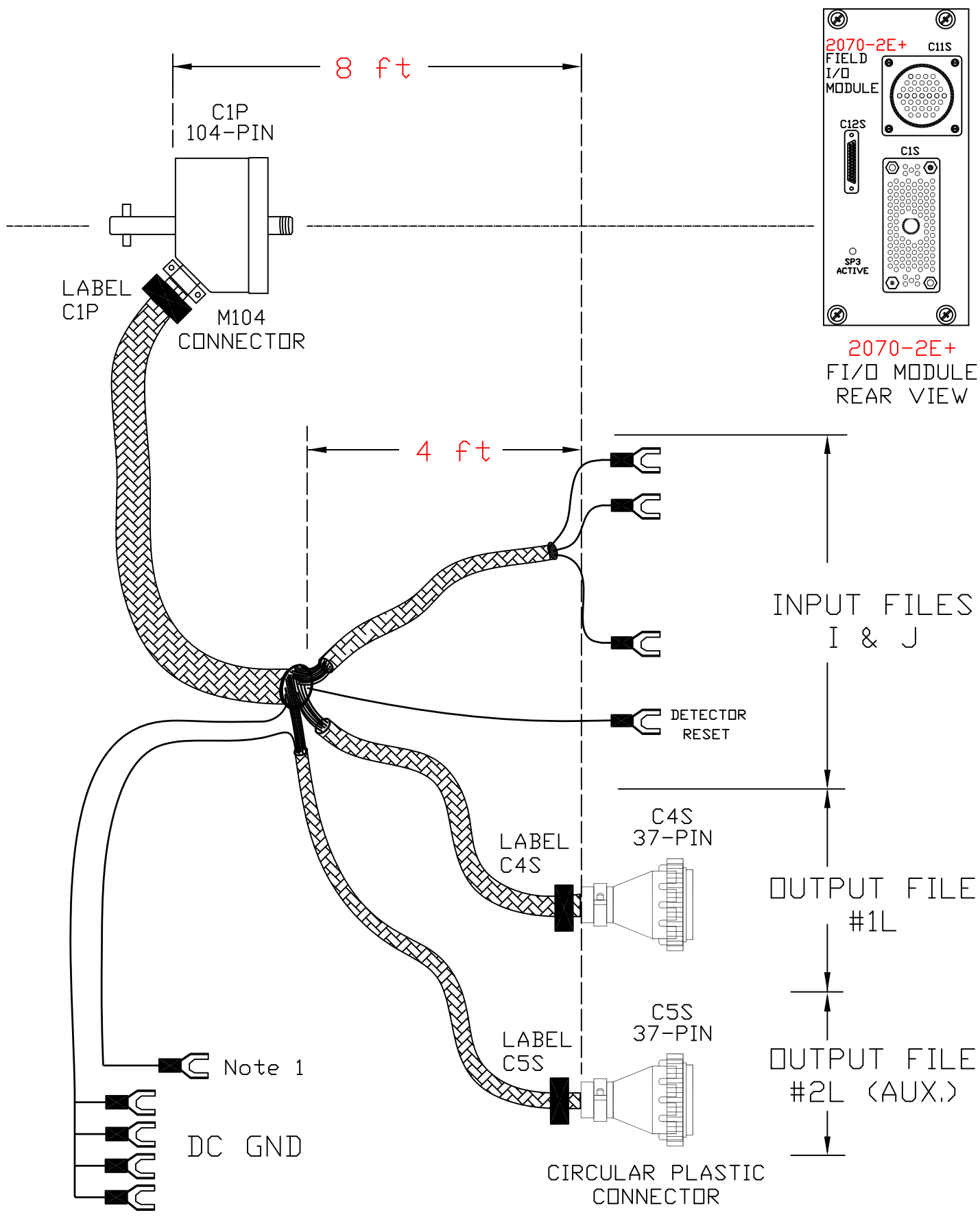


CONNECTOR C2S

NOTES:

1. Cable length shall be 36.00in minimum. The cable shall be 24AWG, 6 conductors, Belden 9536 or equal. The field end connections shall be #6 stud spring spade type.
2. Each conductor (DCD, RTS, RXD, TXD, CTS, GND) shall be labeled.
3. All dimensions shall be inches.

TITLE:		C2 SERIAL HARNESS	
ERRATA 2		NO SCALE	
TEES 2009		A3-8	

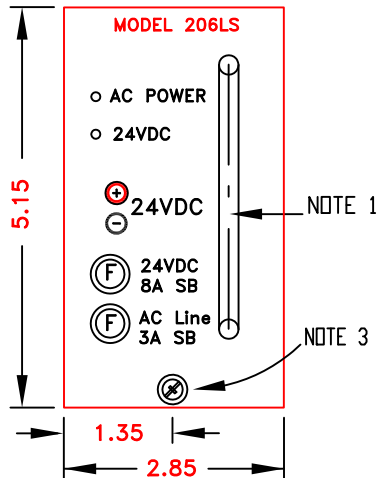


NOTE:

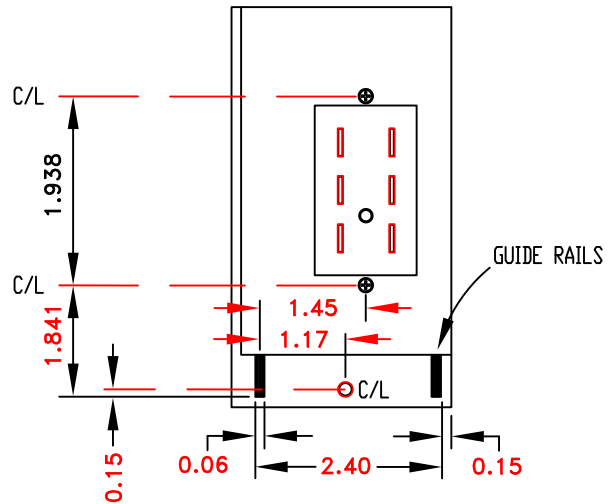
1. Input Panel #1, TB1 (+24VDC) to C5S, pin #24.

TITLE: C1 HARNESS SIGNAL CABINET	
ERRATA 2	NO SCALE
TEES 2009	A3-9

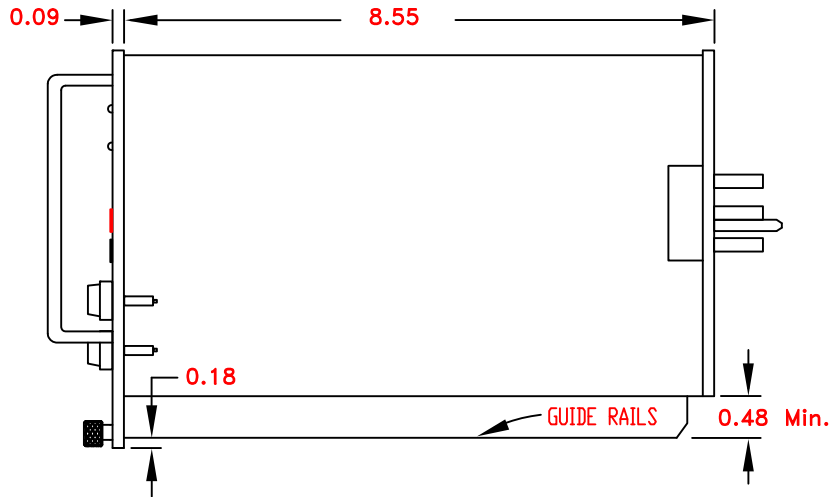
MODEL 206LS POWER SUPPLY MODULE



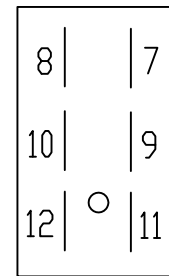
FRONT VIEW



REAR VIEW



SIDE VIEW



REAR VIEW

POWER SUPPLY MODULE WIRING DETAIL

PIN NO.	FUNCTION
7	+24 VDC
8	DC GND
9	EG
10	NA
11	AC- CLEAN
12	AC+ CLEAN

NOTE:

- "U" shaped rod handle fabricated of 0.25 ± 0.05 diameter, aluminum stock, with 4.00 ± 0.125 length, & rod center to center shall be provided. The handle shall be vertically centered. The depth from the vertical centerline of the handle rod to the faceplate shall be 1.25 ± 0.125 .
- Power supply module dimension, from faceplate to connector plug, shall be $8.64 +0.000, -0.125$.
- Thumb screw device.
- Connector BEAU P-5406 or equivalent.
- All dimensions shown are in inches.

MODEL 206LS POWER SUPPLY

ERRATA 2

NO SCALE

TEES 2009

A3-10

APPENDIX A5

CHAPTER 5 DETAILS

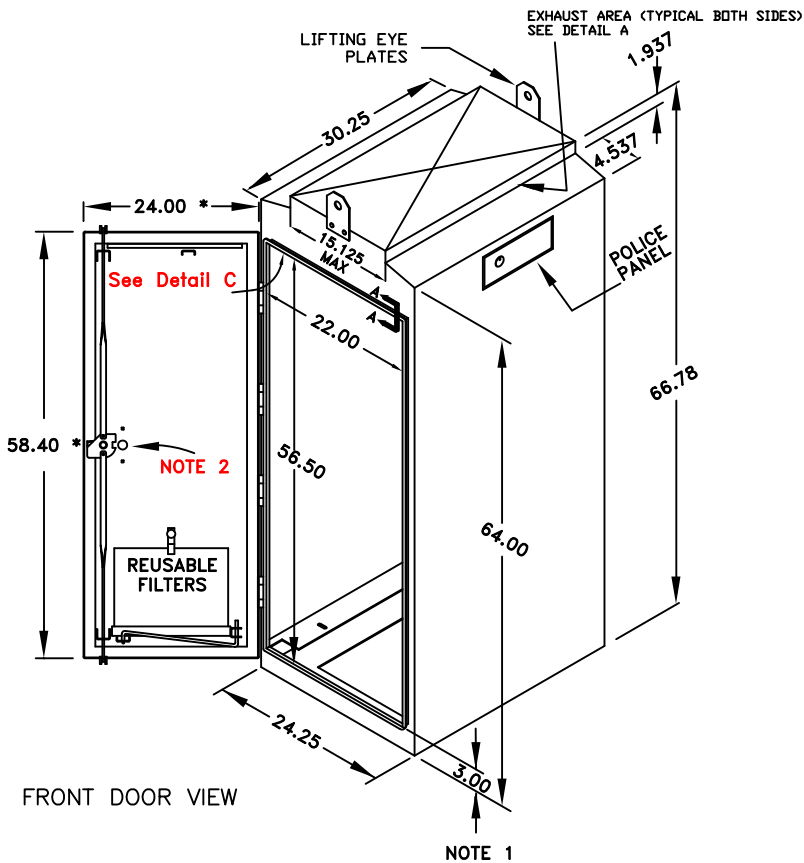
APPENDIX A6

CHAPTER 6 DETAILS

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Cabinet Housing Details - sheet 2 of 4	A6-2
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Model 346LX Side Panel Details	A6-57
Cabinet Equipment Mounting Details sheet 3 of 3	A6-58

CABINET HOUSING 1B



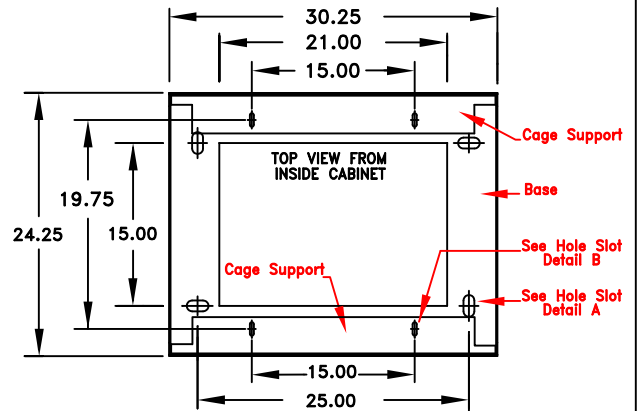
DETAIL A CABINET HOUSING 1B & 2 VENTILATION EXHAUST DETAIL

SECTION A-A CABINET HOUSING 1B & 2 FLANGE AROUND DOOR OPENING

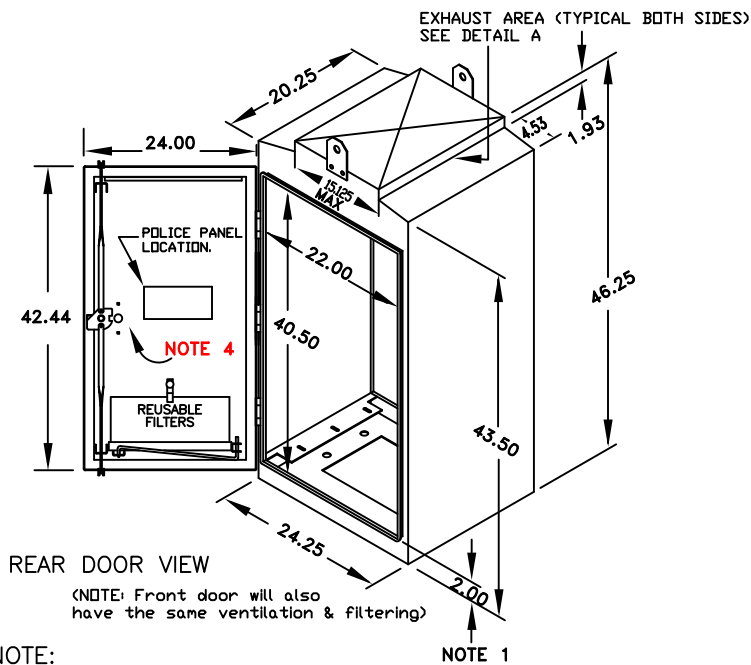


* TOLERANCE +0.0625, -0

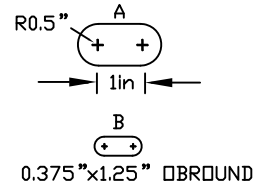
CABINET HOUSING 1B BOTTOM DETAIL



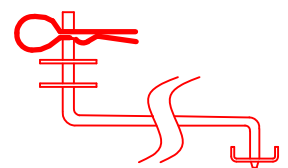
CABINET HOUSING 2



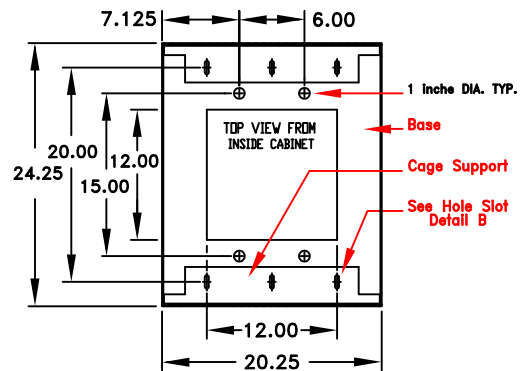
HOLE SLOT DETAIL



DETAIL C



CABINET HOUSING 2 BOTTOM DETAIL



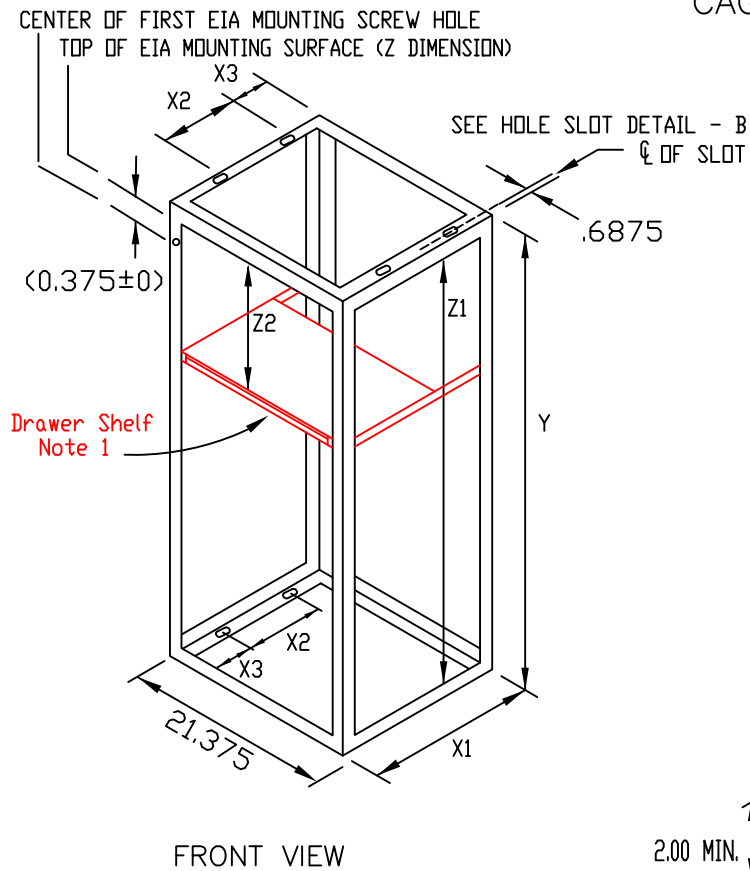
NOTE: ALL HOLE PATTERNS CENTERED ON CABINET BOTTOMS.

NOTE:

1. Cabinet base to door opening.
2. The locks & handles shall be on right side of the front door & the left side of the rear door (viewed externally)
3. All dimensions shown are in inches.
4. The locks & handles shall be on left side of the front door & the right side of the rear door (viewed externally)
5. Upper and lower catches must hold the door open at multiple positions.

TITLE:	
CABINET HOUSING DETAILS SHEET 1 OF 4	
ERRATA 2	NO SCALE
TEES 2009	A6-1

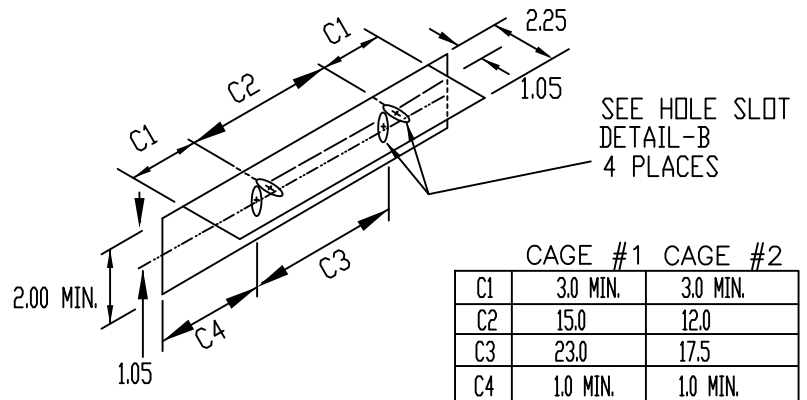
CAGE SUPPORT DETAIL



CABINET CAGE DIMENSIONS

	CAGE #1	CAGE #2
X1	21.375	16.00
X2	15.00	12.00
X3	3.188	2.00
Y	55.50	40.00
Z1	53.00 MIN.	38.75 MIN.
Z2	15.75	7.25

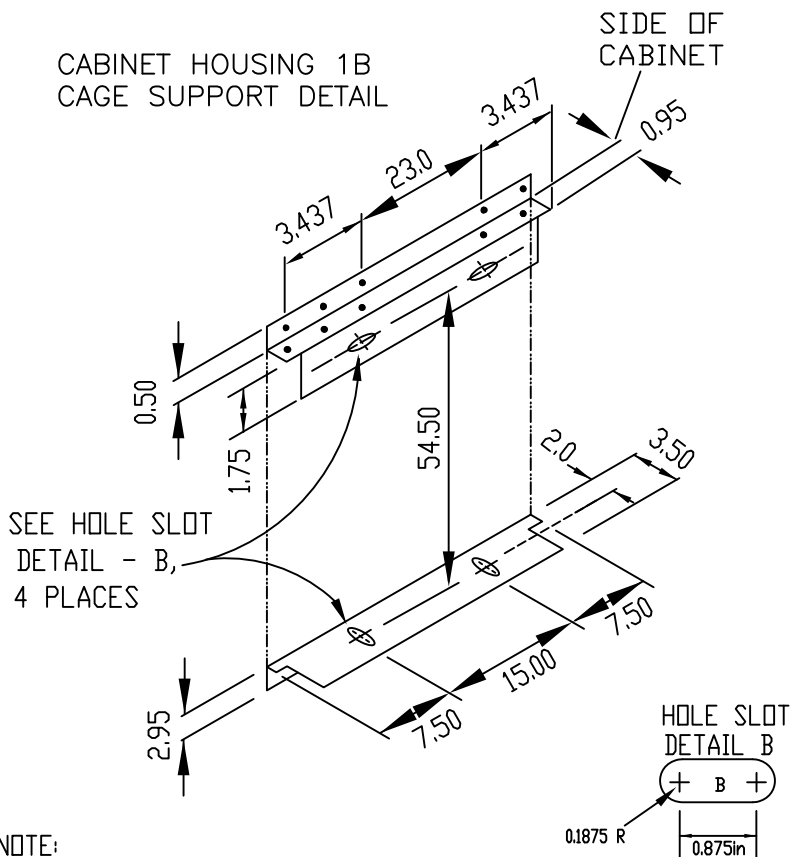
SPACER BRACKET DETAIL



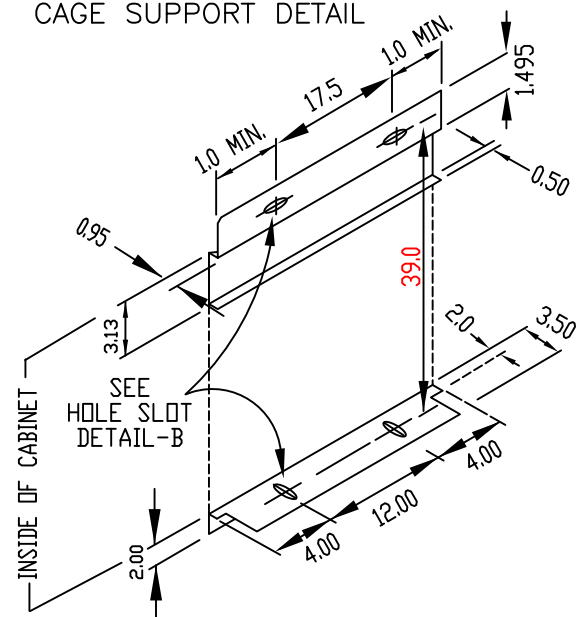
CAGE #1 CAGE #2

	CAGE #1	CAGE #2
C1	3.0 MIN.	3.0 MIN.
C2	15.0	12.0
C3	23.0	17.5
C4	1.0 MIN.	1.0 MIN.

CABINET HOUSING 1B CAGE SUPPORT DETAIL



CABINET HOUSING 2 CAGE SUPPORT DETAIL



NOTE:

1. Drawer Shelf details, A6-6
2. All dimensions shown are in inches

TITLE:

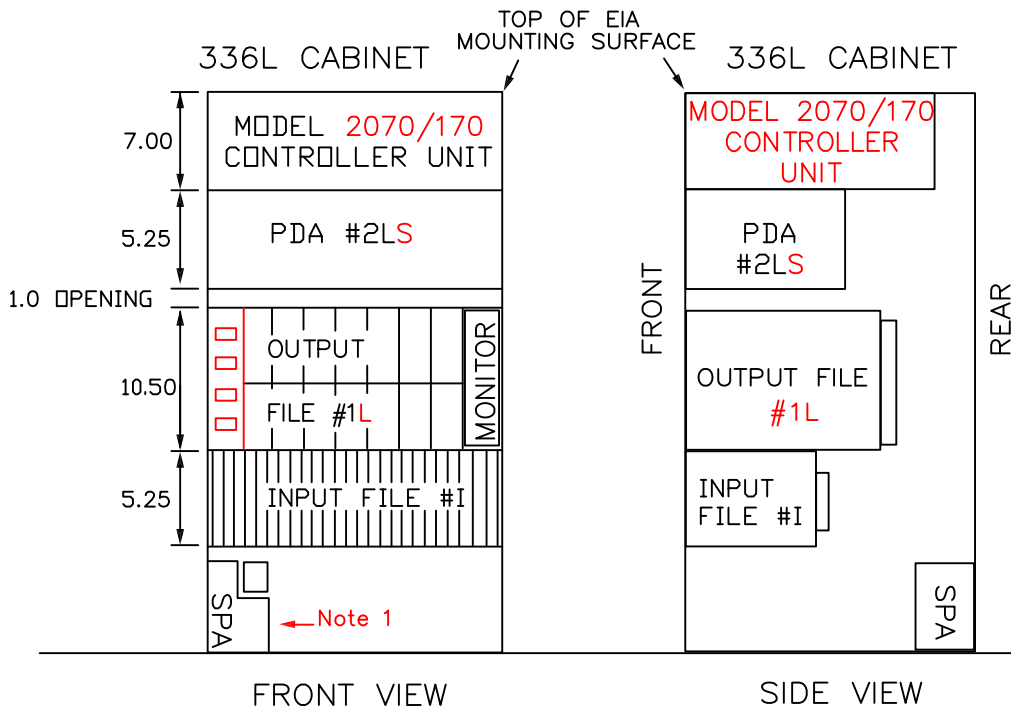
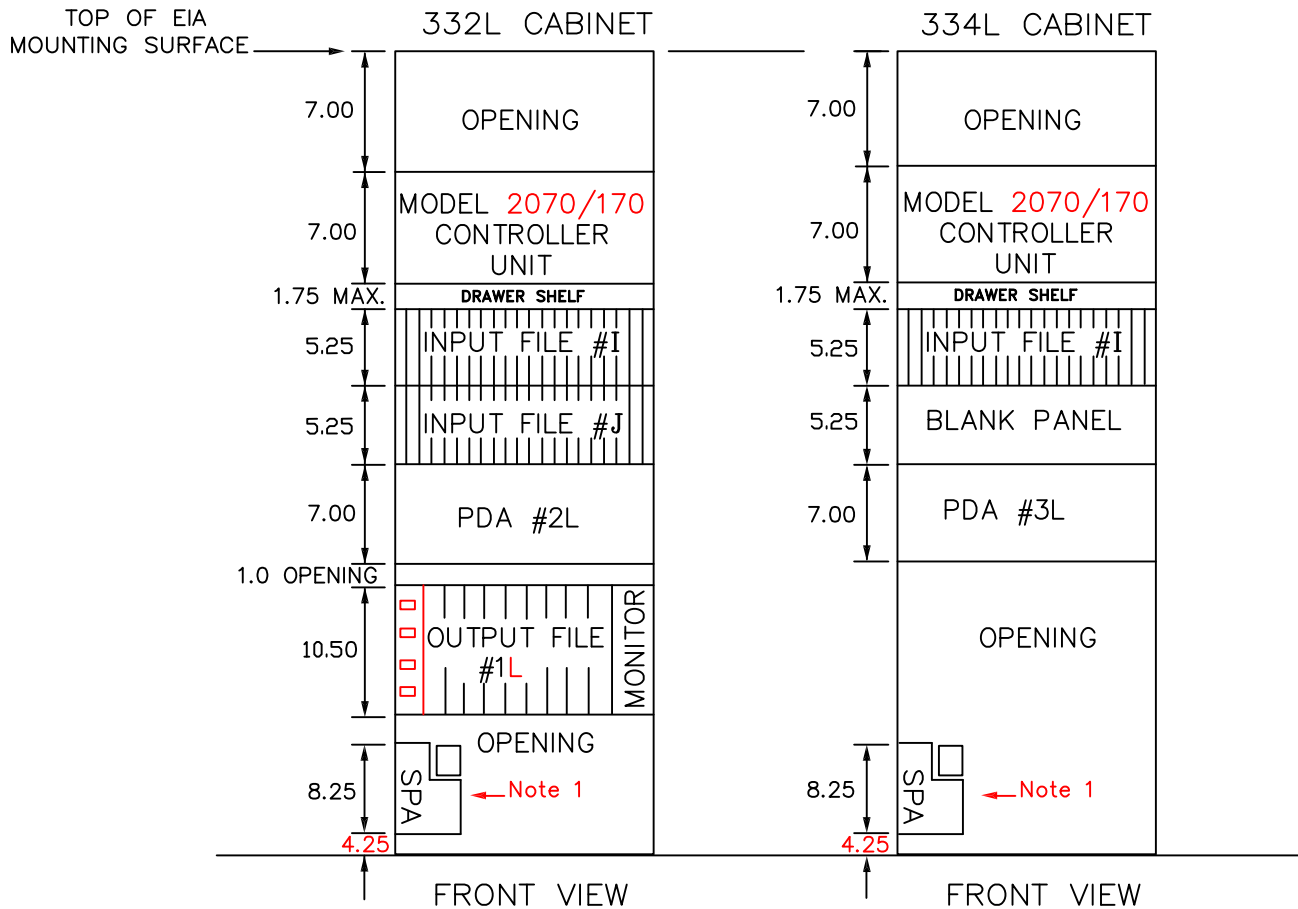
CABINET HOUSING DETAILS SHEET 2 OF 4

ERRATA 2

NO SCALE

TEES 2009

A6-2



NOTE:

1. SPA shall be bolted on the rail and firmly attached to the Service Panel.
2. All dimensions shown are in inches.

TITLE:

CABINET EQUIPMENT MOUNTING DETAILS

SHEET 1 OF 3

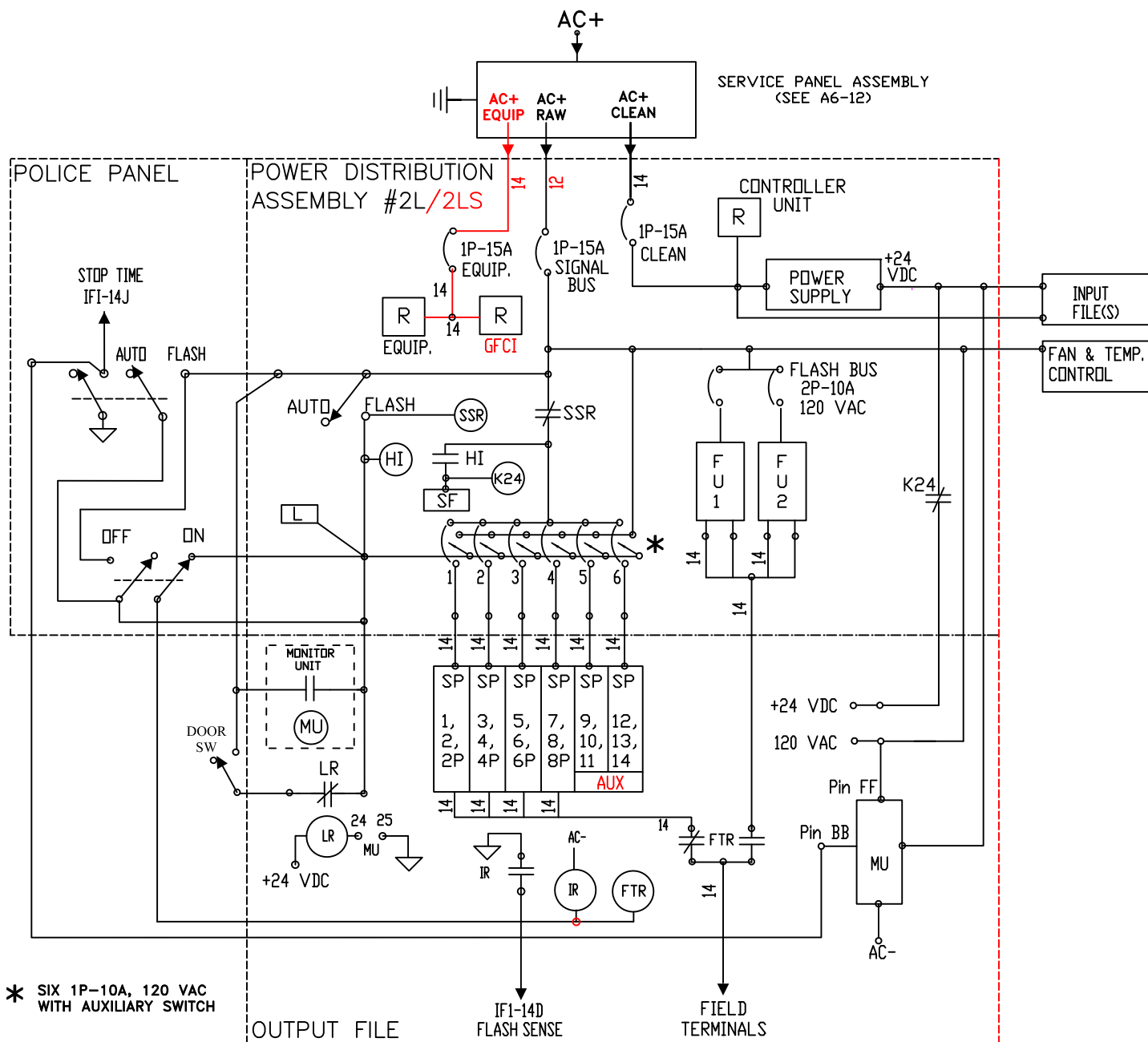
ERRATA 2

NO SCALE

TEES 2009

A6-5

332L & 336L CABINET ONE LINE DIAGRAM



SHEET DEFINITIONS

TBS	TERMINAL BLOCK - SERVICE	(*)	RELAY COIL - * RELAY NAME	TR	TRANSFER RELAY
	EQUIPMENT GROUND		FLASHER UNIT ONE	IR	ISOLATION RELAY
8	WIRE SIZE, IF NOT INDICATED SHALL BE #16 AWG OR LARGER		DC GROUND		SWITCH CONTACT
	CIRCUIT BREAKER	WDT	WATCHDOG TIMER	LR	LOGIC RELAY
	DUPLEX RECEPTACLE	FTR	FLASH TRANSFER RELAY	CB-1	SIGNAL CIRCUIT BREAKER 1 (SECONDARY)
GFCI	GROUND FAULT CIRCUIT INTERRUPTER		PDA FLASH ON DISPLAY LAMP	IFI-14J	INPUT FILE 1, TERMINAL BLOCK 14, POSITION J (CHANNEL 2 INPUT)
	RELAY CONTACT, NORMALLY CLOSED	SPA	SERVICE PANEL ASSEMBLY	IFI-14D	INPUT FILE 1, TERMINAL BLOCK 14, POSITION D
	RELAY CONTACT, NORMALLY OPEN	MU	MONITOR UNIT	C1-65	C1 CONNECTOR, PIN 65
SSR	SOLID STATE RELAY		SSR Fault Indicator		Health Indicator Relay
PDA	POWER DISTRIBUTION ASSEMBLY	T2-6	TERMINAL BLOCK 2, POSITION 6		Disconnect 24VDC Relay
AUX	AUXILIARY				
SP	SWITCH PACK				

TITLE:

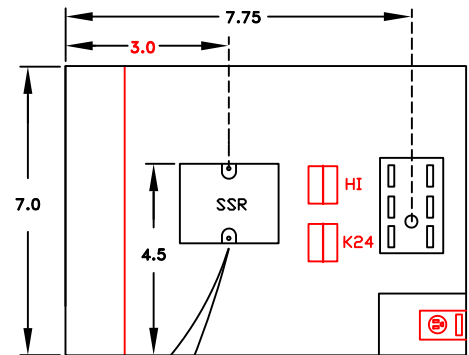
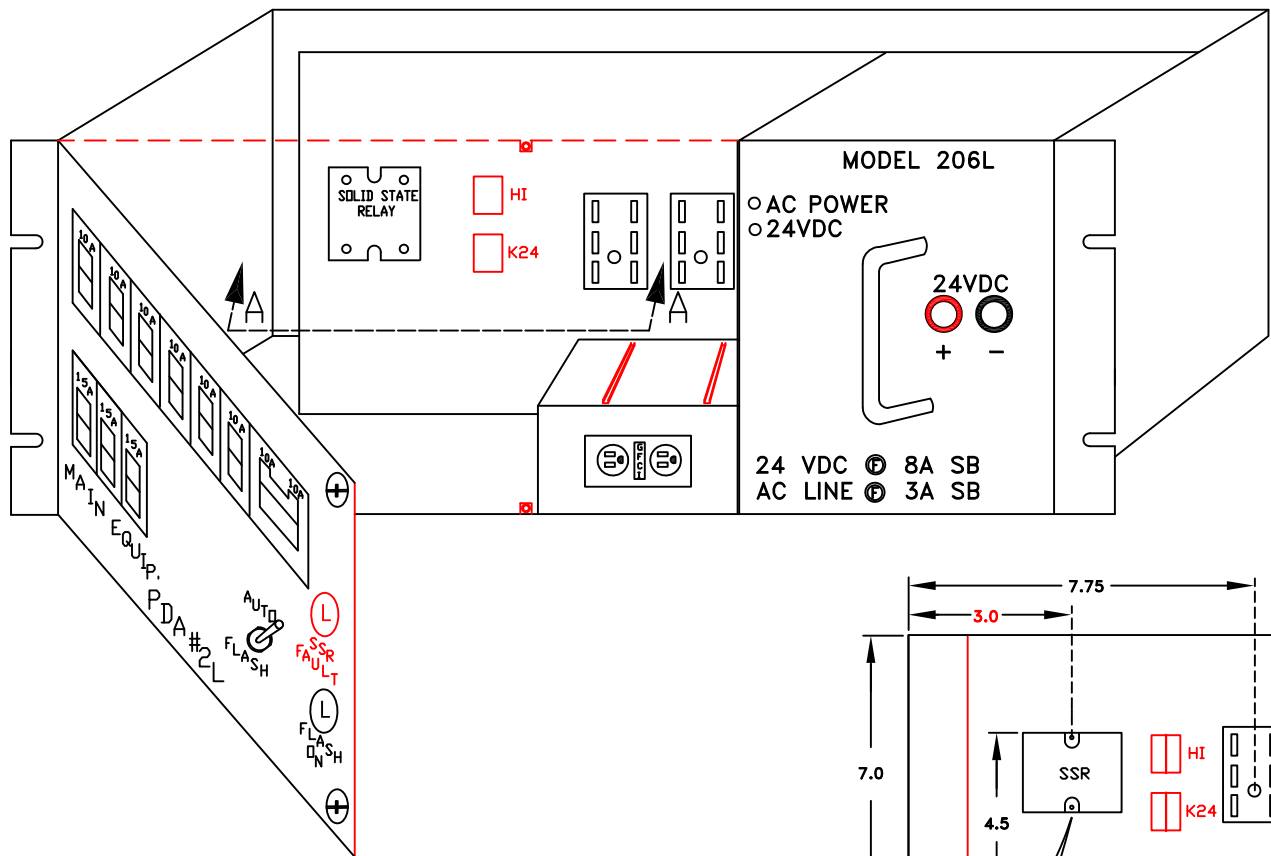
MODEL 332L AND 336L ONE LINE DIAGRAM

ERRATA 2

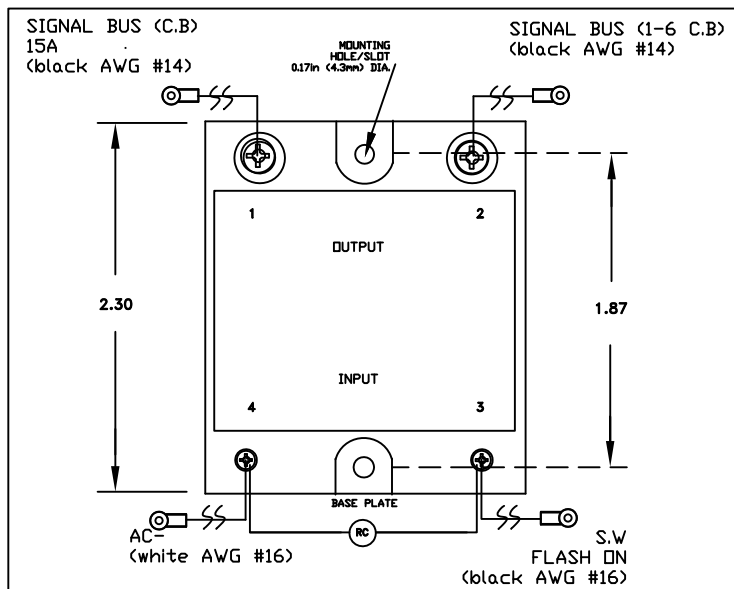
NO SCALE

TEES 2009

A6-7



Section A-A



NOTE:

All dimensions shown are in inches.

TITLE:

PDA #2L
SSR INSTALLATION DETAILS

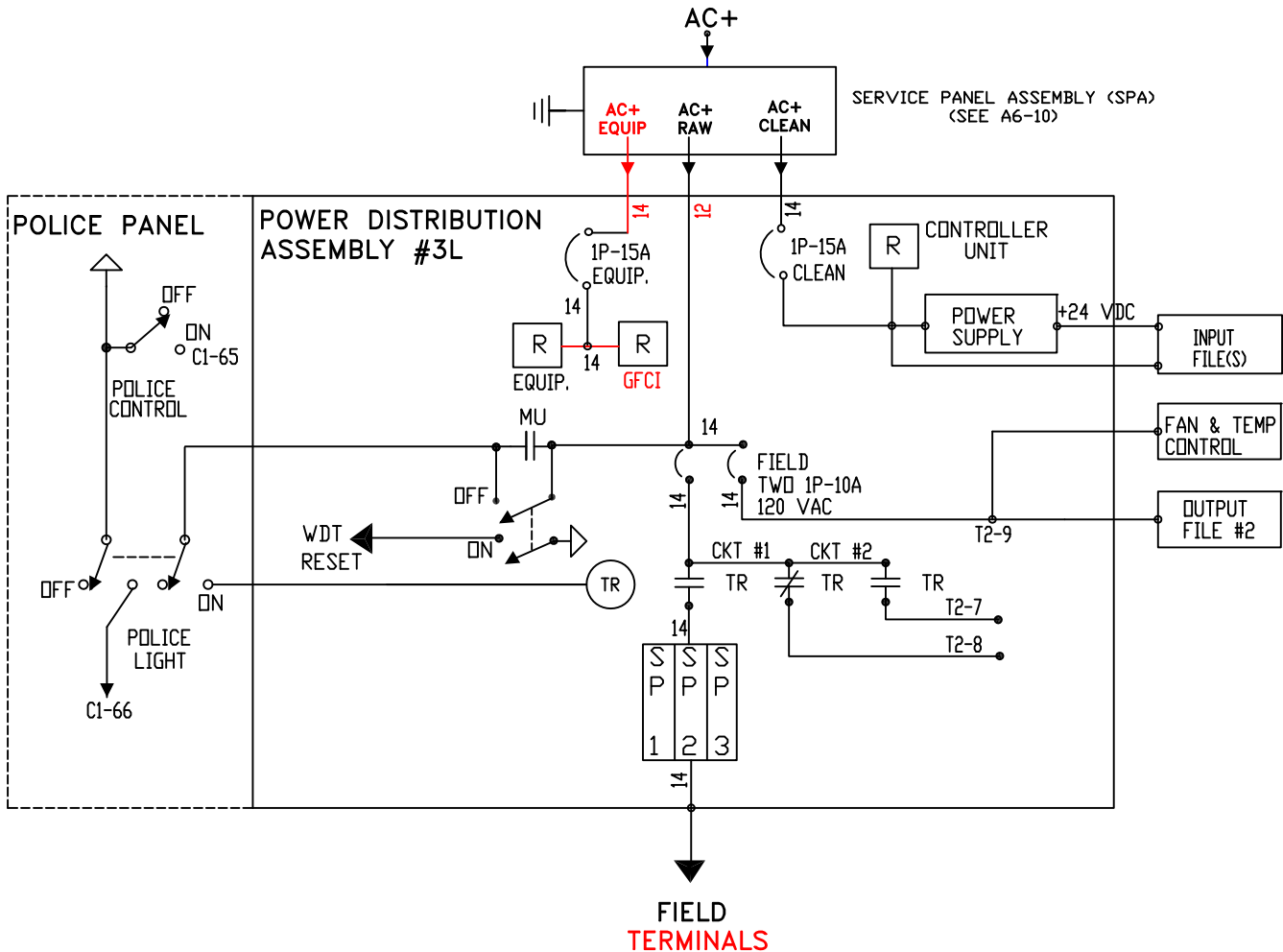
ERRATA 2

NO SCALE

TEES 2009

A6-8

334L CABINET ONE LINE DIAGRAM



SHEET DEFINITIONS

TBS	TERMINAL BLOCK - SERVICE	WDT	WATCHDOG TIMER
	EQUIPMENT GROUND	MU	MONITOR UNIT
	WIRE SIZE, IF NOT INDICATED SHALL BE #16 AWG OR LARGER	CB-1	SIGNAL CIRCUIT BREAKER 1 (SECONDARY)
	CIRCUIT BREAKER	TR	TRANSFER RELAY
	DUPLEX RECEPTACLE	T2-6	TERMINAL BLOCK 2, POSITION 6
GFCI	GROUND FAULT CIRCUIT INTERRUPTER	C1-65	C1 CONNECTOR, PIN 65
	RELAY CONTACT, NORMALLY CLOSED	SPA	SERVICE PANEL ASSEMBLY
	RELAY CONTACT, NORMALLY OPEN	SP	SWITCH PACK
IFI-14J	INPUT FILE I, TERM. BLOCK 14, POSITION J (CHANNEL 2 INPUT)		DC GROUND
	FLASHER UNIT ONE		SWITCH CONTACT
PDA	POWER DISTRIBUTION ASSEMBLY		

TITLE:

MODEL 334L ONE LINE DIAGRAM

ERRATA 2

NO SCALE

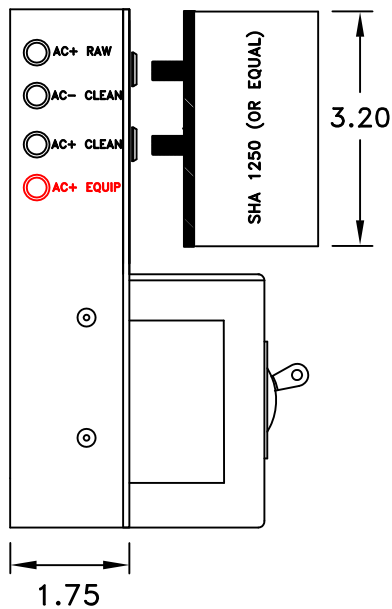
TEES 2009

A6-9

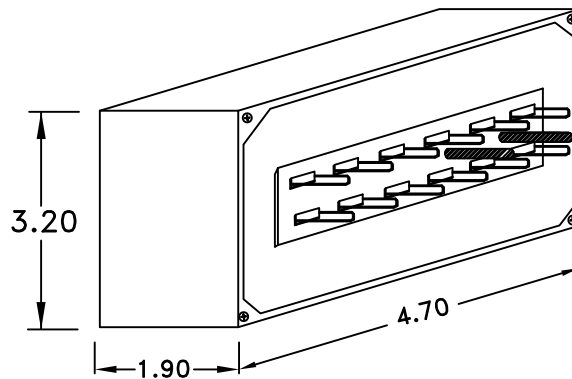


All dimensions shown are in inches.

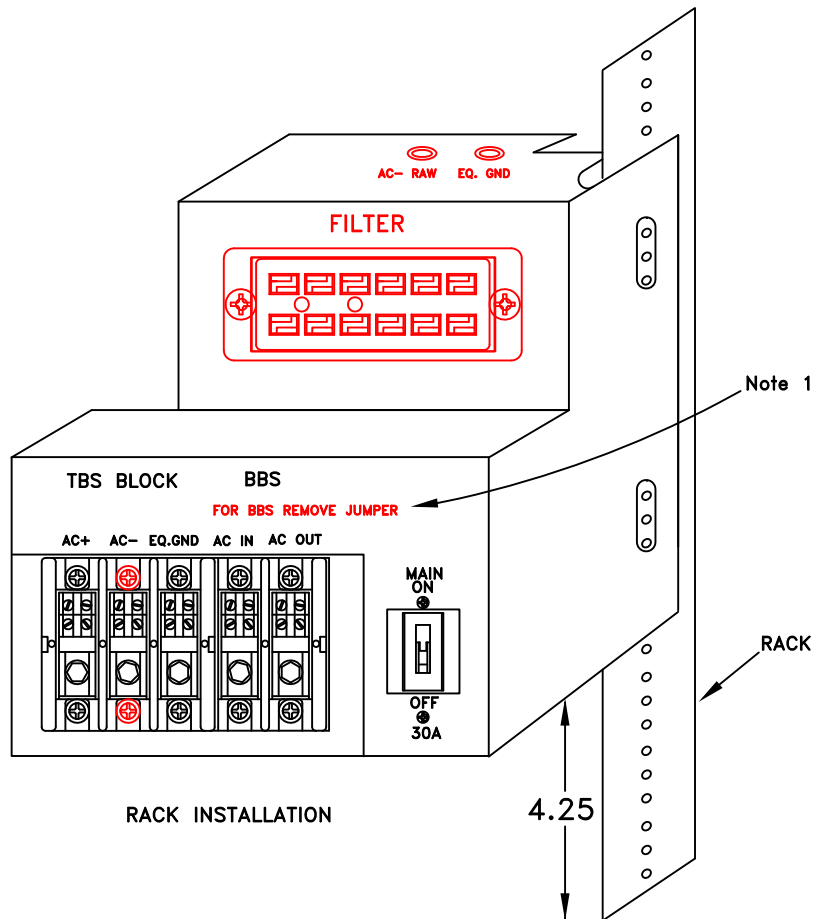
TITLE: SERVICE PANEL ASSEMBLY (SPA) DETAILS SHEET 1 OF 3	
ERRATA 2	NO SCALE
TEES 2009	A6-10



SIDE VIEW



FILTER
(MODEL SHA-1250-ITS OR EQUAL)

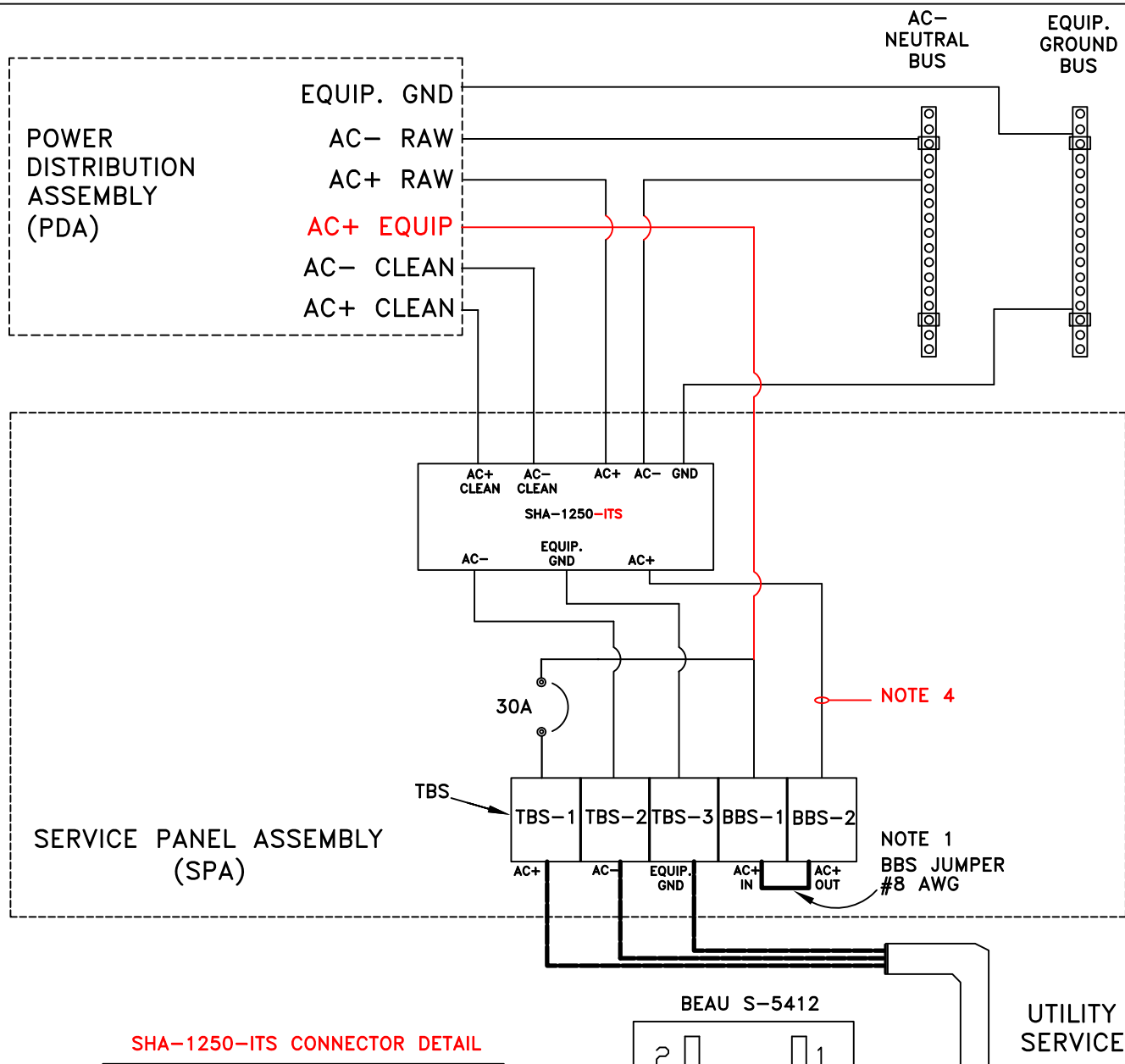


RACK INSTALLATION

NOTES: (FOR THIS DETAIL)

1. Place label "FOR BBS REMOVE JUMPER"
2. The SPA shall be mounted at least 4.25in above the bottom of the cabinet shelf, **except the 336L.**
3. All dimensions shown are in inches.

TITLE:	
SERVICE PANEL ASSEMBLY (SPA) DETAILS SHEET 2 OF 3	
ERRATA 2	NO SCALE
TEES 2009	A6-11



SHA-1250-ITS CONNECTOR DETAIL

PIN	FUNCTION	PIN	FUNCTION
1	AC+ RAW	2	AC+ RAW
3	EQ. GND	4	EQ. GND
5	AC+ CLEAN	6	AC+ RAW
7	AC- CLEAN	8	NA
9	EQ. GND	10	EQ. GND
11	AC- RAW	12	AC- RAW

BEAU S-5412

2		1
4		3
6		5
8		7
10		9
12		11

FRONT VIEW

NOTE:

BBS = Battery Back-up System
TBS = Terminal Block Service

1. Remove jumper when connecting BBS.
2. SHA-1250-ITS connector BEAU S-5412 or equivalent
3. Surge protection shall be provided of indicators
GREEN LED Indicator ON= ok, OFF= error.
YELLOW LED ON= error, Off= ok.
4. **Red insulation for both conductors**

TITLE:

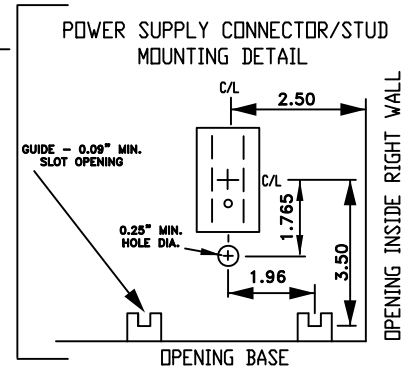
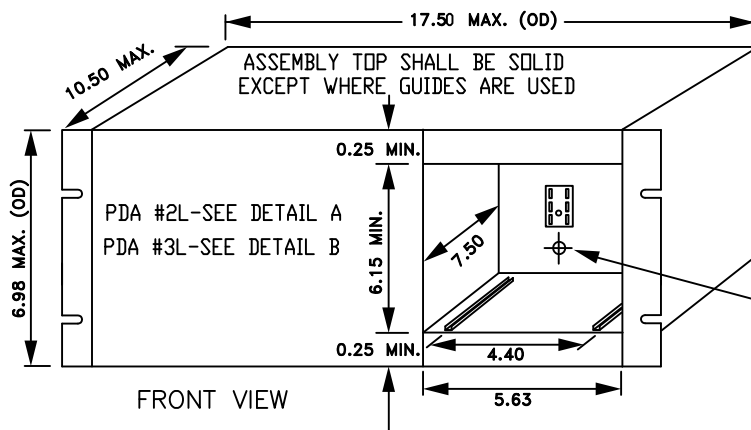
SERVICE PANEL ASSEMBLY (SPA) DETAILS
SHEET 3 OF 3

ERRATA 2

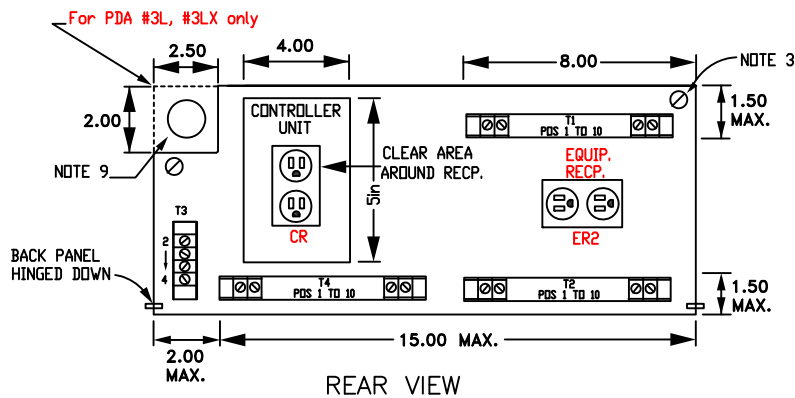
NO SCALE

TEES 2009

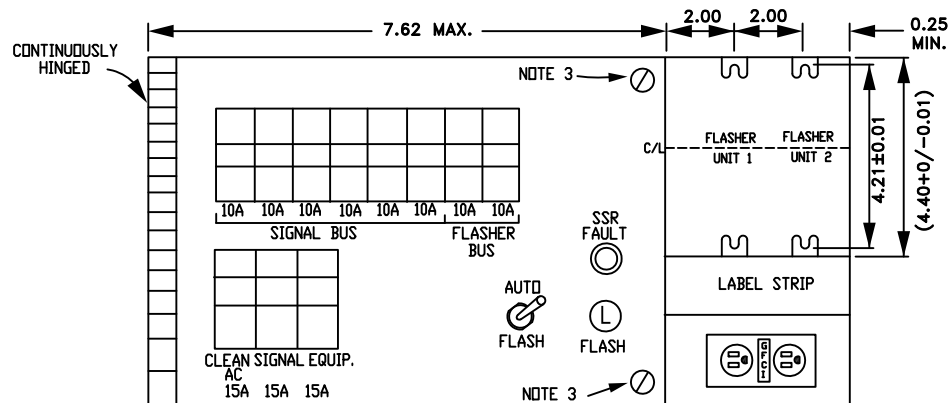
A6-12



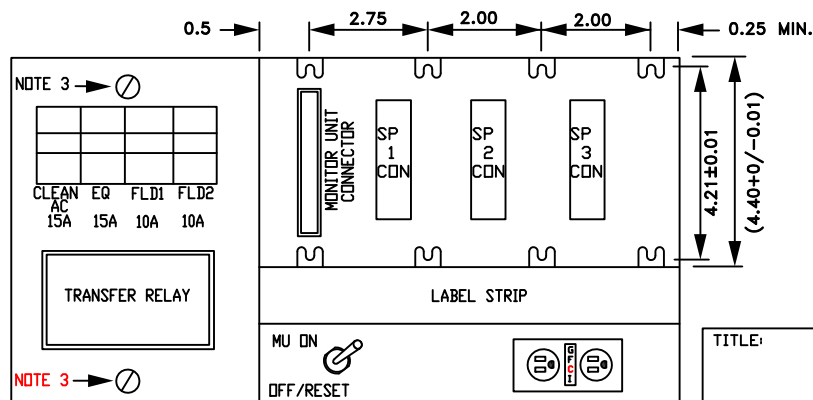
FRONT VIEW



REAR VIEW



DETAIL A



DETAIL B

NOTE:

All dimensions shown are in inches.

TITLE:

PDA #2L & #3L DETAILS

SHEET 1 OF 8

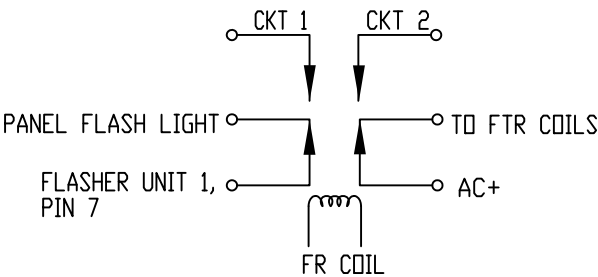
ERRATA 2

NO SCALE

TEES 2009

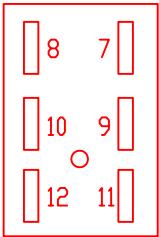
A6-13

FLASH RELAY CONNECTOR SOCKET
WIRING DETAIL



FLASHER UNIT CONNECTOR SOCKET
WIRING DETAIL

PIN NO.	FUNCTION
7	LD Ckt #1
8	LD Ckt #2
9	EG
10	AC- CLEAN
11	AC+ CLEAN
12	NA



REAR VIEW

TITLE: PDA #2L & #3L DETAILS SHEET 2 OF 8	
ERRATA 2	NO SCALE
TEES 2009	A6-14

POWER DISTRIBUTION ASSEMBLY TERMINAL BLOCK ASSIGNMENT DETAIL

PDA's	2L(X,S)	2L(X,S)	3L(X)	2L(X,S) & 3L(X)	2L(X,S)	3L(X)
TERMINAL BLOCK	T1	T2		T3	T4	
SIDE POS	A B	A B	A B	A B	A B	A B
1.	EG BUS / EG	* / ER AC-	EG BUS / EQ GND	24VDC BUS / PS-7	NA / NA	FL1 / SP 3-3
2.	AC- BUS / AC-	01-5 / FU1-7	AC- BUS / AC-	24VDC (CONTROLLED) / PS-7	NA / NA	FL2 / SP 3-5
3.	CR AC- / AC-CLEAN	01-6 / FU1-8	* / AC+ CLEAN	DC GND BUS / PS 8	NA / NA	FL3 / SP 3-7
4.	* / SCB CKT 5	01-7 / FU2-7	* / AC+ RAW	DC GND BUS / PS-8	NA / NA	FL4 / SP 2-3
5.	* / AC+ RAW	01-8 / FU2-8	* / MU		NA / NA	FL5 / SP 2-5
6.	CR AC+ / AC+ CLEAN	* / FTR DRIVE	* / TR COIL		NA / NA	FL6 / SP 2-7
7.	* / SSR	01-1 / SCB CKT 1	NA / TRC2ND		NA / NA	FL7 / SP 1-3
8.	* / SCB CKT 6	01-2 / SCB CKT 2	NA / TRC2NC		NA / NA	FL8 / SP 1-5
9.	* / FCB1 (SEC)	01-3 / SCB CKT 3	03-5 / FLD2		NA / NA	FL9 / SP 1-7
10.	* / ER AC+	01-4 / SCB CKT 4	SPA AC- / AC-CLEAN		NA / NA	NA / NA

A = EXTERNAL SIDE B = INTERNAL SIDE * = WIRE PER ONE LINE DIAGRAM

NOTES: (FOR DETAILS A6-13 TO A6-15)

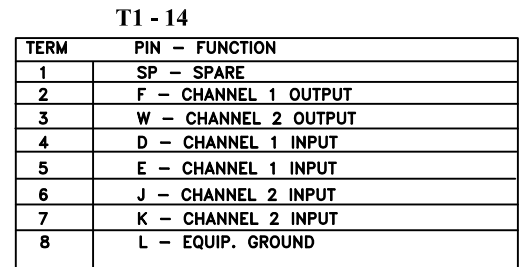
- All dimensions shown are in inches.
- SHEET DEFINITIONS:

CKT = CIRCUIT	EG = EQUIPMENT GROUND
FLD1 = FIELD 1 CIRCUIT BREAKER	FL1 = FIELD LOAD 1
FU1-7 = FLASHER UNIT #1, PIN 7	ER = EQUIPMENT RECEPTACLE
L = LAMP	LD CKT#1 = LOAD CIRCUIT 1
SSR = SOLID STATE RELAY	CR = CONTROLLER RECEPTACLE
MN = MAIN	MU-22 = MONITOR UNIT - PIN 22
OD = OUTSIDE DIMENSION	POS = POSITION
PS-7 = POWER SUPPLY PIN 7	SCB = SIGNAL CIRCUIT BREAKER
SP 3-3 = SWITCH PACK 3, PIN 3	TR = TRANSFER RELAY
01-8 = OUTPUT FILE TB 01, POSITION 8	FCB1 = FIELD CIRCUIT BREAKER 1

- Thumb screw device.
- Transfer relay in PDA #2L(X,S) & #3L(X) shall extend no more than 1.0 inch out from the assembly front face.
- Slack shall be provided in the wiring for the circuit breakers and GFCI receptacle to allow for the removal and repair. Excess bends and stress on the wiring shall be minimized.
- See Output File plan sheet for heavy duty relay and switch pack wiring assignments and connector mounting location.
- Wiring shall be routed (with extra length) to minimize movement when front panel door is opened. The wiring going to the front panel shall be routed such that it does not cause undue twisting or bending of the wires.
- No ventilation hole shall be large enough to place a 0.375 inch diameter object through.
- If PDA #2L, #2LX or #2LS is installed, park the C1 harness #1 - C5S connector at the Input Panel's C5P.
If PDA #3L or #3LX is installed, the C1 harness #2 - C5S connector shall be connected to the PDA's C6P connector, support bracket and wiring shall be installed.

TITLE:	
PDA #2L(X,S) & #3L(X) DETAILS	
SHEET 3 OF 8	
ERRATA 2	NO SCALE
TEES 2009	A6-15

INPUT FILE TERMINAL ASSIGNMENT DETAIL



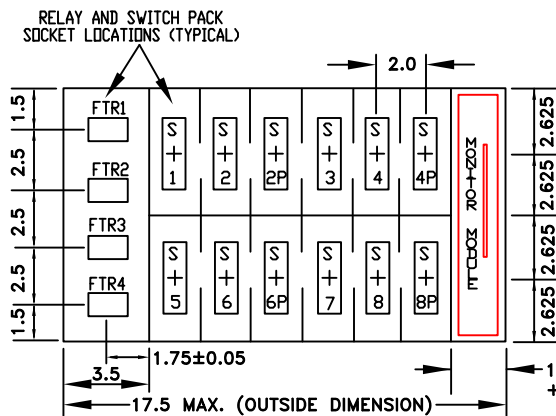
TERM	FUNCTION
1	+24 VDC
2	DC GROUND
3	DETECTOR RESET
4	C1 HARNESS DC GROUND

TERM	FUNCTION
1	AC+ CLEAN
2	AC- CLEAN
3	EQUIP. GROUND

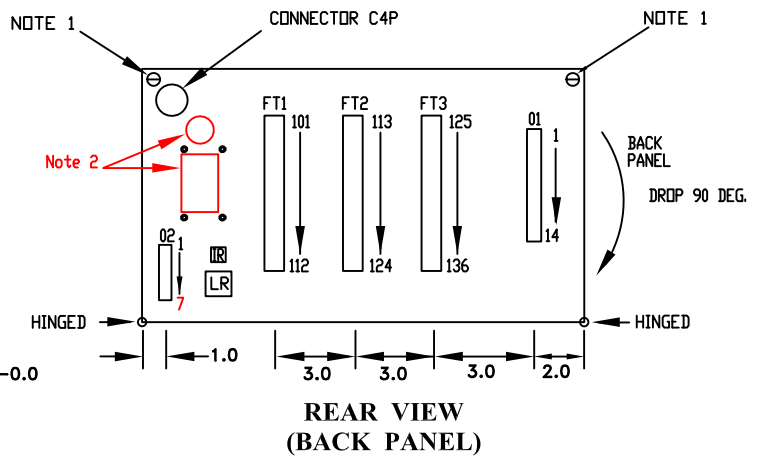
Diagram showing the wiring connections for three slots (Slot 1, Slot 2, Slot 3) to a common bus (Slot 14). The diagram includes connections for DC Ground, +24 VDC, Detector Reset, Loop No. 1 Magnetometer No. 1 (Collector), Loop No. 1 Magnetometer No. 1 (Emitter), Loop No. 2 Magnetometer No. 1 (Collector), Loop No. 2 Magnetometer No. 1 (Emitter), Loop No. 3 Magnetometer No. 2 (Collector), Loop No. 3 Magnetometer No. 2 (Emitter), Loop No. 4 Magnetometer No. 2 (Collector), Loop No. 4 Magnetometer No. 2 (Emitter), AC-, AC+, and Chassis Ground. The connections are shown as lines from the slot headers to the common bus headers.

TITLE:		INPUT/OUTPUT FILE DETAIL SHEET 1 OF 9	
ERRATA 2		NO SCALE	
TEES 2009		A6-16	

OUTPUT FILE #1L DETAIL

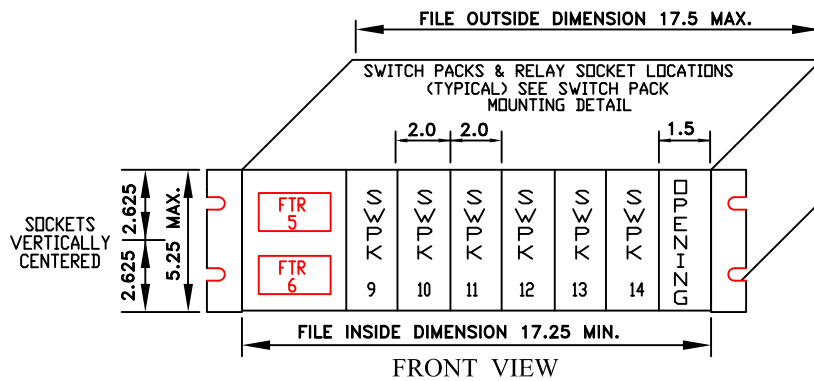


FRONT VIEW

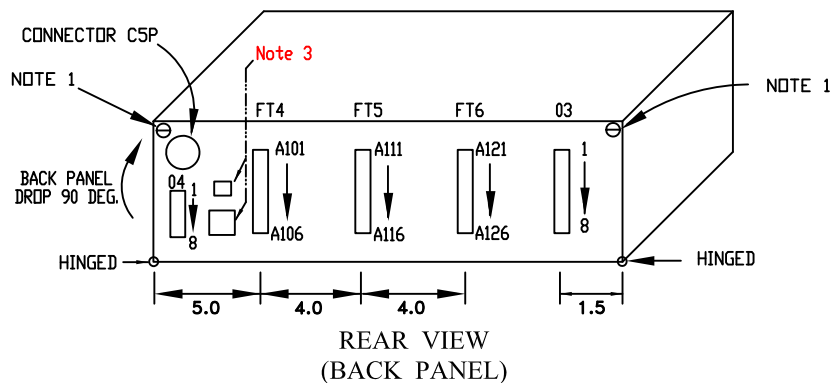


REAR VIEW (BACK PANEL)

OUTPUT FILE #2L DETAIL



FRONT VIEW



REAR VIEW
(BACK PANEL)

NOTE:

1. Thumb screws device
2. Panel stamped for OL Monitor Input Cable and Red Monitor Program Board, but board not installed.
3. Panel stamped for IR & LR relay sockets, but relays not installed
4. All dimensions shown are in inches

TITLE: INPUT/OUTPUT FILE DETAILS SHEET 2 OF 9	
ERRATA 2	NO SCALE
TEES 2009	A6-17

OUTPUT FILE #1L TERMINAL ASSIGNMENT DETAIL

01 TERM	FUNCTION
1	PDA CKT1/SWPKS 1,2,2P-1
2	PDA CKT2/SWPKS 3,4,4P-1
3	PDA CKT3/SWPKS 5,6,6P-1
4	PDA CKT4/SWPKS 7,8,8P-1
5	PDA FU1 CKT1/FTR1
6	PDA FU1 CKT2/FTR2
7	PDA FU2 CKT1/FTR3
8	PDA FU2 CKT2/FTR4
9	EQUIP. GROUND
10	AC-
11	AC+ (FROM PDA)
12	SSR (TO PDA)
13	DOOR SW. (FROM POL PAN)
14	FTR COILS (TO)

02 TERM	FUNCTION
1	+24VDC TO LOGIC RELAY (LR) COIL
2	DC GROUND
3	IFI-14J, STOP TIME (FROM M.U)
4	IFI-14D, FLASH SENSE (FROM I.R)
5	EXTERNAL (M.U) RESET
6	NA
7	+24VDC (CONTROLLED) TO SWITCHPACKS (1-12) POSITION 9

FT1 TERM	FUNCTION	FT2 TERM	FUNCTION	FT3 TERM	FUNCTION
101	SWPK 4-RED	113	SWPK 2P-RED	125	SWPK 1-RED
102	SWPK 4-YEL	114	SWPK 2P-YEL	126	SWPK 1-YEL
103	SWPK 4-GRN	115	SWPK 2P-GRN	127	SWPK 1-GRN
104	SWPK 4P-RED	116	SWPK 3-RED	128	SWPK 2-RED
105	SWPK 4P-YEL	117	SWPK 3-YEL	129	SWPK 2-YEL
106	SWPK 4P-GRN	118	SWPK 3-GRN	130	SWPK 2-GRN
107	SWPK 8-RED	119	SWPK 6P-RED	131	SWPK 5-RED
108	SWPK 8-YEL	120	SWPK 6P-YEL	132	SWPK 5-YEL
109	SWPK 8-GRN	121	SWPK 6P-GRN	133	SWPK 5-GRN
110	SWPK 8P-RED	122	SWPK 7-RED	134	SWPK 6-RED
111	SWPK 8P-YEL	123	SWPK 7-YEL	135	SWPK 6-YEL
112	SWPK 8P-GRN	124	SWPK 7-GRN	136	SWPK 6-GRN

OUTPUT FILE #2L TERMINAL ASSIGNMENT DETAIL

O3 TERM	FUNCTION
1	PDA FU1 CKT1/FTR5
2	PDA FU2 CKT2/FTR6
3	FTR COILS (TO)
4	AC-
5	PDA CKT5/SWPKS 9,10,11-1
6	PDA CKT6/SWPKS 12,13,14-1
7	EQUIP. GROUND
8	AC+ (FROM PDA)

O4 TERM	FUNCTION
1	+24VDC
2	DC GROUND
3	IFI-14J, STOP TIME (FROM M.U)
4	IFI-14D, FLASH SENSE (FROM I.R)
5	EXTERNAL (M.U) RESET
6	WDT INPUT
7	LR COIL (UNIT IN)
8	SSR (PDA)

FT4 TERM	FUNCTION	FT5 TERM	FUNCTION	FT6 TERM	FUNCTION
A101	SWPK 13-RED	A111	SWPK 11-RED	A121	SWPK 9-RED
A102	SWPK 13-YEL	A112	SWPK 11-YEL	A122	SWPK 9-YEL
A103	SWPK 13-GRN	A113	SWPK 11-GRN	A123	SWPK 9-GRN
A104	SWPK 14-RED	A114	SWPK 12-RED	A124	SWPK 10-RED
A105	SWPK 14-YEL	A115	SWPK 12-YEL	A125	SWPK 10-YEL
A106	SWPK 14-GRN	A116	SWPK 12-GRN	A126	SWPK 10-GRN

NOTE:

1. Thumb screws device.
2. All dimensions shown are in inches.

TITLE:

INPUT/OUTPUT FILE DETAILS
SHEET 3 OF 9

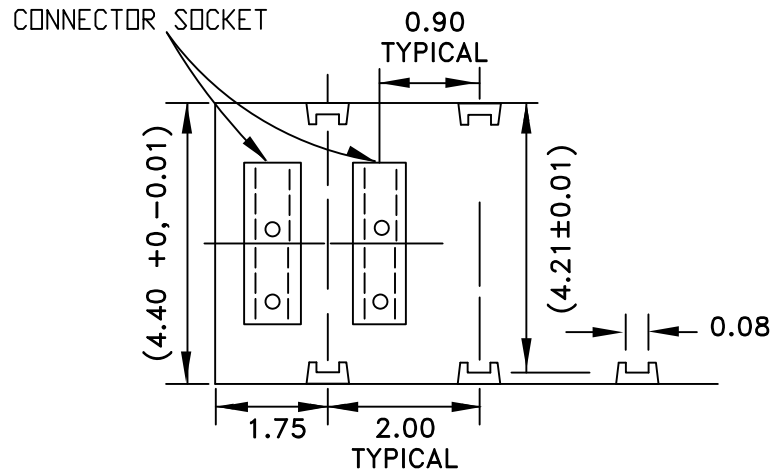
ERRATA 2

NO SCALE

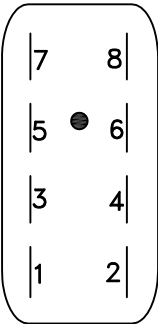
TEES 2009

A6-18

SWITCH PACK MOUNTING DETAIL



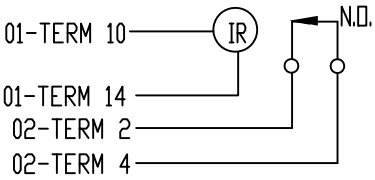
HEAVY DUTY RELAY SOCKET DETAIL



REAR VIEW

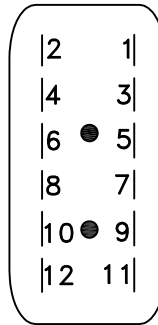
PIN	FUNCTION
1	COIL
2	COIL
3	N.C. CIRCUIT #1
4	N.C. CIRCUIT #2
5	COMMON CIRCUIT #1
6	COMMON CIRCUIT #2
7	N.O. CIRCUIT #1
8	N.O. CIRCUIT #2

ISOLATION RELAY (IR) DETAIL



(Refer to detail A6-16)

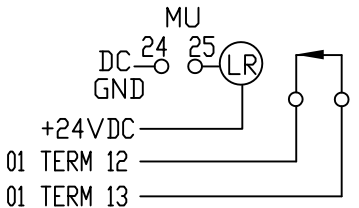
SWITCH PACK SOCKET DETAIL



REAR VIEW

PIN	FUNCTION
1	AC+
2	EQUIP. GROUND
3	RED OUTPUT
4	NA
5	YELLOW OUTPUT
6	RED INPUT
7	GREEN OUTPUT
8	YELLOW INPUT
9	+24 VDC
10	GREEN INPUT
11	NA
12	NA

LOGIC RELAY (LR) DETAIL



(Refer to detail A6-16)

NOTE:

All dimensions shown are in inches

TITLE: INPUT/OUTPUT FILE DETAIL SHEET 4 OF 9

ERRATA 2	NO SCALE
TEES 2009	A6-19

MODEL 210 MONITOR UNIT PIN ASSIGNMENT

CONNECTOR PIN No.	MONITOR FUNCTION	TERMINATION	CONNECTOR PIN No.	MONITOR FUNCTION	TERMINATION
1	SWPKS 2 GRN		A	SWPKS 2 YEL	
2	SWPKS 2P GRN		B	SWPKS 6 GRN	
3	SWPKS 6 YEL		C	SWPKS 6P GRN	
4	SWPKS 4 GRN		D	SWPKS 4 YEL	
5	SWPKS 4P GRN		E	SWPKS 8 GRN	
6	SWPKS 8 YEL		F	SWPKS 8P GRN	
7	SWPKS 5 GRN		H	SWPKS 5 YEL	
8	T&B		J	SWPKS 1 GRN	
9	SWPKS 1 YEL		K	T&B	
10	SWPKS 7 GRN		L	SWPKS 7 YEL	
11	T&B		M	SWPKS 3 GRN	
12	SWPKS 3 YEL		N	T&B	
13	T&B		P	NA	
14	NA		R	T&B	
15	T&B		S	T&B	
16	T&B		T	NA	
17	NA		U	T&B	
18	T&B		V	T&B	
19	NA		W	NA	
20	EQUIP. GROUND	01-TERM 9	X	NA	
21	AC-	01-TERM 10	Y	DC GROUND	02-TERM 2
22	WATCHDOG TIMER	C4-37	Z	EXTERNAL RESET	02-TERM 5
23	+24 VDC	02-TERM 1	AA	T&B	
24	B.D. OUT CKT	LOGIC RELAY COIL	BB	STOPTIME	02-TERM 3
25	B.D. OUT CKT	DC GROUND	CC	NA	
26	NA		DD	NA	
27	NA		EE	OUTPUT SW-SIDE 2	01-TERM 12
28	OUTPUT-SW SIDE 1	AC+	FF	AC+	01-TERM 11

NOTES: (FOR DETAILS A6-20)

- Top of relays shall be flush with face of file.
- The isolation relay shall be Potter & Brumfield R10-E1-X2-115 (or equal). The logic relay (LR) shall be Potter & Brumfield KUP11(D11 or 15) or equal.
- See connectors C4 & C5 wiring lists for connector/file interface.
- Sheet definitions:
 CKT = CIRCUIT
 FU = FLASHER UNIT
 FTR = FLASH TRANSFER RELAY
 IFI-14D = INPUT FILE "I", TB 14, POSITION D
 SSR = SOLID STATE RELAY
 MU = MONITOR UNIT
 N.C. = NORMALLY CLOSED RELAY CIRCUIT
 N.O = NORMALLY OPEN RELAY CIRCUIT
 PDA FU1 CKT1 = PDA FLASHER UNIT 1, OUTPUT CIRCUIT 1
 POL PAN = POLICE PANEL
 SW = SWITCH
 SWPK(S) = SWITCH PACK(S)
 T&B = CONDUCTORS CONNECTED TO PIN, TWO FEET IN LENGTH WITH RING LUG ON UNCONNECTED END, TIED & BUNDLED SEPARATELY.
 2P-2 = PHASE 2 PED. PIN 2
- For details, see A3-3 & A3-4.
- All dimensions shown are in inches.

TITLE:

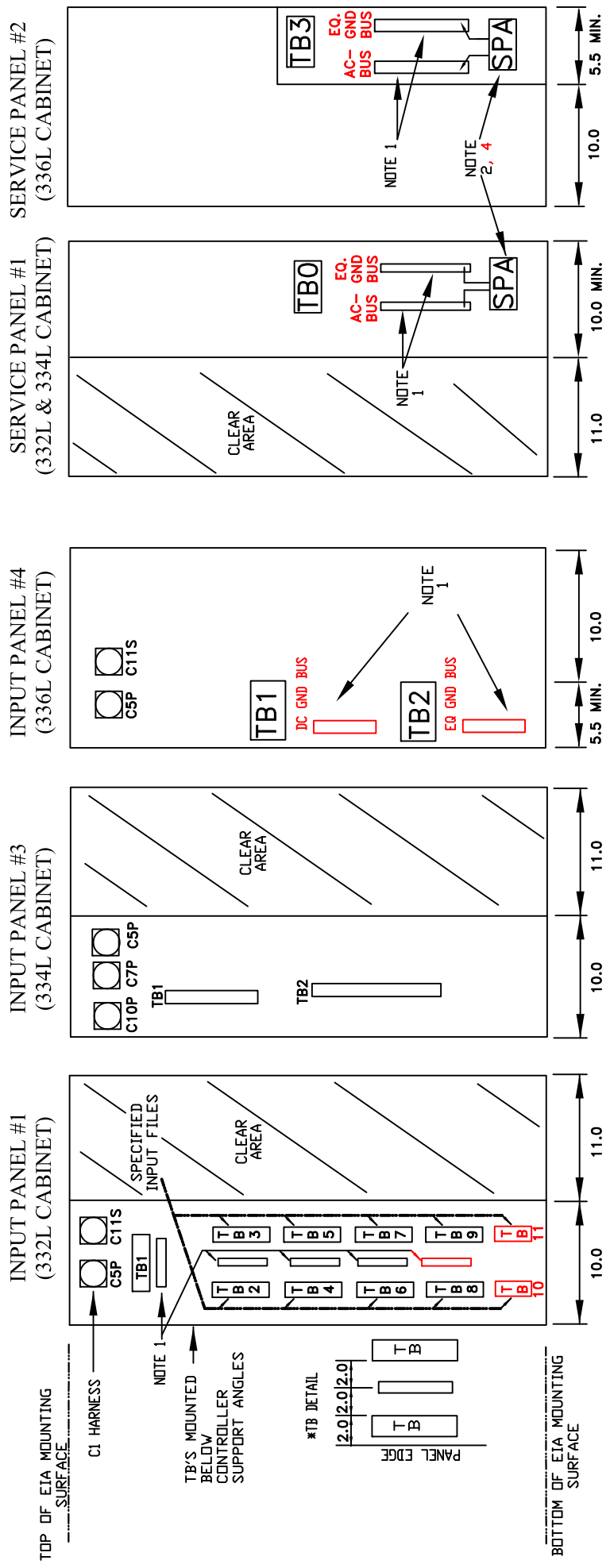
INPUT/OUTPUT FILE DETAILS SHEET 5 OF 9

ERRATA 2

NO SCALE

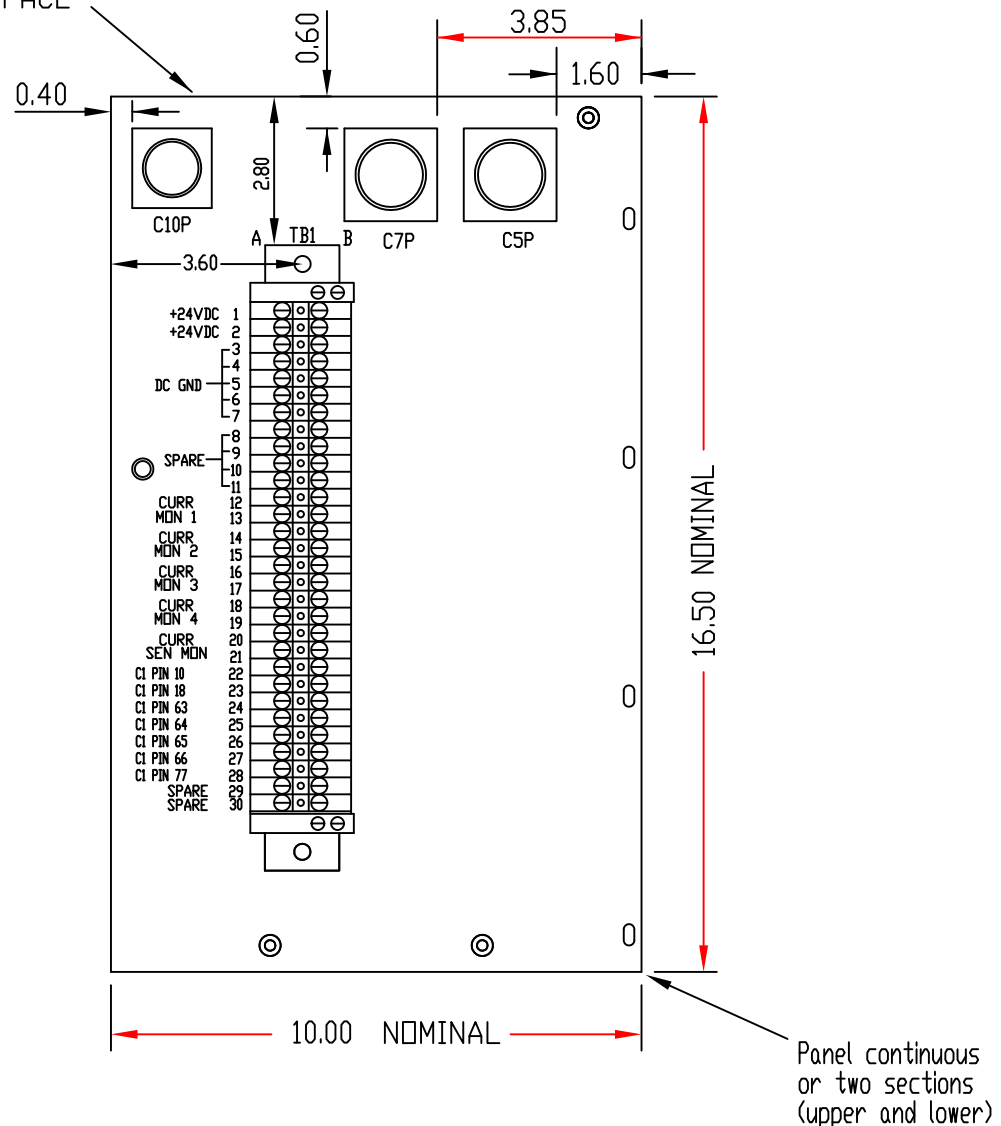
TEES 2009

A6-20



TITLE: SIDE PANEL DETAILS SHEET 1 OF 4	
ERRATA 2	NO SCALE
TEES 2009	A6-21

TOP OF EIA
MOUNTING SURFACE



NOTES:

1. Provide and install a 30 position TB1 Terminal Block & three circular connectors, C5P, C7P & C10P (no contacts), TB1 shall be Open Construct Phoenix Contact Terminal Block **UT 6, Weidmuller Terminal Block WDU 10** or equal, mounted on DIN Railing (supported every 6 inches with position function label tabs and positions commoned and end locks.
2. A 4 foot length "CMS" Harness of 14 #20 (or larger) Conductors shall be furnished and installed in the cabinet. One end of the harness shall be the C10S Connector resting in C10P (mounted on the Input Panel #3) when not in used. The other end shall be stripped (according to manufacturers requirements) and connected to the "B Side" of TB1. The conductor bundle shall have external protection.
3. All dimensions shown are in inches.

TITLE:

SIDE PANEL DETAILS
SHEET 2 OF 4

ERRATA 2

No Scale

TEES 2009

A6-22

TERMINAL BLOCK ASSIGNMENT

332L, 342LX INPUT PANEL #1

POS	A	B	POS	A	B
TB2-1		I-1D	TB3-1	DET 21	J-1D
TB2-2	DET 1	I-1E	TB3-2		J-1E
TB2-3		I-1J	TB3-3	DET 22	J-1J
TB2-4	DET 2	I-1K	TB3-4		J-1K
TB2-5		I-2D	TB3-5	DET 23	J-2D
TB2-6	DET 3	I-2E	TB3-6		J-2E
TB2-7		I-2J	TB3-7	DET 24	J-2J
TB2-8	DET 4	I-2K	TB3-8		J-2K
TB2-9		I-3D	TB3-9	DET 25	J-3D
TB2-10	DET 5	I-3E	TB3-10		J-3E
TB2-11		I-3J	TB3-11	DET 26	J-3J
TB2-12	DET 6	I-3K	TB3-12		J-3K
TB4-1		I-4D	TB5-1	DET 27	J-4D
TB4-2	DET 7	I-4E	TB5-2		J-4E
TB4-3		I-4J	TB5-3	DET 28	J-4J
TB4-4	DET 8	I-4K	TB5-4		J-4K
TB4-5		I-5D	TB5-5	DET 29	J-5D
TB4-6	DET 9	I-5E	TB5-6		J-5E
TB4-7		I-5J	TB5-7	DET 30	J-5J
TB4-8	DET 10	I-5K	TB5-8		J-5K
TB4-9		I-6D	TB5-9	DET 31	J-6D
TB4-10	DET 11	I-6E	TB5-10		J-6E
TB4-11		I-6J	TB5-11	DET 32	J-6J
TB4-12	DET 12	I-6K	TB5-12		J-6K
TB6-1		I-7D	TB7-1	DET 33	J-7D
TB6-2	DET 13	I-7E	TB7-2		J-7E
TB6-3		I-7J	TB7-3	DET 34	J-7J
TB6-4	DET 14	I-7K	TB7-4		J-7K
TB6-5		I-8D	TB7-5	DET 35	J-8D
TB6-6	DET 15	I-8E	TB7-6		J-8E
TB6-7		I-8J	TB7-7	DET 36	J-8J
TB6-8	DET 16	I-8K	TB7-8		J-8K
TB6-9		I-9D	TB7-9	DET 37	J-9D
TB6-10	DET 17	I-9E	TB7-10		J-9E
TB6-11		I-9J	TB7-11	DET 38	J-9J
TB6-12	DET 18	I-9K	TB7-12		J-9K
TB8-1	MANUAL	I-11D	TB9-1	SPARE 2	J-11D
TB8-2	SPARE	I-11J	TB9-2	SPARE 3	J-11J
TB8-3	11 COM	I-11K	TB9-3	11 COM	J-11K
TB8-4	PED Ø2	I-12D	TB9-4	EVA	J-12D
TB8-5	PED Ø4	I-12J	TB9-5	EVC	J-12J
TB8-6	12 COM	I-12K	TB9-6	12 COM	J-12K
TB8-7	PED Ø6	I-13D	TB9-7	EVb	J-13D
TB8-8	PED Ø8	I-13J	TB9-8	EVD	J-13J
TB8-9	13 COM	I-13K	TB9-9	13 COM	J-13K
TB8-10	FLH SENSE	I-14D	TB9-10	RR1	J-14D
TB8-11	STOP TIME	I-14J	TB9-11	RR2	J-14J
TB8-12	14 COM	I-14K	TB9-12	14 COM	J-14K
TB10-1	DET 19	I-10D	TB11-1	DET 39	J-10D
TB10-2		I-10E	TB11-2		J-10E
TB10-3	DET 20	I-10J	TB11-3	DET 40	J-10J
TB10-4		I-10K	TB11-4		J-10K

TB1- SEE INPUT PANEL #4 TB1 ASSIGNMENTS

334L, 344LX INPUT PANEL #3, TB #1

POS	A	B
TB1-1	+24 VDC	I/O FILES
TB1-2	+24 VDC	CAB. HARNESS #5
TB1-3	DC GND	C1 PINS 1 & 104
TB1-4	DC GND	I/O FILES & CAB. HARNESS #5
TB1-5	DC GND	
TB1-6	DC GND	
TB1-7	DC GND	
TB1-8	SPARE	NA
TB1-9	SPARE	NA
TB1-10	SPARE	NA
TB1-11	SPARE	NA
TB1-12	CURR. MONITOR 1	CAB. HARNESS #5
TB1-13	CURR. MONITOR 1	CAB. HARNESS #5
TB1-14	CURR. MONITOR 2	CAB. HARNESS #5
TB1-15	CURR. MONITOR 2	CAB. HARNESS #5
TB1-16	CURR. MONITOR 3	CAB. HARNESS #5
TB1-17	CURR. MONITOR 3	CAB. HARNESS #5
TB1-18	CURR. MONITOR 4	CAB. HARNESS #5
TB1-19	CURR. MONITOR 4	CAB. HARNESS #5
TB1-20	CURR. SEN. MON.	CAB. HARNESS #5
TB1-21	CURR. SEN. MON.	CAB. HARNESS #5
TB1-22	C1 PIN 10	CIA CONTROL 4
TB1-23	C1 PIN 18	NA
TB1-24	C1 PIN 63	NA
TB1-25	C1 PIN 64	NA
TB1-26	C1 PIN 65	POL. CONTROL SW.
TB1-27	C1 PIN 66	POL. LIGHTS SW.
TB1-28	C1 PIN 77	NA
TB1-29	SPARE	CAB. HARNESS #5
TB1-30	SPARE	CAB. HARNESS #5

336L, 346LX INPUT PANEL #4

TERM	A	B
TB1-1	(+24 VDC) O2-1/T3-1	I15-1, J15-1
TB1-2	M RESET	O2-5
TB1-3	O2-7/T3-2	C5-24
TB1-4	RESERVED	RESERVED (COMM IN)
TB1-5	RESERVED	RESERVED (COMM IN)
TB1-6	RESERVED	RESERVED (COMM OUT)
TB1-7	RESERVED	RESERVED (COMM OUT)
TB1-8	RESERVED	RESERVED
TB2-1 TO 6	NA	NA

334L, 344LX INPUT PANEL #3, TB #2

POS	A	B	POS	A	B
TB2-1	I-1D		TB2-38	EQ. GND	
TB2-2	I-1E		TB2-39	I-8J	
TB2-3	EQ. GND		TB2-40	I-8K	
TB2-4	I-1J		TB2-41	I-9D	
TB2-5	I-1K		TB2-42	I-9E	
TB2-6	I-2D		TB2-43	EQ. GND	
TB2-7	I-2E		TB2-44	I-9J	
TB2-8	EQ. GND		TB2-45	I-9K	
TB2-9	I-2J		TB2-46	I-10D	
TB2-10	I-2K		TB2-47	I-10E	
TB2-11	I-3D		TB2-48	EQ. GND	
TB2-12	I-3E		TB2-49	I-10J	
TB2-13	EQ. GND		TB2-50	I-10K	
TB2-14	I-3J		TB2-51	I-11D	
TB2-15	I-3K		TB2-52	I-11E	
TB2-16	I-4D		TB2-53	EQ. GND	
TB2-17	I-4E		TB2-54	I-11J	
TB2-18	EQ. GND		TB2-55	I-11K	
TB2-19	I-4J		TB2-56	I-12D	
TB2-20	I-4K		TB2-57	I-12E	
TB2-21	I-5D		TB2-58	EQ. GND	
TB2-22	I-5E		TB2-59	I-12J	
TB2-23	EQ. GND		TB2-60	I-12K	
TB2-24	I-5J		TB2-61	I-13D	
TB2-25	I-5K		TB2-62	I-13E	
TB2-26	I-6D		TB2-63	EQ. GND	
TB2-27	I-6E		TB2-64	I-13J	
TB2-28	EQ. GND		TB2-65	I-13K	
TB2-29	I-6J		TB2-66	I-14D	
TB2-30	I-6K		TB2-67	I-14E	
TB2-31	I-7D		TB2-68	EQ. GND	
TB2-32	I-7E		TB2-69	I-14J	
TB2-33	EQ. GND		TB2-70	I-14K	
TB2-34	I-7J		TB2-71	SPARE	
TB2-35	I-7K		TB2-72	SPARE	
TB2-36	I-8D		TB2-73	EQ. GND	
TB2-37	I-8E				

33xL, 34xLX SERVICE PANEL 1,
336L, 346LX SERVICE PANEL 2

TERM	A	B
TBS-1	AC+	TO PDA (without BBS) TO BBS-1 (with BBS)
TBS-2	AC-	AC- BUS
TBS-3	GND	TO EQ.GND BUS
BBS-1	AC+ IN	MBPS AC+ IN
BBS-2	MBPS AC+ OUT	TO PDA
TB0-1 TO 12	NA	NA
TB3-1 TO 6	NA	NA

See Service Panel Assembly (SPA) details A6-10, A6-11 & A6-40

NOTES:

- Sheet Definitions:
11 COM = DC COMMON
COMM = COMMUNICATION
DET1 = DETECTOR #1
EVA = EMERGENCY VEHICLE PREEMPTION A
IFI-1D = INPUT FILE 1, SLOT 1, CONNECTOR PIN D
OF = OUTPUT FILE
M = MONITOR MODULE
NA = NOT ASSIGNED
RR1 = RAILROAD PREEMPTION 1
MBPS = MANUAL BYPASS SWITCH
BBS = BATTERY BACK-UP SYSTEM
PDA = POWER DISTRIBUTION ASSEMBLY
x = 2, 4
- All dimensions shown are in inches.

TITLE:

SIDE PANEL DETAILS
SHEET 4 OF 4

ERRATA 2

NO SCALE

TEES 2009

A6-24

C1 HARNESS WIRING LIST #1

PIN	SOURCE	DESTINATION	FUNCTION	PIN	SOURCE	DESTINATION	FUNCTION
1	DC GND	DC GND BUS	-	53	I2-7	IFI-11W	SPARE #1
2	O1-1	C4-1	SWPK 4P-RED	54	I2-8	IFJ-11F	SPARE #2
3	O1-2	C4-2	SWPK 4P-GRN	55	I3-1	IFJ-1F&W	5 CE
4	O1-3	C4-3	SWPK 4-RED	56	I3-2	IFI-1F&W	1 CE
5	O1-4	C4-4	SWPK 4-YEL	57	I3-3	IFJ-5F&W	7 CE
6	O1-5	C4-5	SWPK 4-GRN	58	I3-4	IFI-5F&W	3 CE
7	O1-6	C4-6	SWPK 3-RED	59	I3-5	IFJ-9F	5 CE
8	O1-7	C4-7	SWPK 3-YEL	60	I3-6	IFI-9F	1 CE
9	O1-8	C4-8	SWPK 3-GRN	61	I3-7	IFJ-9W	7 CE
10	O2-1	C4-9	SWPK 2P-RED	62	I3-8	IFI-9W	3 CE
11	O2-2	C4-10	SWPK 2P-GRN	63	I4-5	IFI-3F	2 CE
12	O2-3	C4-11	SWPK 2-RED	64	I4-6	IFJ-3F	6 CE
13	O2-4	C4-12	SWPK 2-YEL	65	I4-7	IFI-7F	4 CE
14	DC GND	IFI-15-4	INPUT DC GND	66	I4-8	IFJ-7F	8 CE
15	O2-5	C4-13	SWPK 2-GRN	67	I5-1	IFI-12F	2 PED
16	O2-6	C4-14	SWPK 1-RED	68	I5-2	IFI-13F	6 PED
17	O2-7	C4-15	SWPK 1-YEL	69	I5-3	IFI-12W	4 PED
18	O2-8	C4-16	SWPK 1-GRN	70	I5-4	IFI-13W	8 PED
19	O3-1	C4-17	SWPK 8P-RED	71	I5-5	IFJ-12F	EVA PREEMPT
20	O3-2	C4-18	SWPK 8P-GRN	72	I5-6	IFJ-13F	EVb PREEMPT
21	O3-3	C4-19	SWPK 8-RED	73	I5-7	IFJ-12W	EVC PREEMPT
22	O3-4	C4-20	SWPK 8-YEL	74	I5-8	IFJ-13W	EVD PREEMPT
23	O3-5	C4-21	SWPK 8-GRN	75	I6-1	IFJ-11W	SPARE #3
24	O3-6	C4-22	SWPK 7-RED	76	I6-2	IFI-3W	2 CE
25	O3-7	C4-23	SWPK 7-YEL	77	I6-3	IFJ-3W	6 CE
26	O3-8	C4-24	SWPK 7-GRN	78	I6-4	IFI-7W	4 CE
27	O4-1	C4-25	SWPK 6P-RED	79	I6-5	IFJ-7W	8 CE
28	O4-2	C4-26	SWPK 6P-GRN	80	I6-6	IFI-11F	ADVANCE
29	O4-3	C4-27	SWPK 6-RED	81	I6-7	IFI-14F	FLASH SENSE
30	O4-4	C4-28	SWPK 6-YEL	82	I6-8	IFI-14W	STOP TIME
31	O4-5	C4-29	SWPK 6-GRN	83	O6-1	C5-1	SWPK 14-RED
32	O4-6	C4-30	SWPK 5-RED	84	O6-2	C5-2	SWPK 14-GRN
33	O4-7	C4-31	SWPK 5-YEL	85	O6-3	C5-3	SWPK 13-RED
34	O4-8	C4-32	SWPK 5-GRN	86	O6-4	C5-4	SWPK 13-YEL
35	O5-1	C4-33	SWPK 2P-YEL	87	O6-5	C5-5	SWPK 13-GRN
36	O5-2	C4-34	SWPK 6P-YEL	88	O6-6	C5-6	SWPK 12-RED
37	O5-3	C4-35	SWPK 4P-YEL	89	O6-7	C5-7	SWPK 12-YEL
38	O5-4	C4-36	SWPK 8P-YEL	90	O6-8	C5-8	SWPK 12-GRN
39	I1-1	IFI-2F	2 CE	91	O7-1	C5-9	SWPK 11-RED
40	I1-2	IFJ-2F	6 CE	92	DC GND	DC GND BUS	-
41	I1-3	IFI-6F	4 CE	93	O7-2	C5-10	SWPK 11-GRN
42	I1-4	IFJ-6F	8 CE	94	O7-3	C5-11	SWPK 10-RED
43	I1-5	IFI-2W	2 CE	95	O7-4	C5-12	SWPK 10-YEL
44	I1-6	IFJ-2W	6 CE	96	O7-5	C5-13	SWPK 10-GRN
45	I1-7	IFI-6W	4 CE	97	O7-6	C5-14	SWPK 9-RED
46	I1-8	IFJ-6W	8 CE	98	O7-7	C5-15	SWPK 9-YEL
47	I2-1	IFI-4F&W	2 CALL	99	O7-8	C5-16	SWPK 9-GRN
48	I2-2	IFJ-4F&W	6 CALL	100	O5-5	C5-17	SWPK 14-YEL
49	I2-3	IFI-8F&W	4 CALL	101	O5-6	C5-18	SWPK 11-YEL
50	I2-4	IFJ-8F&W	8 CALL	102	O5-7	IFI&J-15-3	DETECTOR RESET
51	I2-5	IFJ-14F	RR1 PREEMPT	103	O5-8	C4-37	WDT-MU
52	I2-6	IFJ-14W	RR2 PREEMPT	104	DC GND	IFJ-15-4	INPUT DC GND

TITLE:

HARNESS WIRING DETAILS
SHEET 1 OF 5

ERRATA 2

NO SCALE

TEES 2009

A6-25

C1 HARNESS WIRING LIST #2

PIN	SOURCE	DESTINATION	FUNCTION	PIN	SOURCE	DESTINATION	FUNCTION
1	DC GND	TB1/3-7	DC GND BUS	53	I2-7	IFI-11F	RATE CODE 2
2	O1-1	C6-1	SWPK 1-RED	54	I2-8	IFI-11W	RATE CODE 1
3	O1-2	C6-2	SWPK 1-GRN	55	I3-1	IFI-4F	MAIN 9
4	O1-3	C6-3	SWPK 2-RED	56	I3-2	IFI-4W	MAIN 10
5	O1-4	C6-4	SWPK 2-YEL	57	I3-3	IFI-6F	MAIN 3
6	O1-5	C6-5	SWPK 2-GRN	58	I3-4	IFI-6W	MAIN 4
7	O1-6	C6-6	SWPK 3-RED	59	I3-5	IFI-7F	MAIN 5
8	O1-7	C6-7	SWPK 3-YEL	60	I3-6	IFI-7W	MAIN 6
9	O1-8	C6-8	SWPK 3-GRN	61	I3-7	IFI-8F	MAIN 11
10	O2-1	TB1/22	CIA CONTROL 4	62	I3-8	IFI-8W	MAIN 12
11	O2-2	C7-25	CMS CLOCK	63	I4-5	TB1/24	MAIN 17
12	O2-3	C7-26	CMS ENABLE	64	I4-6	TB1/25	MAIN 18
13	O2-4	C7-27	CMS CLEAR	65	I4-7	TB1/26	POL. CONTR'L SW.
14	DC GND	IFI-15-4	INPUT DC GND	66	I4-8	TB1/27	POL. LIGHTS SW.
15	O2-5	C7-28	CMS DIM LEVEL 1	67	I5-1	C7-16	CIA SENSE 1
16	O2-6	C7-29	CMS DIM LEVEL 2	68	I5-2	C7-31	CIA SENSE 2
17	O2-7	C7-30	CMS DIM LEVEL 3	69	I5-3	C7-32	CIA SENSE 3
18	O2-8	TB1/23	-	70	I5-4	C7-33	CIA SENSE 4
19	O3-1	C7-9	CMS ADDRESS 1	71	I5-5	C7-34	CIA SENSE 5
20	O3-2	C7-10	CMS ADDRESS 2	72	I5-6	C7-35	CIA SENSE 6
21	O3-3	C7-11	CMS ADDRESS 3	73	I5-7	C7-36	CIA SENSE 7
22	O3-4	C7-12	CMS ADDRESS 4	74	I5-8	C7-37	CIA SENSE 8
23	O3-5	C7-13	CMS ADDRESS 5	75	I6-1	C7-5	CMS LATCH
24	O3-6	C7-14	CMS ADDRESS 6	76	I6-2	C7-6	PHASE FIRE
25	O3-7	C7-15	CMS ADDRESS 7	77	I6-3	TB1/29	MAIN 19
26	O3-8	C7-4	CIA CONTROL 5	78	I6-4	C7-8	CMS TEST REQ.
27	O4-1	C7-17	CMS DATA 1	79	I6-5	IFI-10F	MAIN 15
28	O4-2	C7-18	CMS DATA 2	80	I6-6	IFI-9W	MAIN 14
29	O4-3	C7-19	CMS DATA 3	81	I6-7	IFI-9F	MAIN 13
30	O4-4	C7-20	CMS DATA 4	82	I6-8	IFI-10W	MAIN 16
31	O4-5	C7-21	CMS DATA 5	83	O6-1	C5-1	SWPK 14-RED
32	O4-6	C7-22	CMS DATA 6	84	O6-2	C5-2	SWPK 14-GRN
33	O4-7	C7-23	CMS DATA 7	85	O6-3	C5-3	SWPK 13-RED
34	O4-8	C7-24	CMS DATA 8	86	O6-4	C5-4	SWPK 13-YEL
35	O5-1	C7-1	CIA CONTROL 1	87	O6-5	C5-5	SWPK 13-GRN
36	O5-2	C7-2	CIA CONTROL 2	88	O6-6	C5-6	SWPK 12-RED
37	O5-3	C6-9	SWPK 1-YEL	89	O6-7	C5-7	SWPK 12-YEL
38	O5-4	C7-3	CIA CONTROL 3	90	O6-8	C5-8	SWPK 12-GRN
39	I1-1	IFI-1W	PASSAGE 1	91	O7-1	C5-9	SWPK 11-RED
40	I1-2	IFI-12W	PASSAGE 2	92	DC GND	TB1/3-7	-
41	I1-3	IFI-12F	DEMAND 2	93	O7-2	C5-10	SWPK 11-GRN
42	I1-4	IFI-13W	OFF RAMP 2	94	O7-3	C5-11	SWPK 10-RED
43	I1-5	IFI-13F	QUE 2	95	O7-4	C5-12	SWPK 10-YEL
44	I1-6	IFI-14W	PASSAGE 3	96	O7-5	C5-13	SWPK 10-GRN
45	I1-7	IFI-14F	DEMAND 3	97	O7-6	C5-14	SWPK 9-RED
46	I1-8	IFI-1F	DEMAND 1	98	O7-7	C5-15	SWPK 9-YEL
47	I2-1	IFI-2W	OFF RAMP 1	99	O7-8	C5-16	SWPK 9-GRN
48	I2-2	IFI-3W	MAIN 7	100	O5-5	C5-17	SWPK 14-YEL
49	I2-3	IFI-3F	MAIN 8	101	O5-6	C5-18	SWPK 11-YEL
50	I2-4	IFI-2F	QUE 1	102	O5-7	IFI-15-3	DETECTOR RESET
51	I2-5	IFI-5F	MAIN 1	103	O5-8	C6-10	WDT
52	I2-6	IFI-5W	MAIN 2	104	DC GND	TB1/3-7	DC GND BUS

TITLE:

HARNESS WIRING DETAILS
SHEET 2 OF 5

ERRATA 2

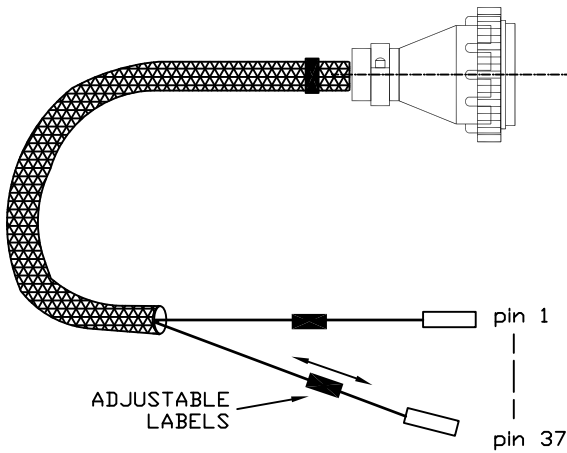
NO SCALE

TEES 2009

A6-26

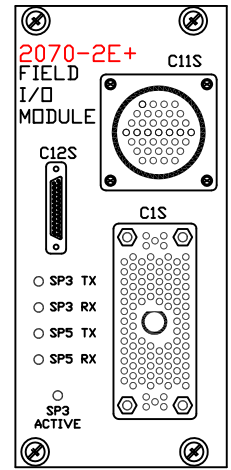
C11P HARNESS

TYCO/AMP - Circular Plastic Connector (CPC)				
Shell Size	No. of Position	Key	Receptacle	Plug
23	37	A	206151-1	206150-1

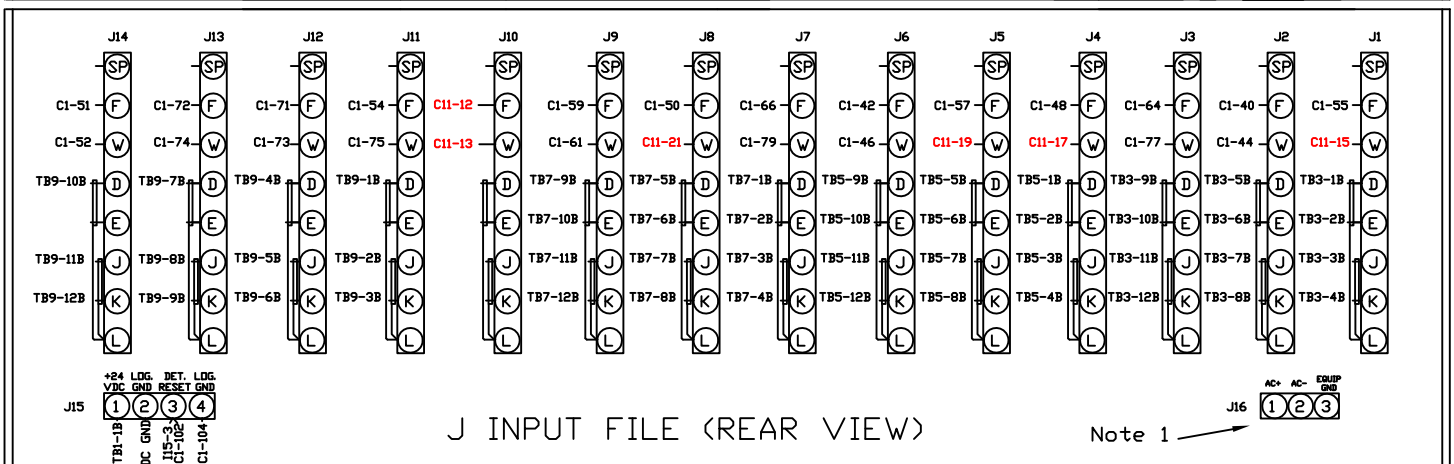
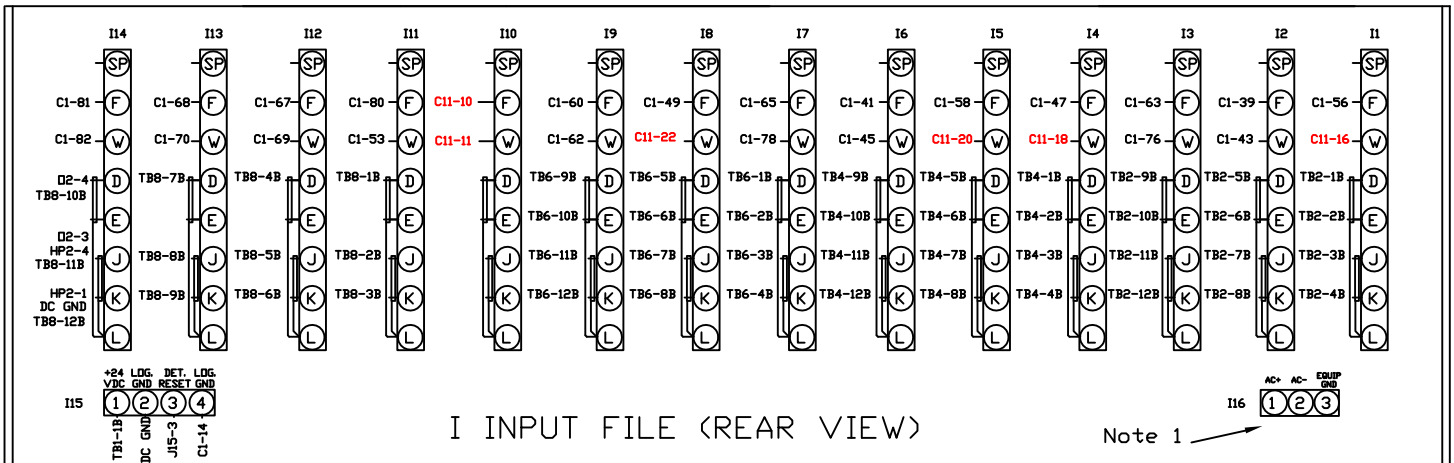


C11	CONN TO	C11	CONN TO	C11	CONN TO	C11	CONN TO
1	NA	11	IFI-10W	21	IFJ-8W	31	DCG#2
2	NA	12	IFJ-10F	22	IFI-8W	32	NA
3	NA	13	IFJ-10W	23	NA	33	NA
4	NA	14	DCG#2	24	NA	34	NA
5	NA	15	IFJ-1W	25	NA	35	NA
6	NA	16	IFI-1W	26	NA	36	NA
7	NA	17	IFJ-4W	27	NA	37	DCG#2
8	NA	18	IFI-4W	28	NA		
9	DCG#2	19	IFJ-5W	29	NA		
10	IFI-10F	20	IFI-5W	30	NA		

IFI-10F = INPUT FILE I, TERMINAL BLOCK 10, TERMINAL DESIGNATION F (CHANNEL 1 OUTPUT)
IFI-10W = INPUT FILE J, TERMINAL BLOCK 10, TERMINAL DESIGNATION W (CHANNEL 2 OUTPUT)



2070-2E+ FI/O MODULE
REAR VIEW



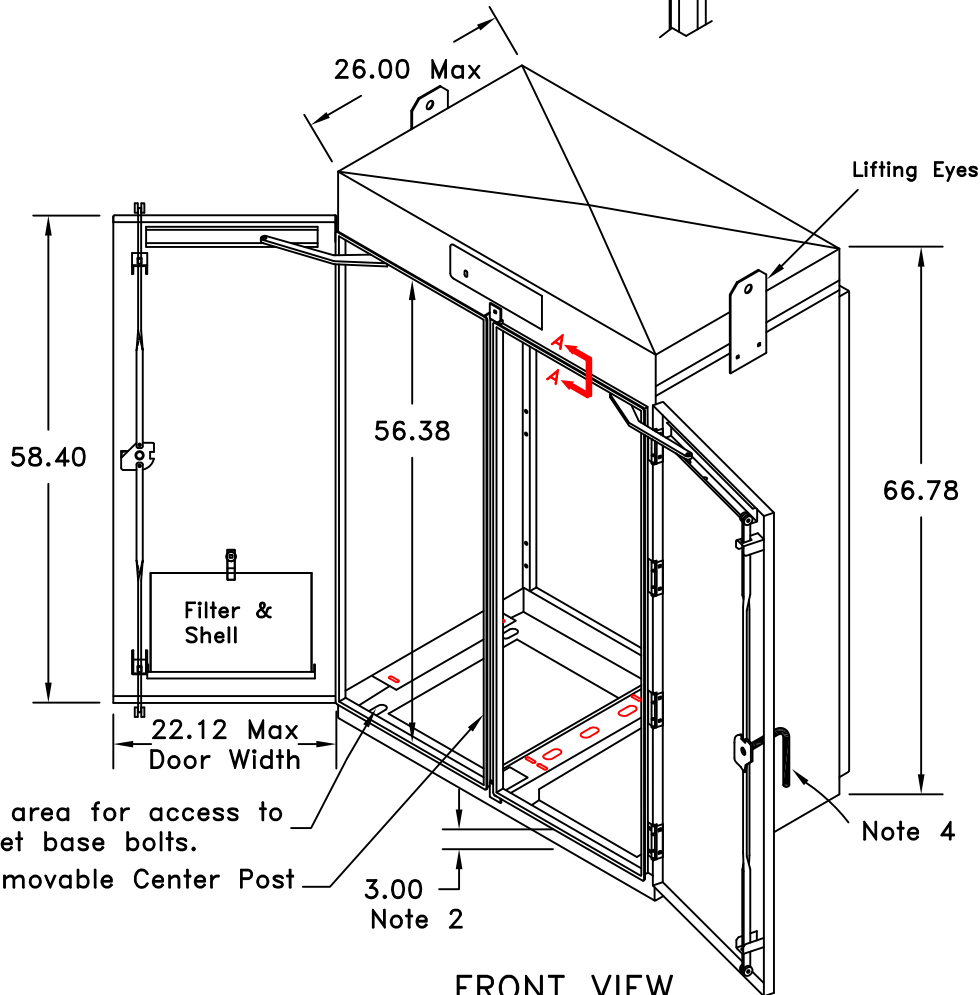
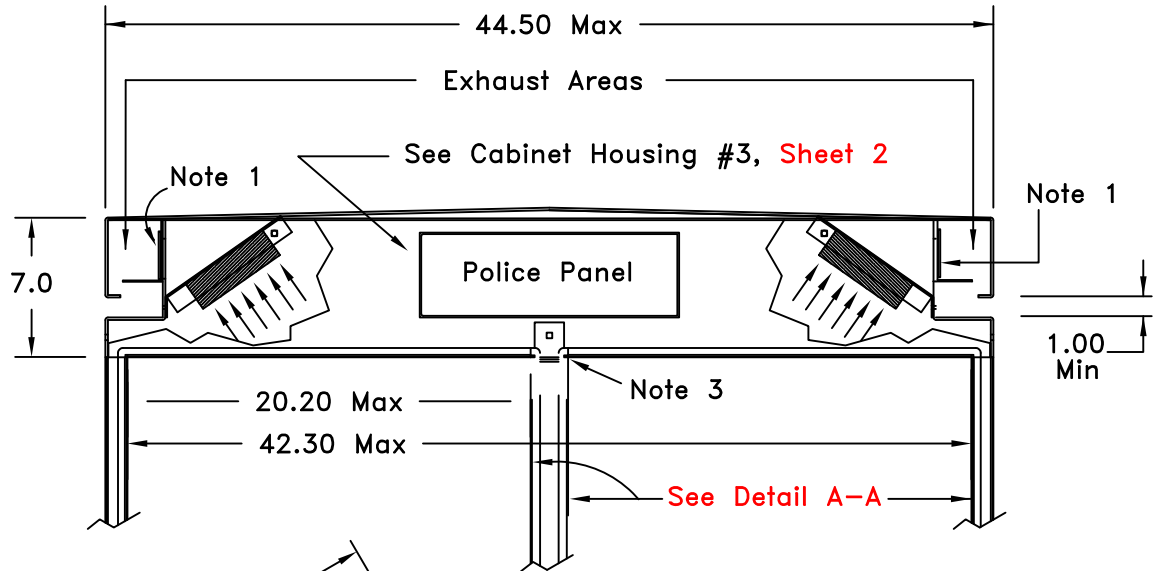
CALTRANS MODEL 33xL, 34xLX CABINETS I & J INPUT FILE

NOTE:

1. No AC power at the Input File for the LX cabinet, see A6-50.
2. For C1S and C11S Pin Assignment, see A9-9.

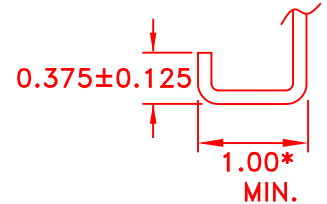
TITLE:	
C11 HARNESS TERMINATION DETAIL	
ERRATA 2	NO SCALE
TEES 2009	A6-31

EXHAUST DETAIL



SECTION A-A DETAIL

Flange Around
Door Opening



* TOLERANCE +0.0625
-0

NOTES:

1. Perforated Screen
2. From Cabinet base to door lip
3. After center post is installed a sealant shall be applied to prevent leakage.
4. The locks & handles shall be centered vertically on the door opposite from the hinges on both, the rear & front.

TITLE:

CABINET HOUSING #3 DETAILS
SHEET 1 OF 7

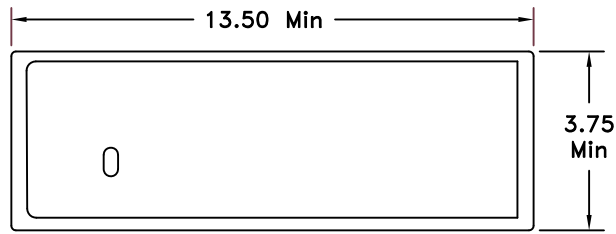
ERRATA 2

NO SCALE

TEES 2009

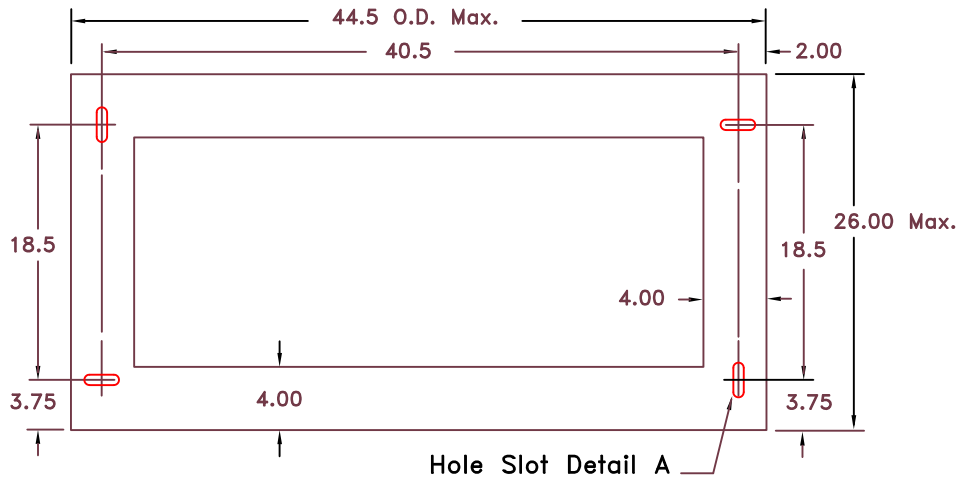
A6-32

CABINET HOUSING #3 & #4 POLICE PANEL DETAIL

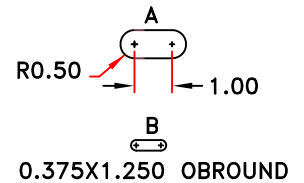


Police Panel Shall Be 3.00" Deep

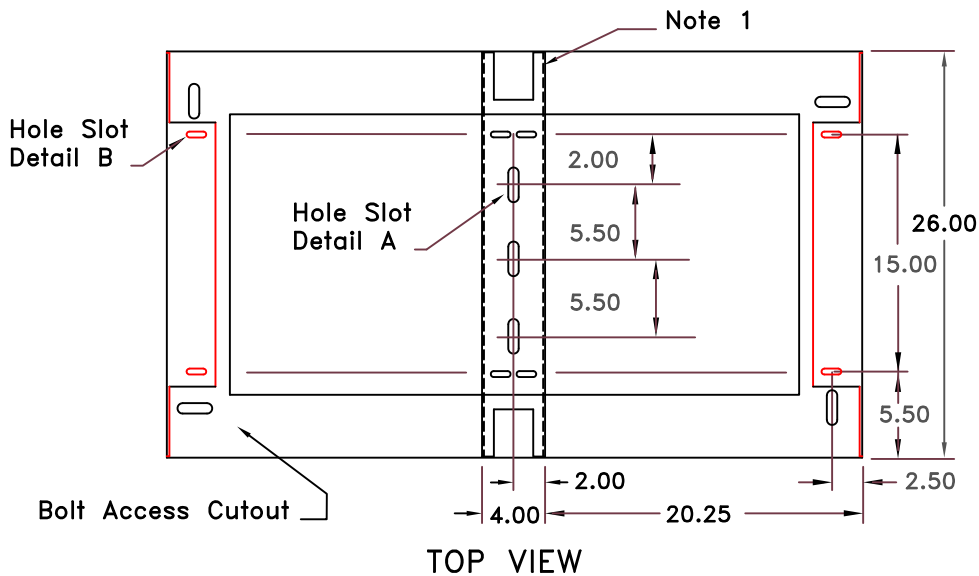
CABINET HOUSING #3 & #4 BOTTOM DETAIL



HOLE SLOT DETAIL



CAGE SUPPORT DETAIL

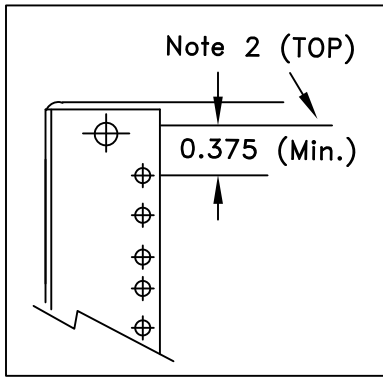


TOP VIEW

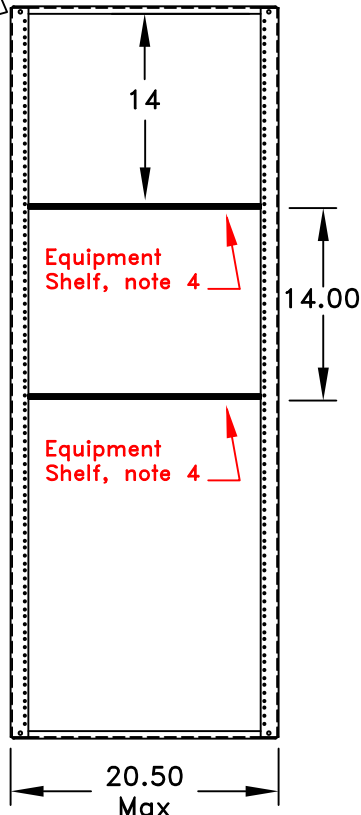
NOTES:

1. Tac Weld Cage Support to bottom assembly front and rear. See Cage Support Assembly Detail.
2. Uses Type LX Foundation.

TITLE: CABINET HOUSING #3 & #4 DETAILS SHEET 2 OF 7	
ERRATA 2	NO SCALE
TEES 2009	A6-33

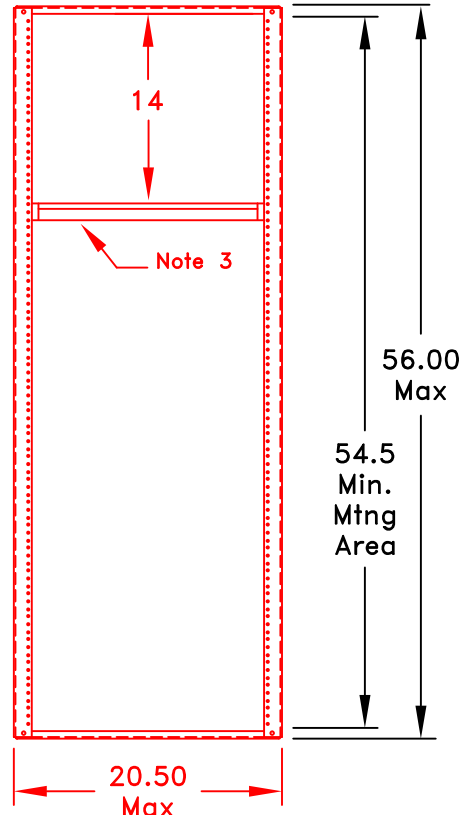


(Front & Rear Typical)
FRONT VIEW



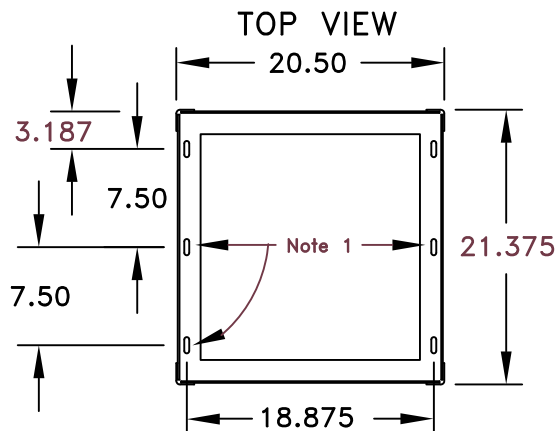
(Rack 2)

(Front & Rear Typical)
FRONT VIEW



(Rack 1)

Note 2 (BOTTOM)



(Rack 1 & 2)

HOLE SLOT DETAIL

B



0.375X1.250 OBOUND

NOTES

1. Hole Slot Detail B, Cage #1 details A6-2.
2. TOP, Refers to the bottom lip of the top hat.
BOTTOM, Refers to the top lip of the bottom hat.
3. Controller unit support drawer shelf assembly, A6-6.
4. Equipment shelf, A6-41.

TITLE:

CABINET HOUSING #3 DETAILS
SHEET 3 OF 7

ERRATA 2

TEES 2009

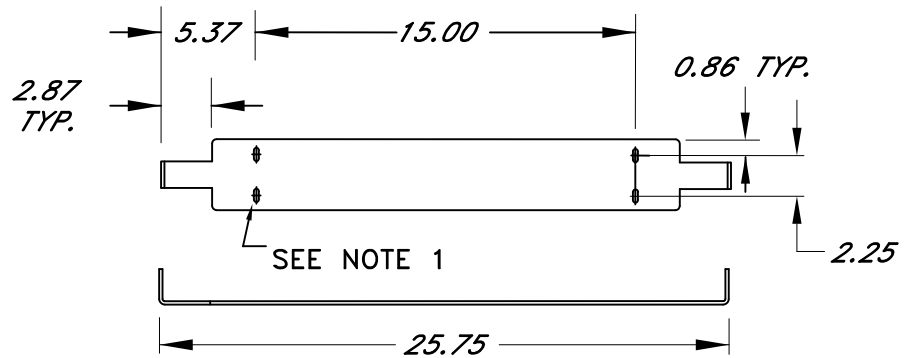
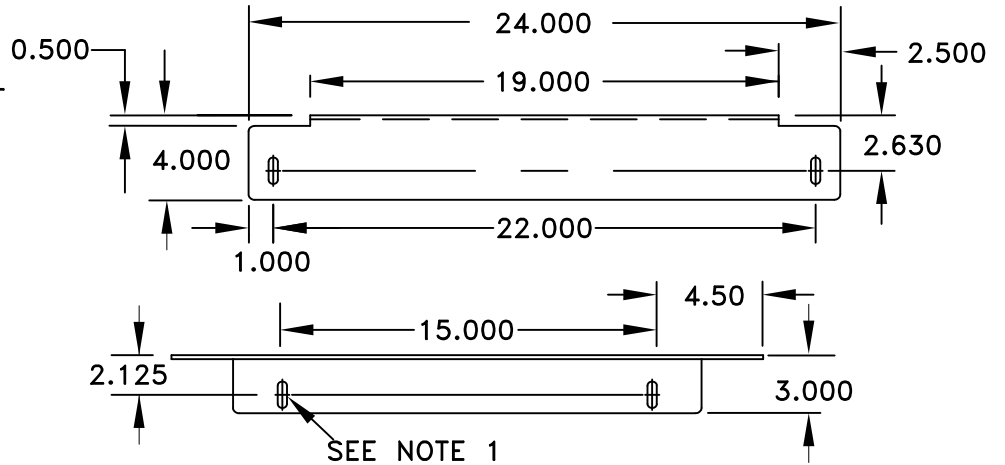
NO SCALE

A6-34

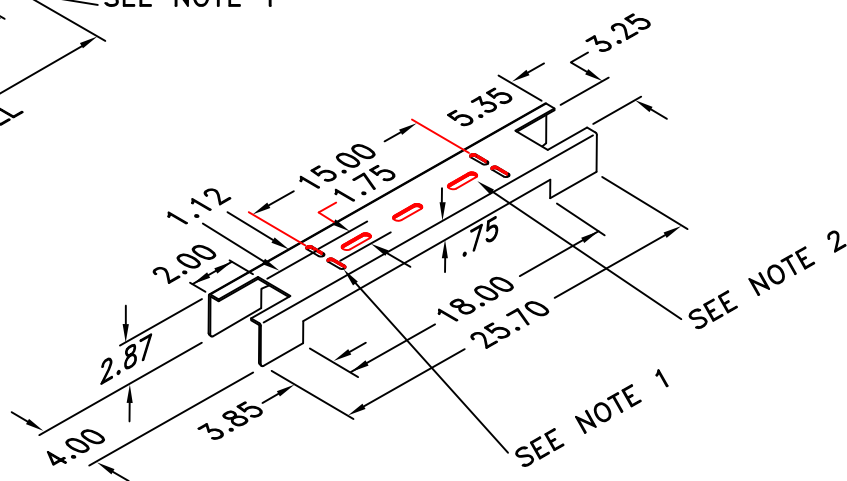
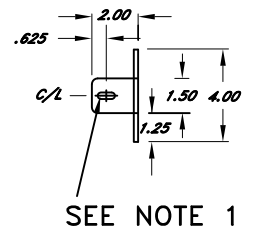
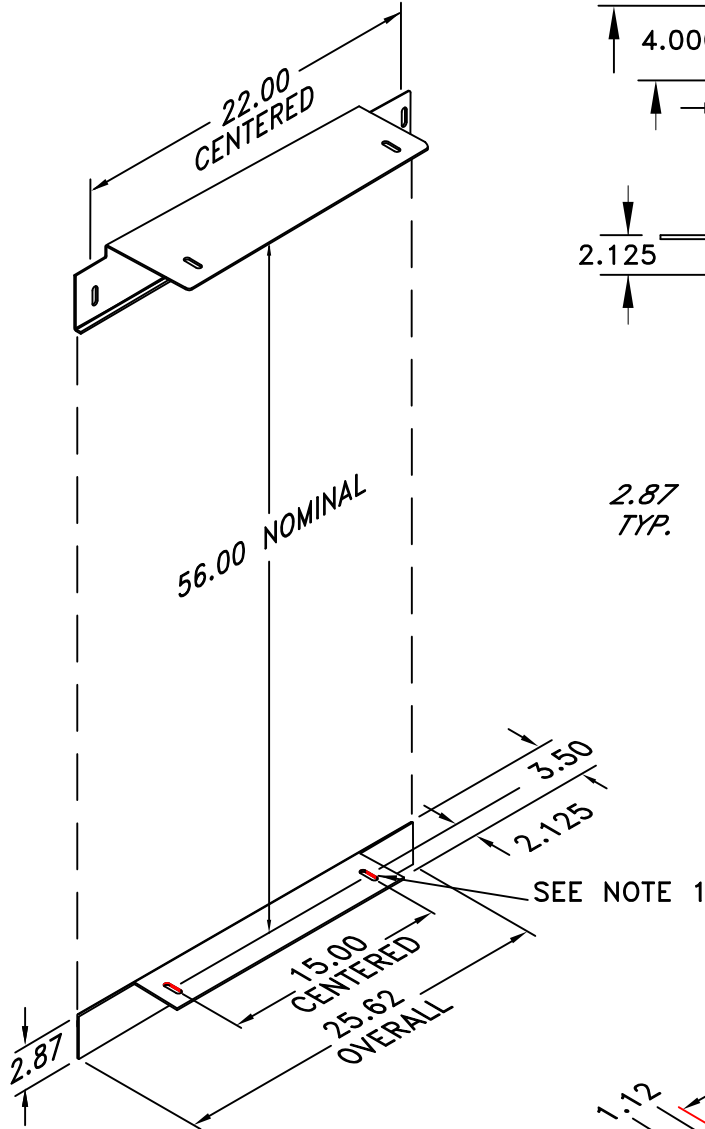
HOUSINGS 3 TO CAGE 1 SUPPORT DETAILS

SPANNER BRACKET BRACKET DETAIL

SPANNER BRACKET
ATTACHED TO SIDE OF CABINET



TOP RACK SUPPORT



NOTES:

1. Hole Slot Detail B see Cabinet Housings 3 Detail 2
2. Hole Slot Detail A see Cabinet Housings 3 Detail 2

3. All dimensions shown are in inches.

CENTER CHANNEL
PART IS WELDED TO BOTTOM PLATE

TITLE:

CABINET HOUSING #3 DETAILS
SHEET 4 OF 7

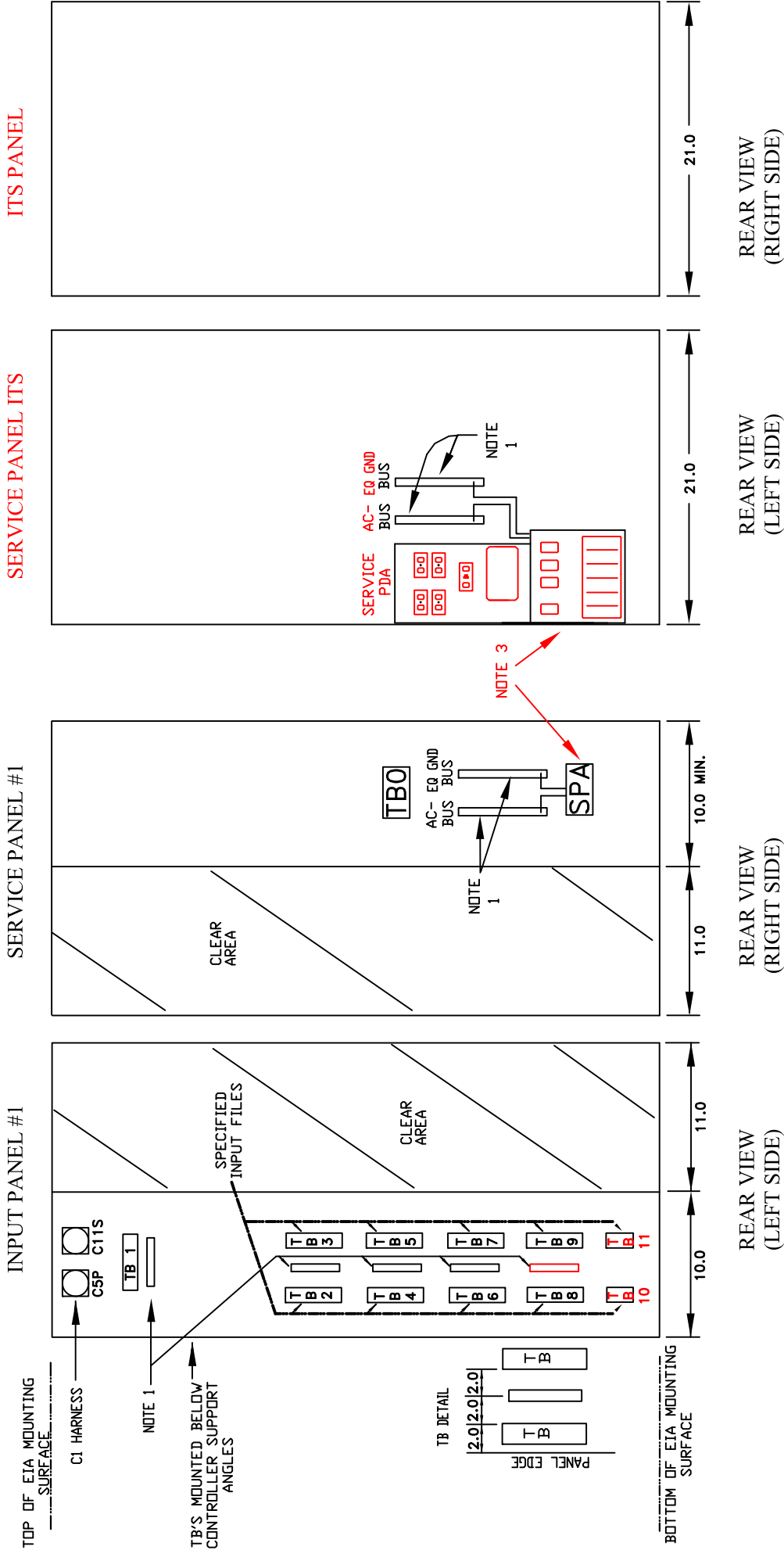
ERRATA 2

TEES 2009

NO SCALE

A6-35

MODEL 342LX SIDE PANEL



- NOTES:
1. 10 terminal (#8 wire) minimum copper bus.
 2. The terminal block shall have terminal positions necessary to match position assignments.
 3. SPA and the Service PDA shall be bolted on the Rail and firmly attached to the Service Panel.
 4. All dimensions shown are in inches.

TITLE: MODEL 342LX SIDE PANEL DETAIL

ERRATA 2

NO SCALE

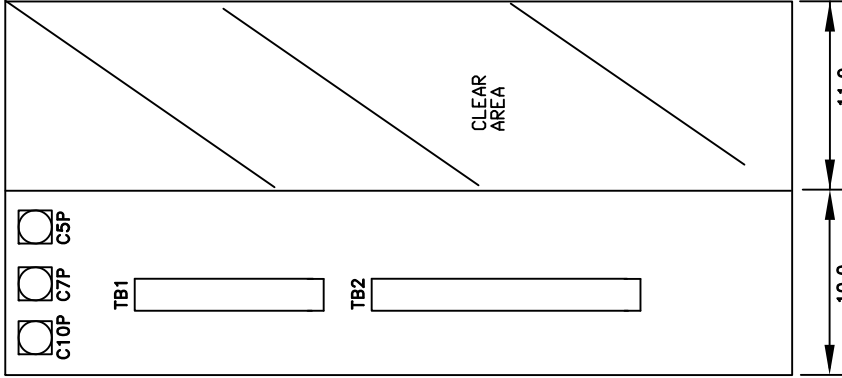
TEES 2009

A6-36

MODEL 344LX SIDE PANEL

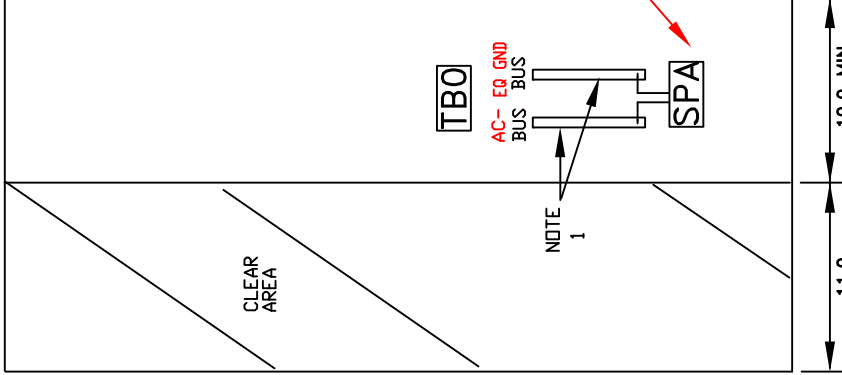
TOP OF EIA MOUNTING
SURFACE

INPUT PANEL #3



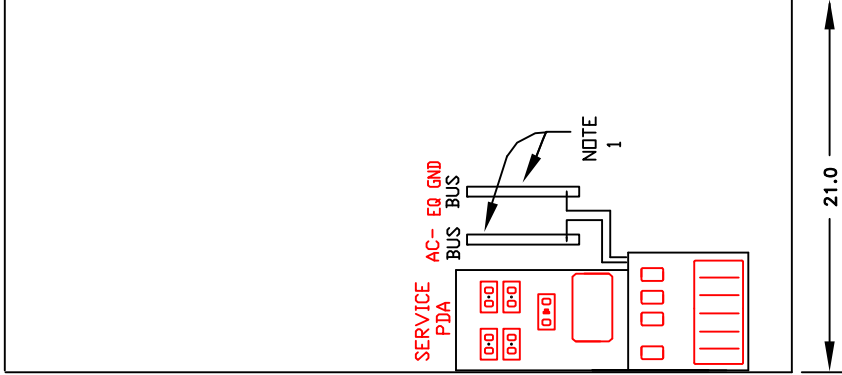
REAR VIEW
(LEFT SIDE)

SERVICE PANEL #1



REAR VIEW
(RIGHT SIDE)

SERVICE PANEL ITS



REAR VIEW
(LEFT SIDE)

ITS PANEL



REAR VIEW
(RIGHT SIDE)

NOTES:

1. 10 terminal (#8 wire) minimum copper bus.
2. The terminal block shall have terminal positions necessary to match position assignments. Terminal position screws shall be 8-32 except for TBS, TBO, TB3, which shall be 10-32
3. SPA and the Service PDA shall be bolted on the Rail and firmly attached to the Service Panel.
4. All dimensions shown are in inches.

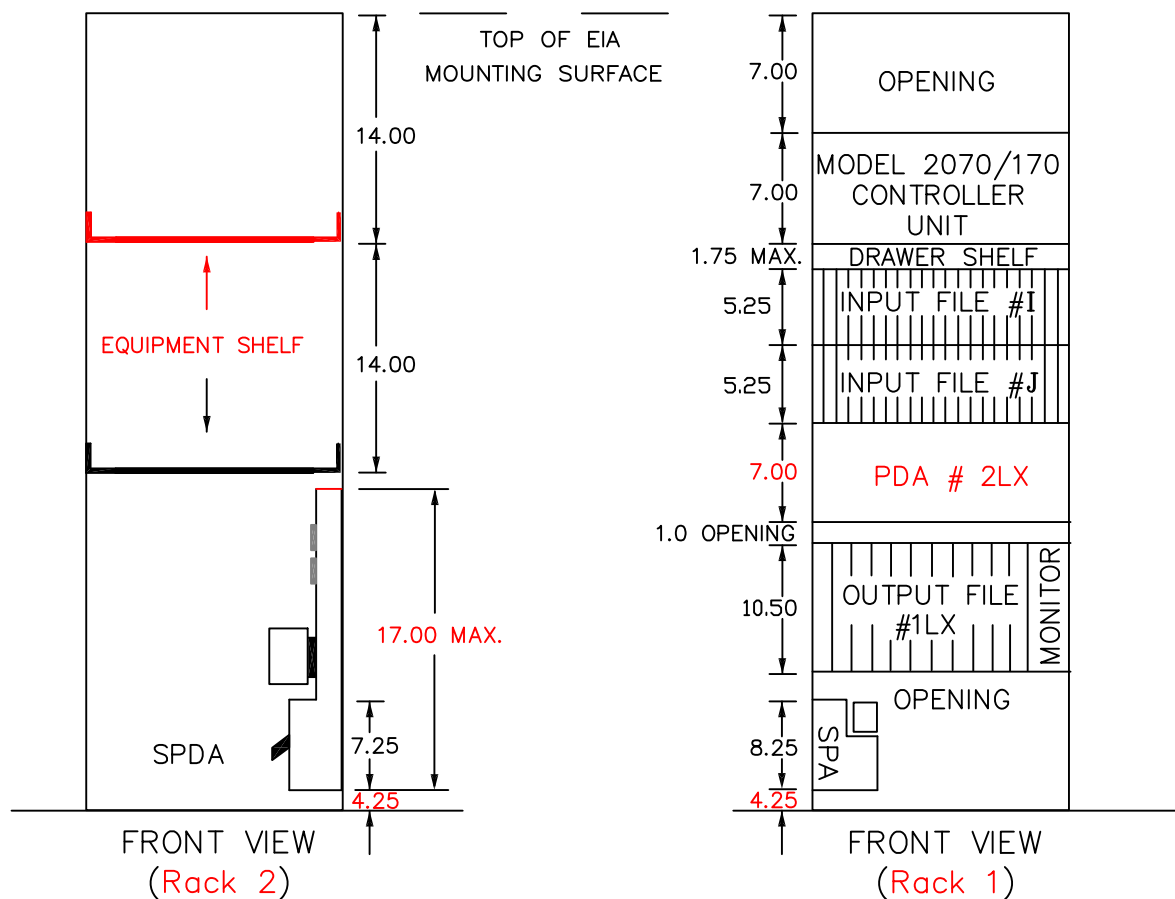
TITLE: MODEL 344LX SIDE PANEL DETAIL

ERRATA 2 NO SCALE

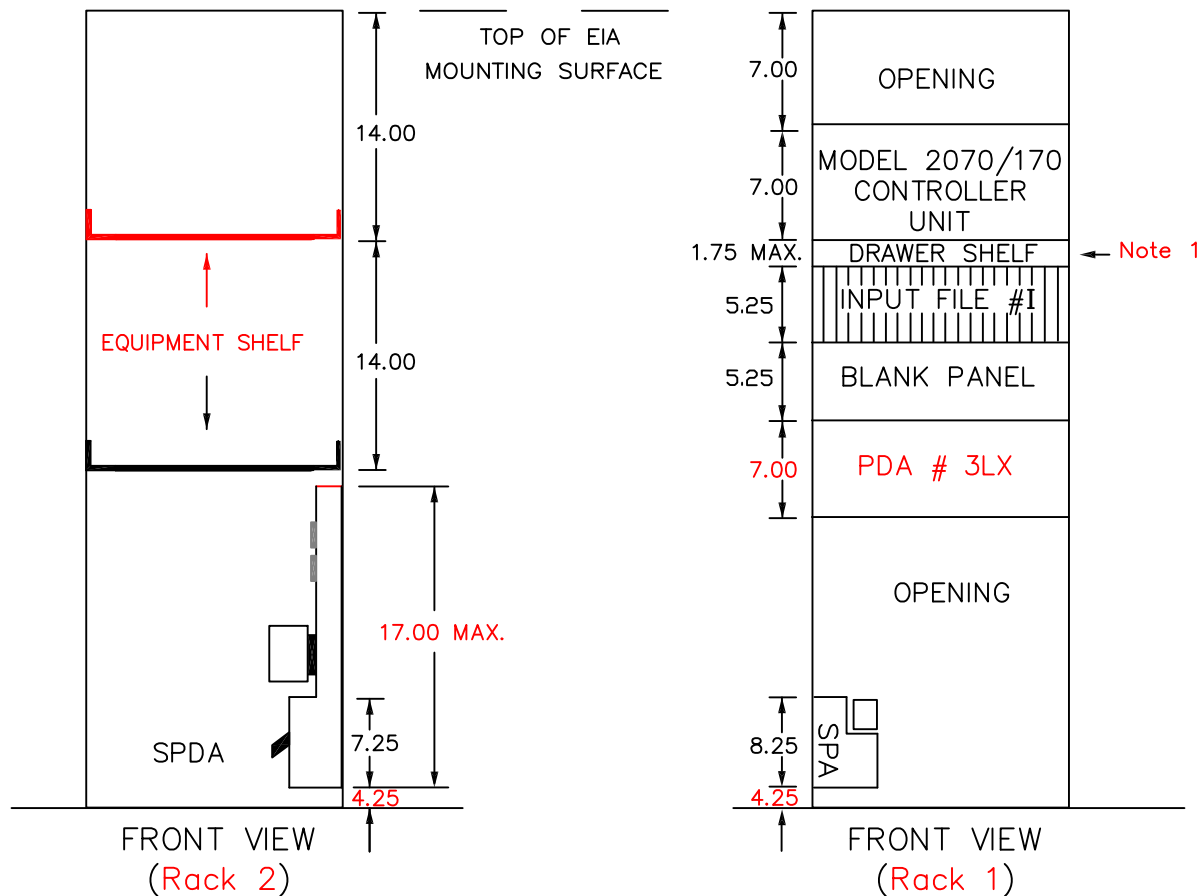
TEES 2009

A6-37

MODEL 342LX



MODEL 344LX



TITLE:

CABINET EQUIPMENT MOUNTING DETAILS
SHEET 2 OF 3

ERRATA 2

NO SCALE

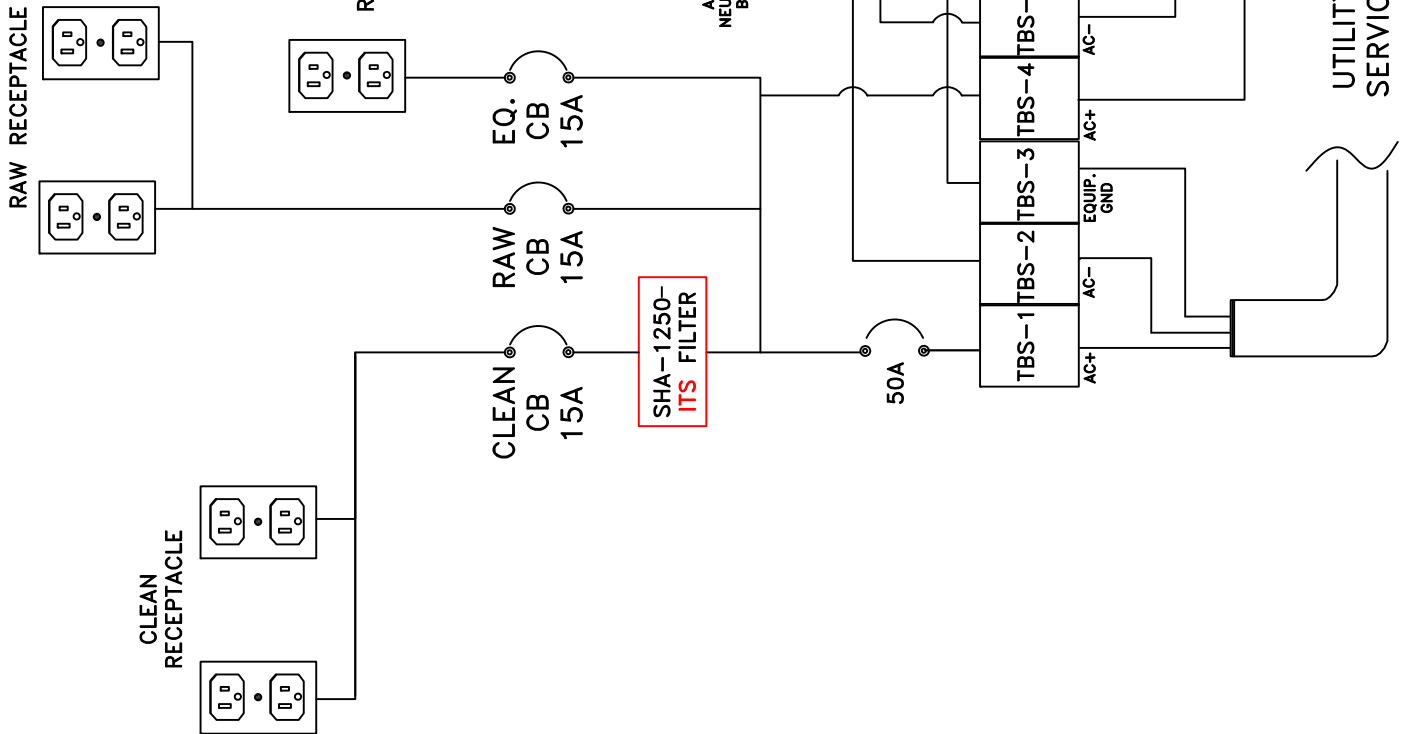
TEES 2009

A6-38

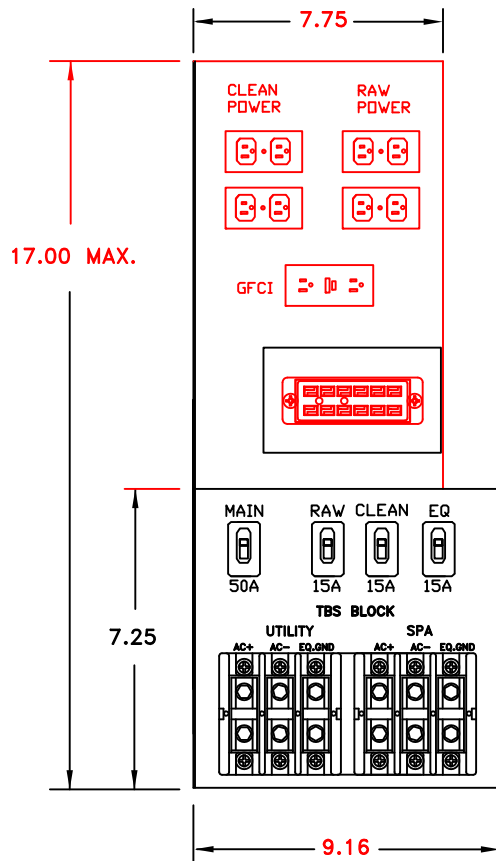
NOTE:

1. Controller unit support drawer shelf assembly.
2. All dimensions shown are in inches.

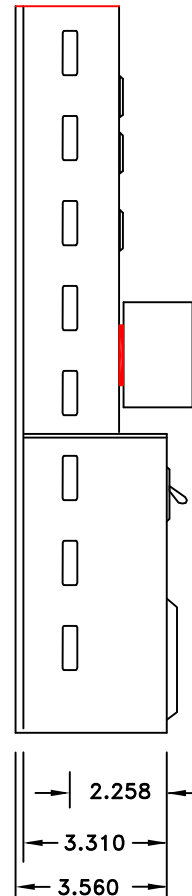
MODEL 342LX, 344LX & 346LX



TITLE:	
SERVICE PDA DETAILS SHEET 1 OF 2	
ERRATA 2	NO SCALE
TEES 2009	A6-39



REAR VIEW
(LEFT SIDE)



REAR VIEW

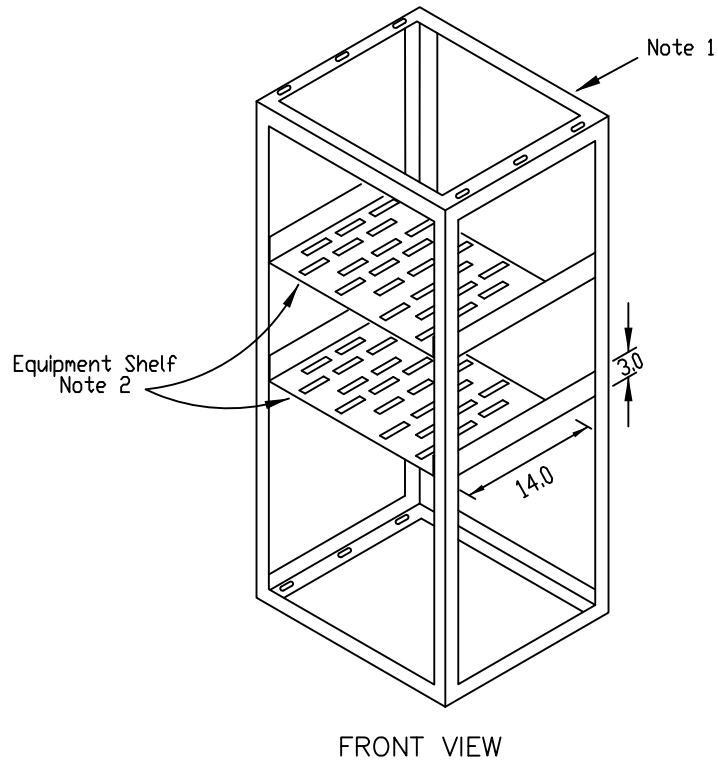
MODEL 342LX, 344LX & 346LX

NOTES:

1. The Service PDA shall be mounted at least 4.25in above the bottom of the LX cabinet.
2. All dimensions shown are in inches.

TITLE:	
SERVICE PDA DETAILS SHEET 2 OF 2	
ERRATA 2	NO SCALE
TEES 2009	A6-40

Rack #1 EQUIPMENT SHELF INSTALLATION DETAILS
(FOR CABINET HOUSING #3)

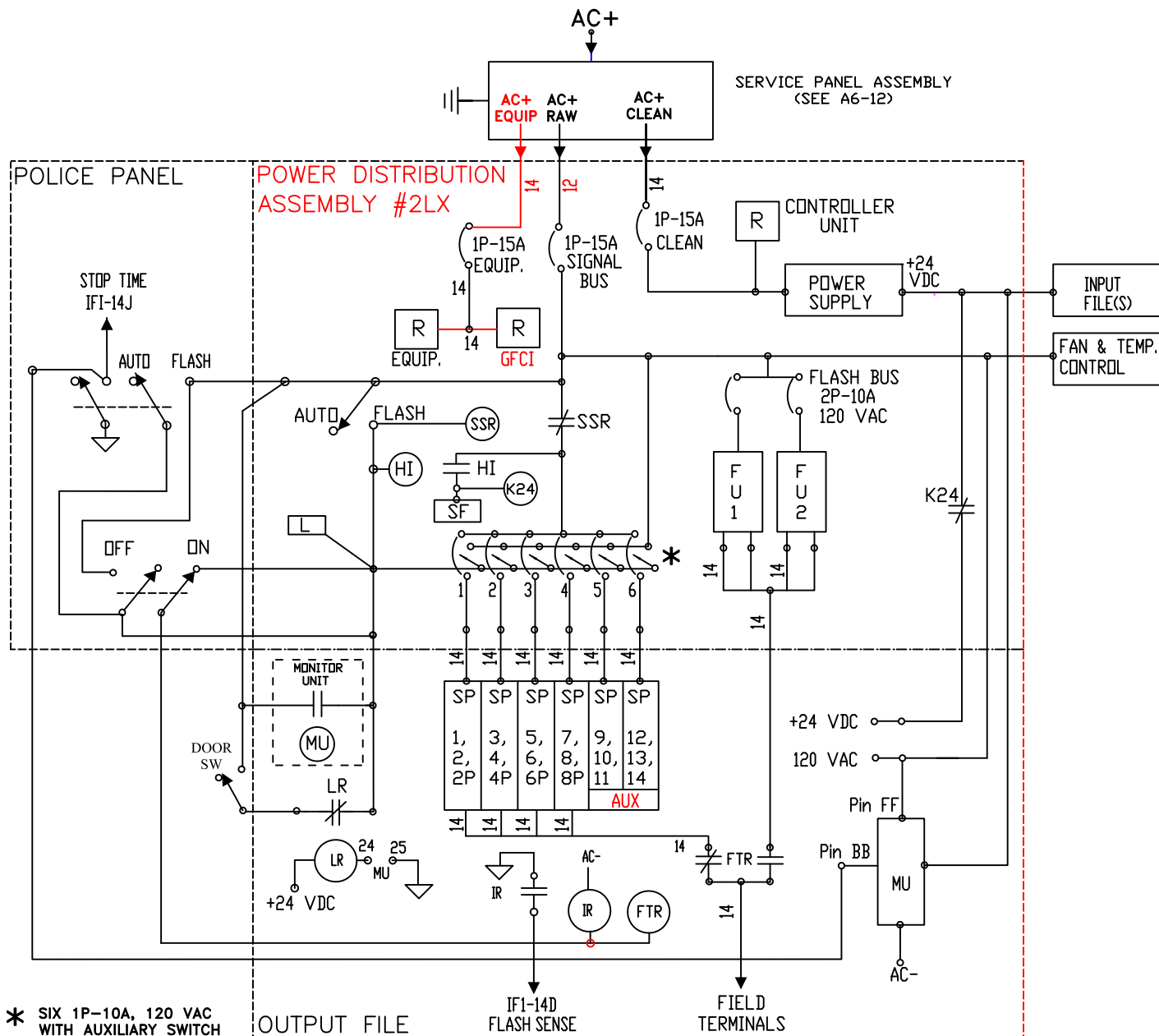


NOTE:

1. Cabinet Housing #3 details, A6-32 & A6-34.
2. Equipment Shelf with Air Vents
3. All dimensions shown are in inches

TITLE: RACK #1 DRAWER AND SHELF INSTALLATION DETAILS	
ERRATA 2	NO SCALE
TEES 2009	A6-41

342LX & 346LX CABINET ONE LINE DIAGRAM



SHEET DEFINITIONS

TBS	TERMINAL BLOCK - SERVICE	(*)	RELAY COIL - * RELAY NAME	TR	TRANSFER RELAY
	EQUIPMENT GROUND		FLASHER UNIT ONE	IR	ISOLATION RELAY
8	WIRE SIZE, IF NOT INDICATED SHALL BE #16 AWG OR LARGER		DC GROUND		SWITCH CONTACT
	CIRCUIT BREAKER	WDT	WATCHDOG TIMER	LR	LOGIC RELAY
	DUPLEX RECEPTACLE	FTR	FLASH TRANSFER RELAY	CB-1	SIGNAL CIRCUIT BREAKER 1 (SECONDARY)
GFCI	GROUND FAULT CIRCUIT INTERRUPTER		PDA FLASH ON DISPLAY LAMP	IFI-14J	INPUT FILE 1, TERMINAL BLOCK 14, POSITION J (CHANNEL 2 INPUT)
	RELAY CONTACT, NORMALLY CLOSED	SPA	SERVICE PANEL ASSEMBLY	IFI-14D	INPUT FILE 1, TERMINAL BLOCK 14, POSITION D
	RELAY CONTACT, NORMALLY OPEN	MU	MONITOR UNIT	C1-65	C1 CONNECTOR, PIN 65
SSR	SOLID STATE RELAY		SSR Fault Indicator		Health Indicator Relay
PDA	POWER DISTRIBUTION ASSEMBLY	T2-6	TERMINAL BLOCK 2, POSITION 6		Disconnect 24VDC Relay
AUX	AUXILIARY				
SP	SWITCH PACK				

TITLE: MODEL 342LX AND 346LX ONE LINE DIAGRAM

ERRATA 2

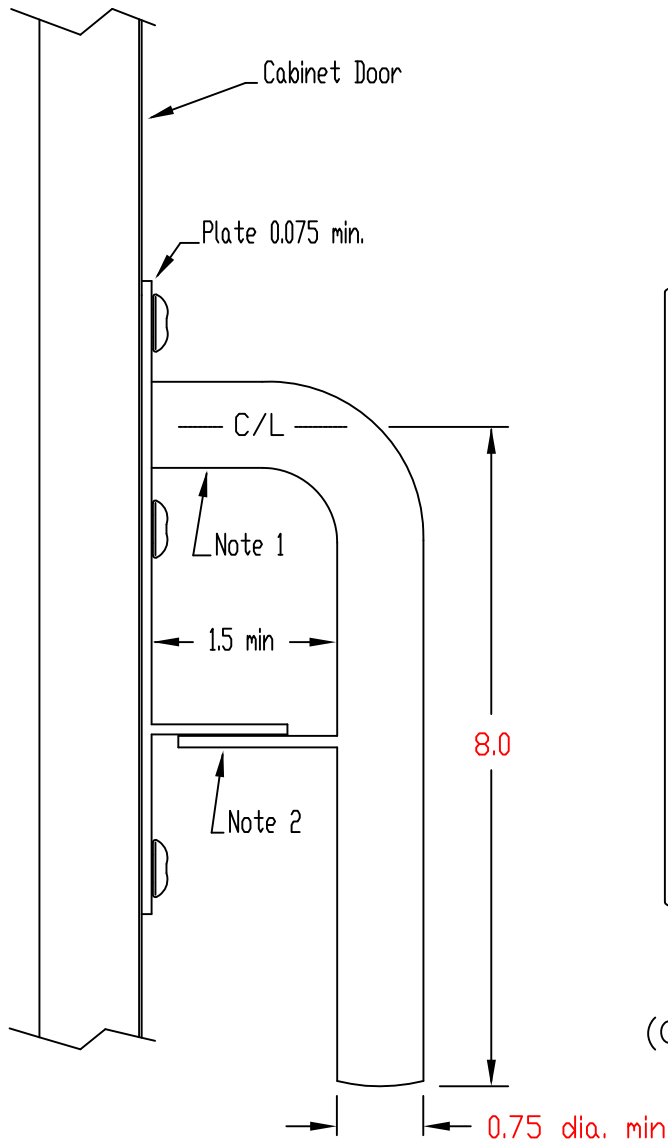
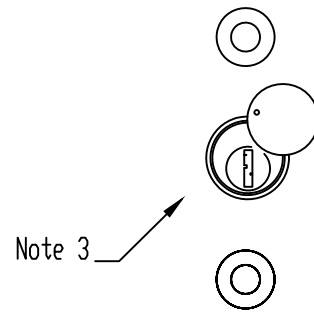
NO SCALE

TEES 2009

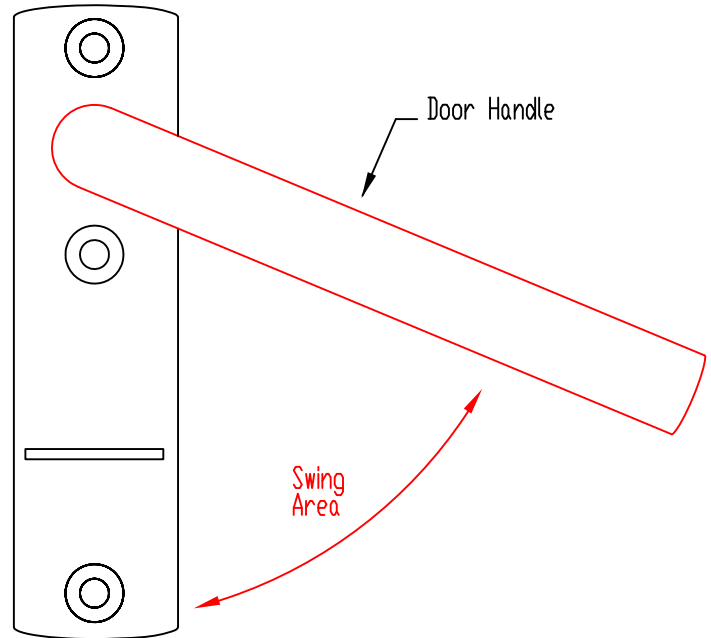
A6-42

HOUSING 1B, 2, 3 & 4 HANDLE DETAILS

LOCK DETAILS



SIDE VIEW
(Locked position)



FRONT VIEW
(Open position)

NOTES:

1. Handle shank, 0.5 inch minimum
2. Provision for padlock, horizontal or verticle position.
3. Door lock, Corbin 2 Type or equal.
4. All dimensions shown are in inches.

TITLE:

**CABINET DOOR HANDLE DETAILS
SHEET 1 OF 1**

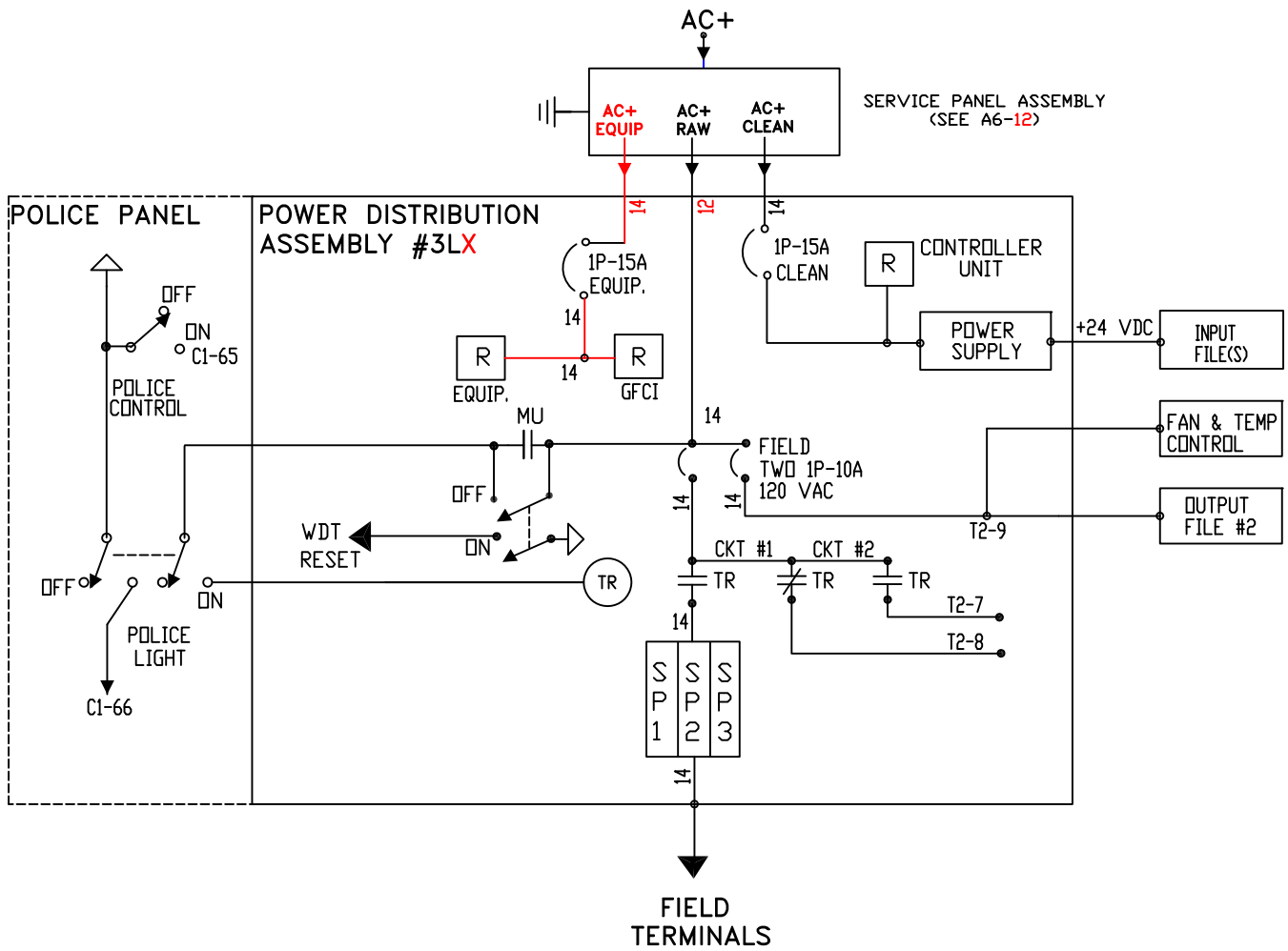
ERRATA 2

No Scale

TEES 2009

A6-43

344LX CABINET ONE LINE DIAGRAM



SHEET DEFINITIONS

TBS	TERMINAL BLOCK - SERVICE	WDT	WATCHDOG TIMER
	EQUIPMENT GROUND	MU	MONITOR UNIT
	WIRE SIZE, IF NOT INDICATED SHALL BE #16 AWG OR LARGER	CB-1	SIGNAL CIRCUIT BREAKER 1 (SECONDARY)
	CIRCUIT BREAKER	TR	TRANSFER RELAY
	DUPLEX RECEPTACLE	T2-6	TERMINAL BLOCK 2, POSITION 6
GFCI	GROUND FAULT CIRCUIT INTERRUPTER	C1-65	C1 CONNECTOR, PIN 65
	RELAY CONTACT, NORMALLY CLOSED	SPA	SERVICE PANEL ASSEMBLY
	RELAY CONTACT, NORMALLY OPEN	SP	SWITCH PACK
IFI-14J	INPUT FILE 1, TERM. BLOCK 14, POSITION J (CHANNEL 2 INPUT)		DC GROUND
	FLASHER UNIT ONE		SWITCH CONTACT
PDA	POWER DISTRIBUTION ASSEMBLY		

TITLE:

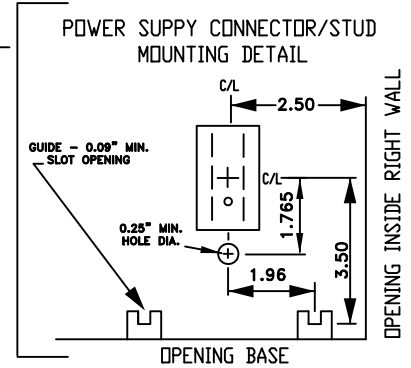
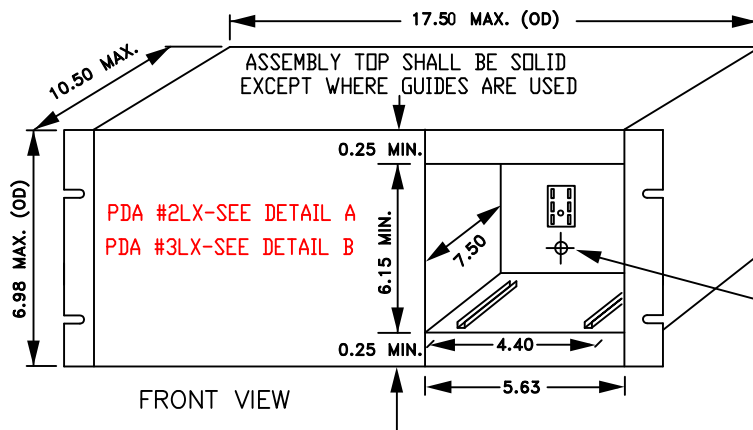
MODEL 344LX ONE LINE DIAGRAM

ERRATA 2

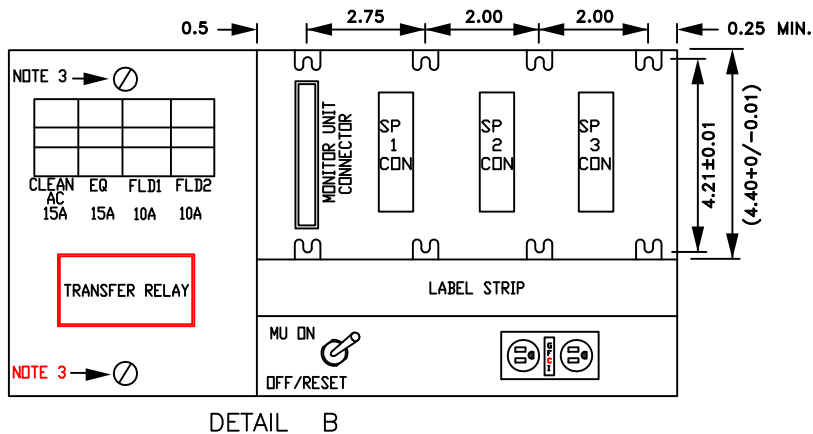
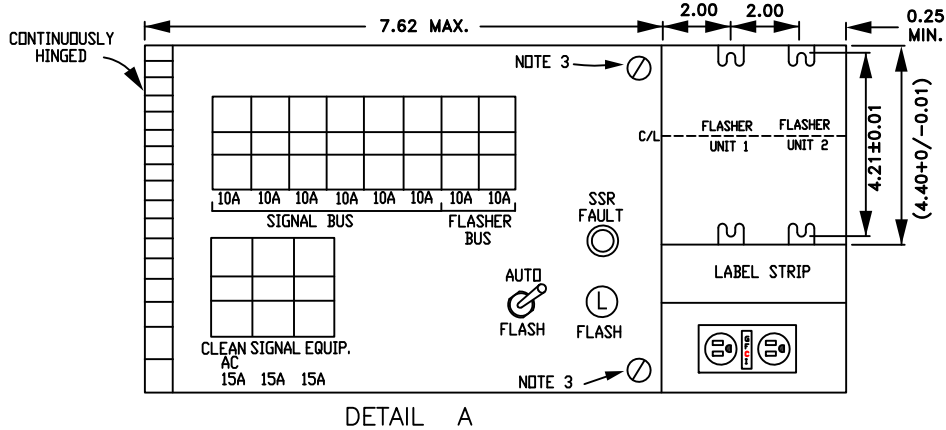
NO SCALE

TEES 2009

A6-44



FRONT VIEW



NOTE:

See A6-14 and A6-15 for sheets 3 & 4.

TITLE:

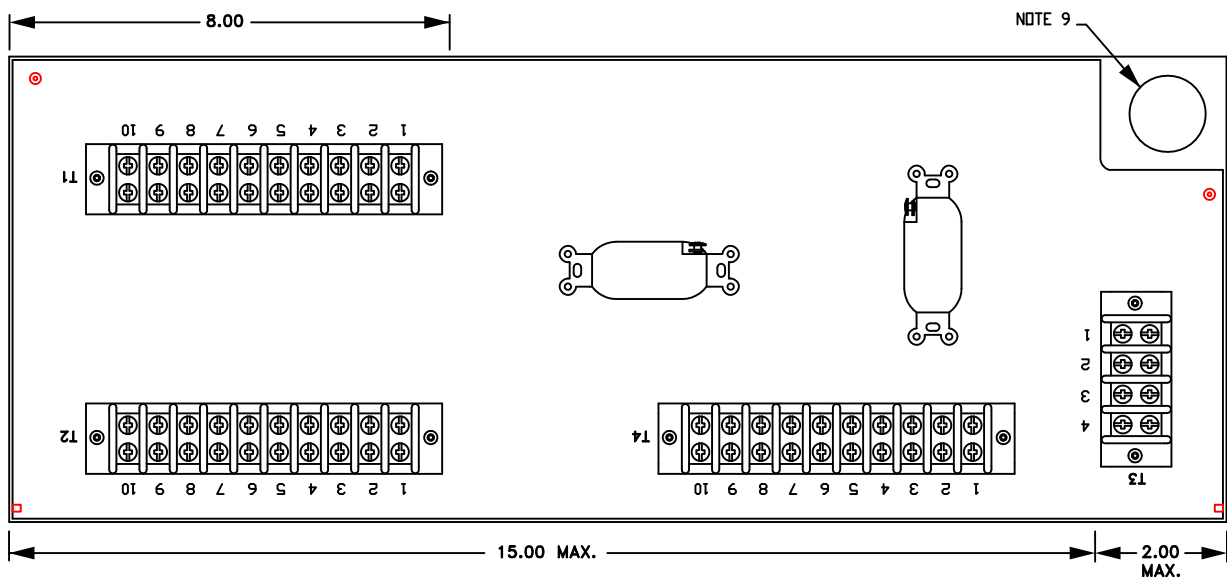
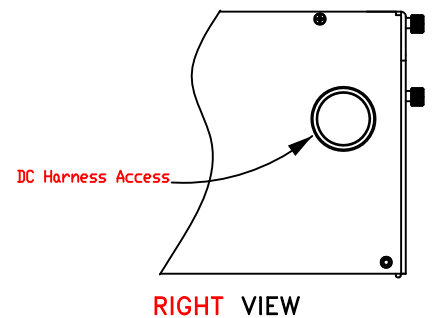
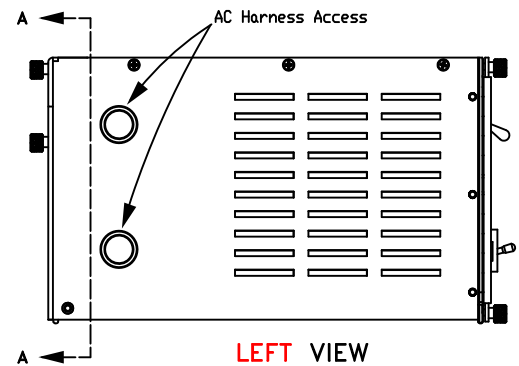
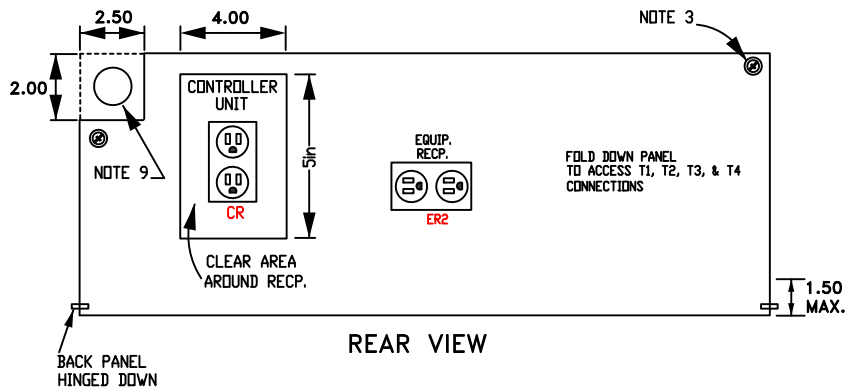
PDA #2LX & #3LX DETAILS
SHEET 4 OF 8

ERRATA 2

NO SCALE

TEES 2009

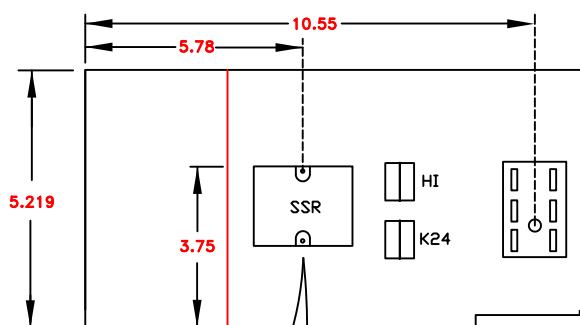
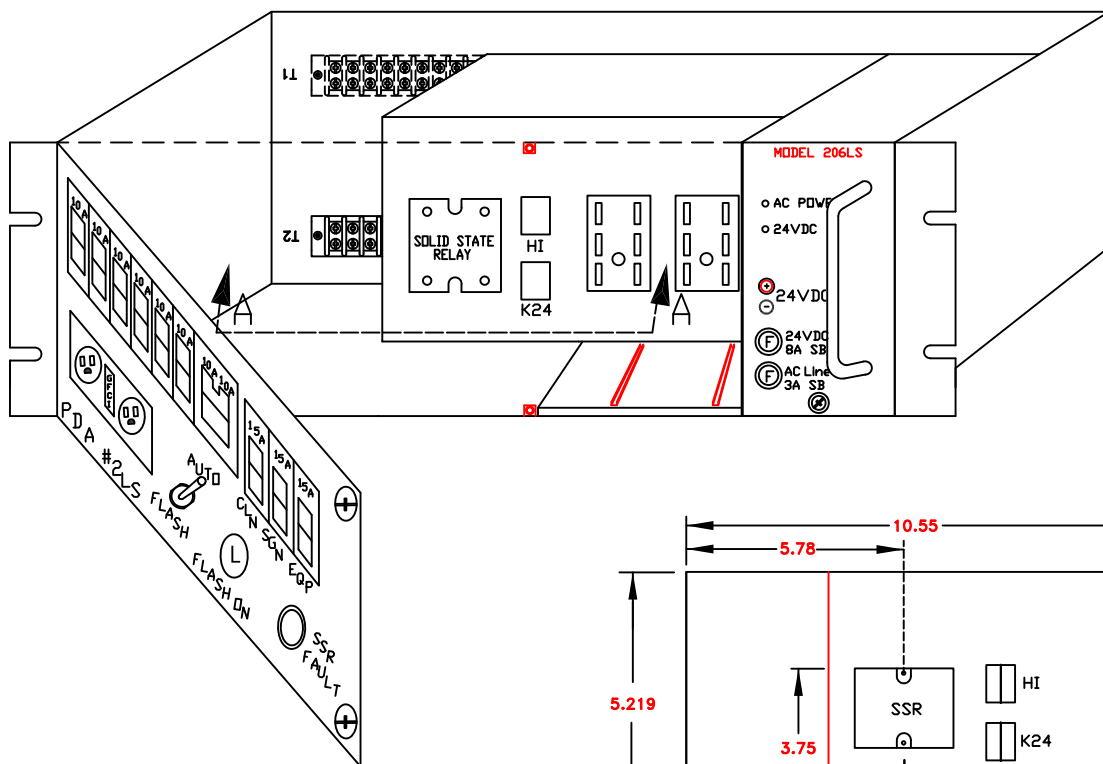
A6-45



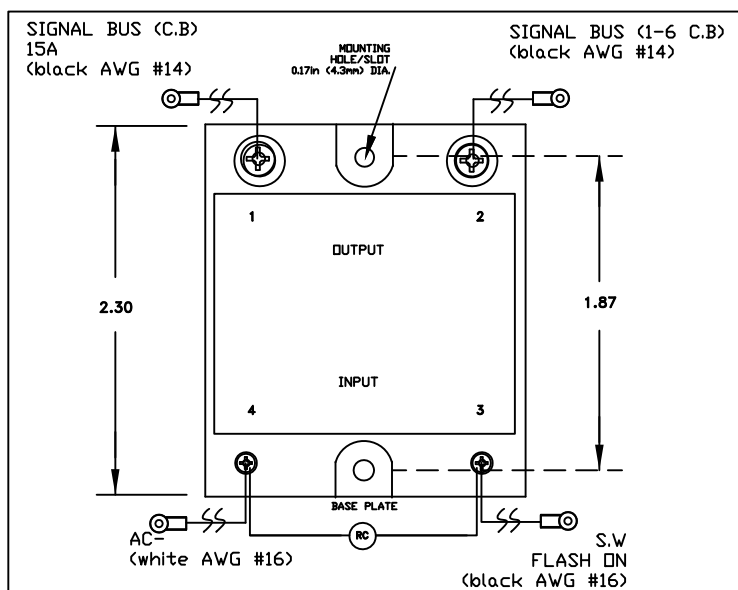
NOTE:

See A6-14 and A6-15 for sheets 3 & 4.

TITLE:	
PDA #2LX & 3LX DETAILS SHEET 5 OF 8	
ERRATA 2	NO SCALE
TEES 2009	A6-46



Section A-A



NOTE:

1. PDA top and bottom vented.
2. All dimensions shown are in inches.

TITLE:

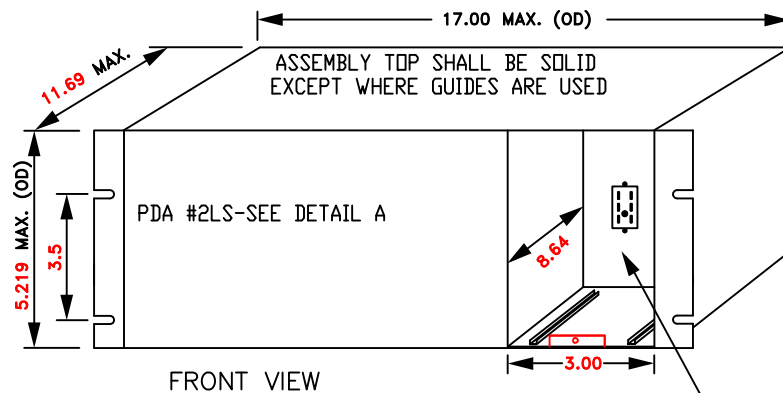
**PDA #2LS
SSR INSTALLATION DETAILS
SHEET 6 OF 8**

ERRATA 2

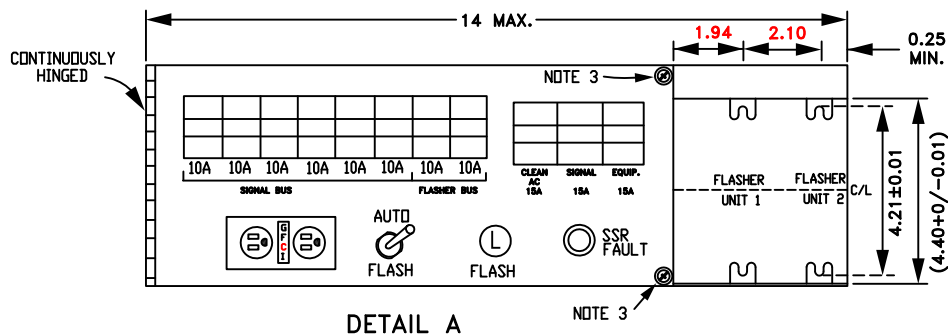
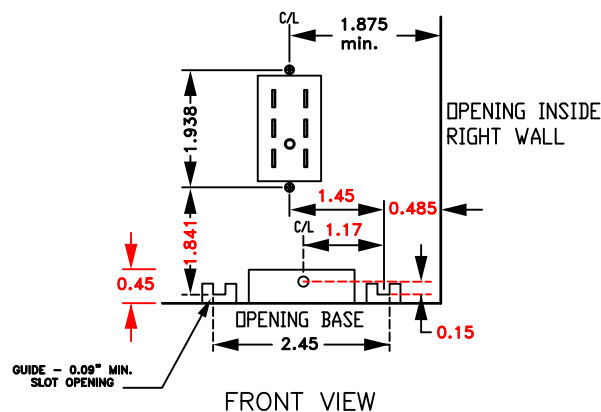
NO SCALE

TEES 2009

A6-47



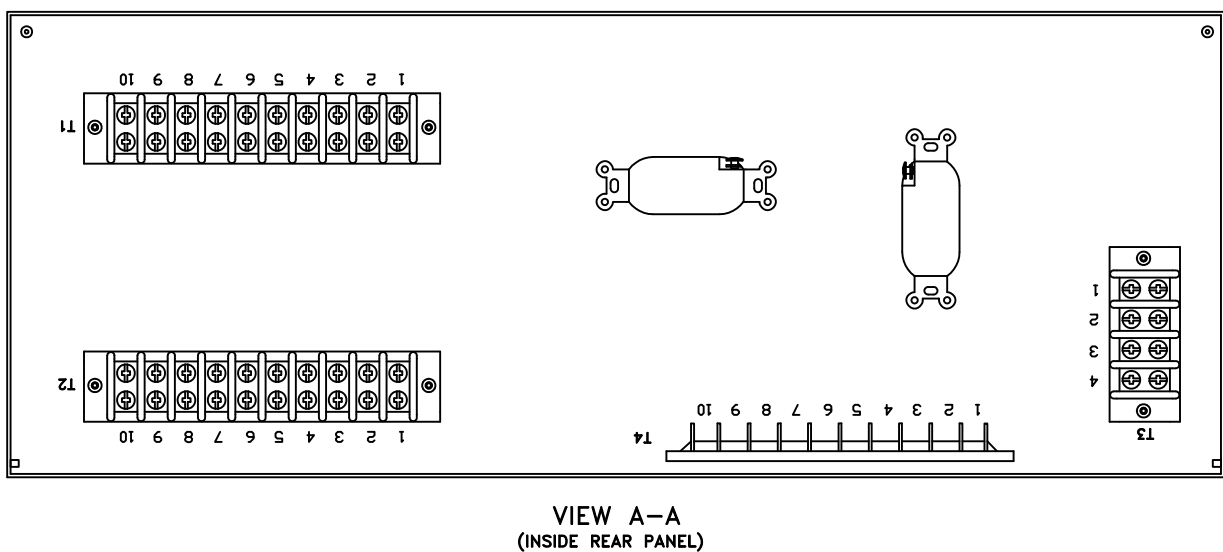
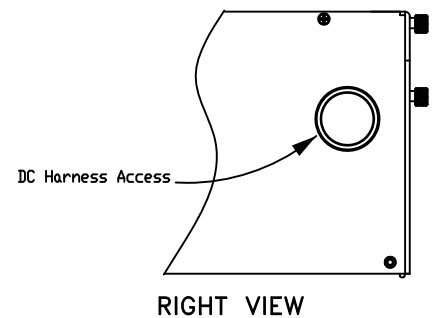
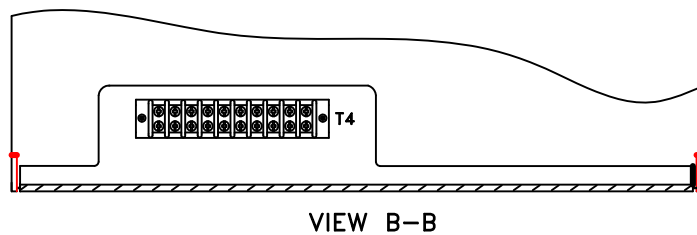
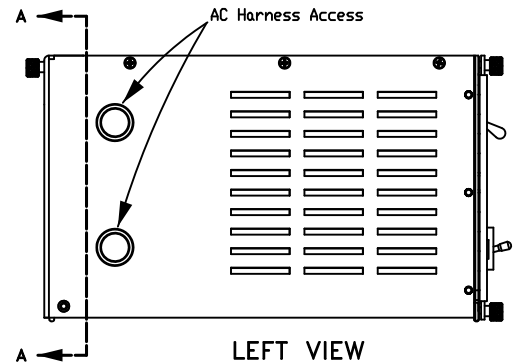
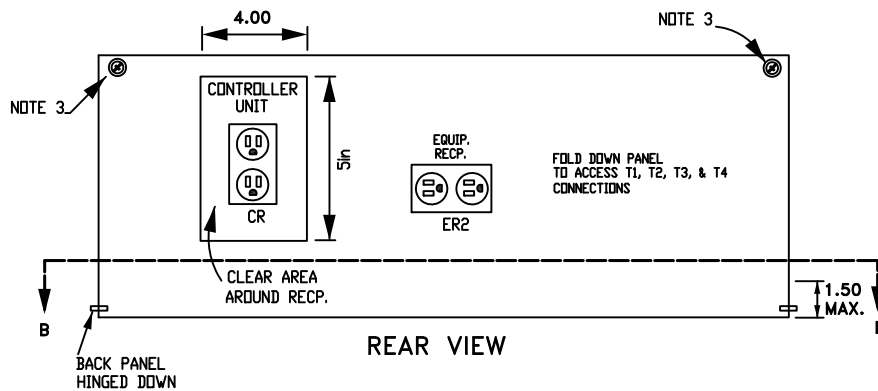
POWER SUPPLY CONNECTOR/STUD MOUNTING DETAIL



NOTE:

1. See A6-14 and A6-15 for sheets 4 & 5.
2. All dimensions shown are in inches.

TITLE:	
PDA #2LS DETAILS SHEET 7 OF 8	
ERRATA 2	NO SCALE
TEES 2009	A6-48



NOTE:

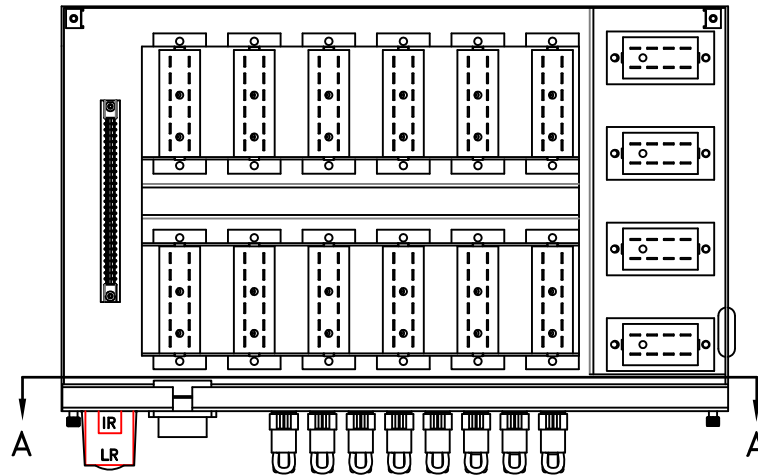
See A6-14 and A6-15 for sheets 4 & 5.

TITLE:	
PDA #2LS DETAILS SHEET 8 OF 8	
ERRATA 2	NO SCALE
TEES 2009	A6-49

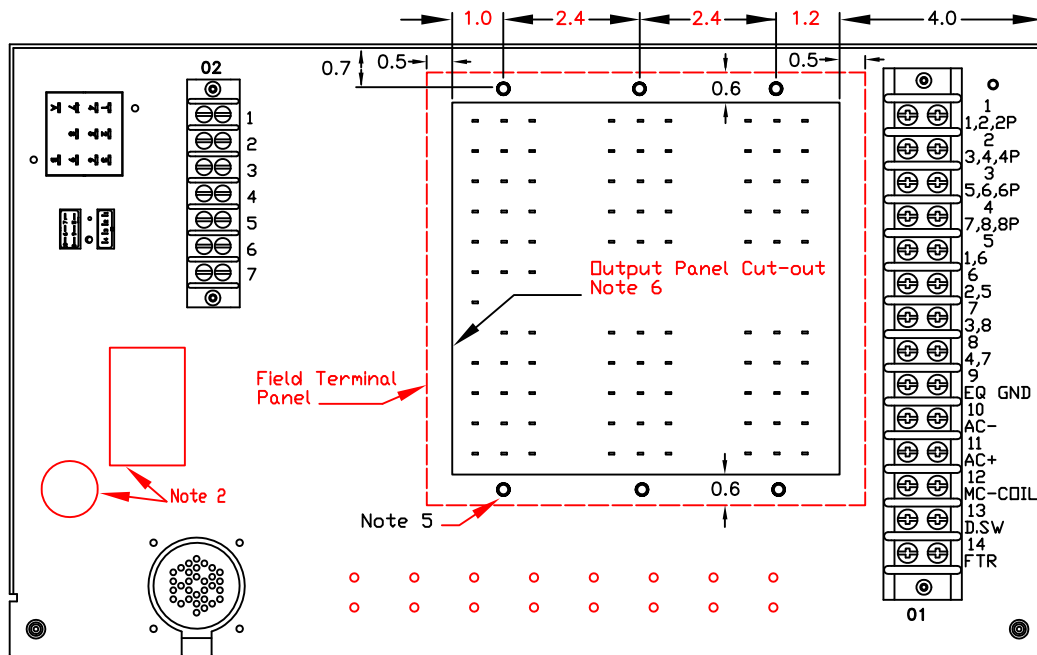


TITLE:	
INPUT/OUTPUT FILE #1LX DETAILS SHEET 7 OF 9	
ERRATA 2	NO SCALE
TEES 2009	A6-51

OUTPUT FILE #1LX DETAIL



REAR VIEW
(BACK PANEL - OPEN)



NOTE:

VIEW A-A

1. Thumb screws device
2. Panel stamped for OL Monitor Input Cable and Red Monitor Program Board, but board not installed.
3. For Terminal Assignment, see Output File #1 detail.
4. See A6-18, A6-19 & A6-20 for sheets 5, 6 & 7.
5. Holes 0.2 Dia. for Field Terminal Panel & Output Panels.
6. Cut-out Height = 7 - 7.3, Width = 7
7. All dimensions shown are in inches

TITLE:

INPUT/OUTPUT FILE #1LX DETAILS
SHEET 8 OF 9

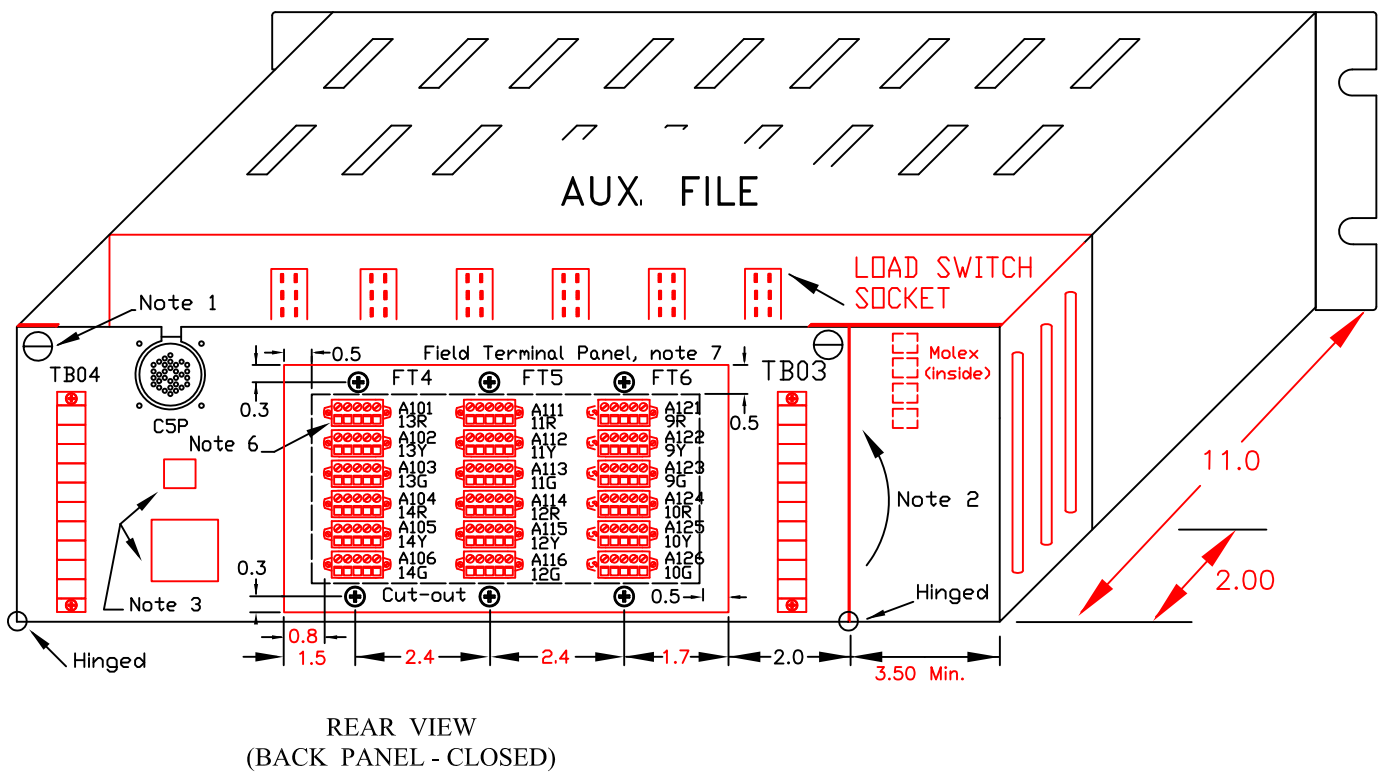
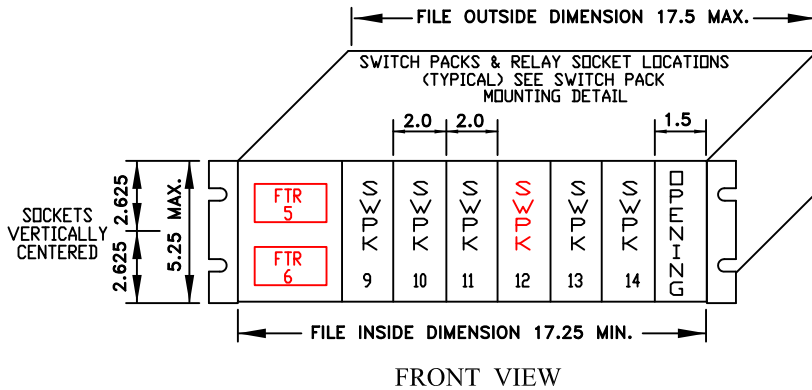
ERRATA 2

TEES 2009

NO SCALE

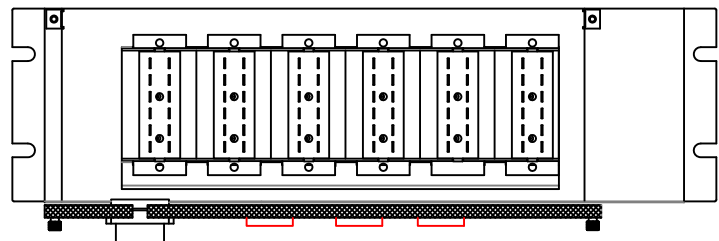
A6-52

OUTPUT FILE #2LX DETAIL



NOTE:

1. Thumb screws device
2. Back Panel Drop 90 Deg.
3. Panel stamped for IR & LR relay sockets, but relays not installed
4. For Terminal Assignment, see Output File #2L detail.
5. See A6-18, A6-19 & A6-20 for sheets 5, 6 & 7.
6. Field Terminal contacts shall be 5-pin screw type, Weidmuller BLT-C18, Phoenix or equivalent.
7. Height = 4.6 - 4.8, Width = 8
8. All dimensions shown are in inches



REAR VIEW (BACK PANEL - OPEN)

TITLE:

INPUT/OUTPUT FILE #2LX DETAILS
SHEET 9 OF 9

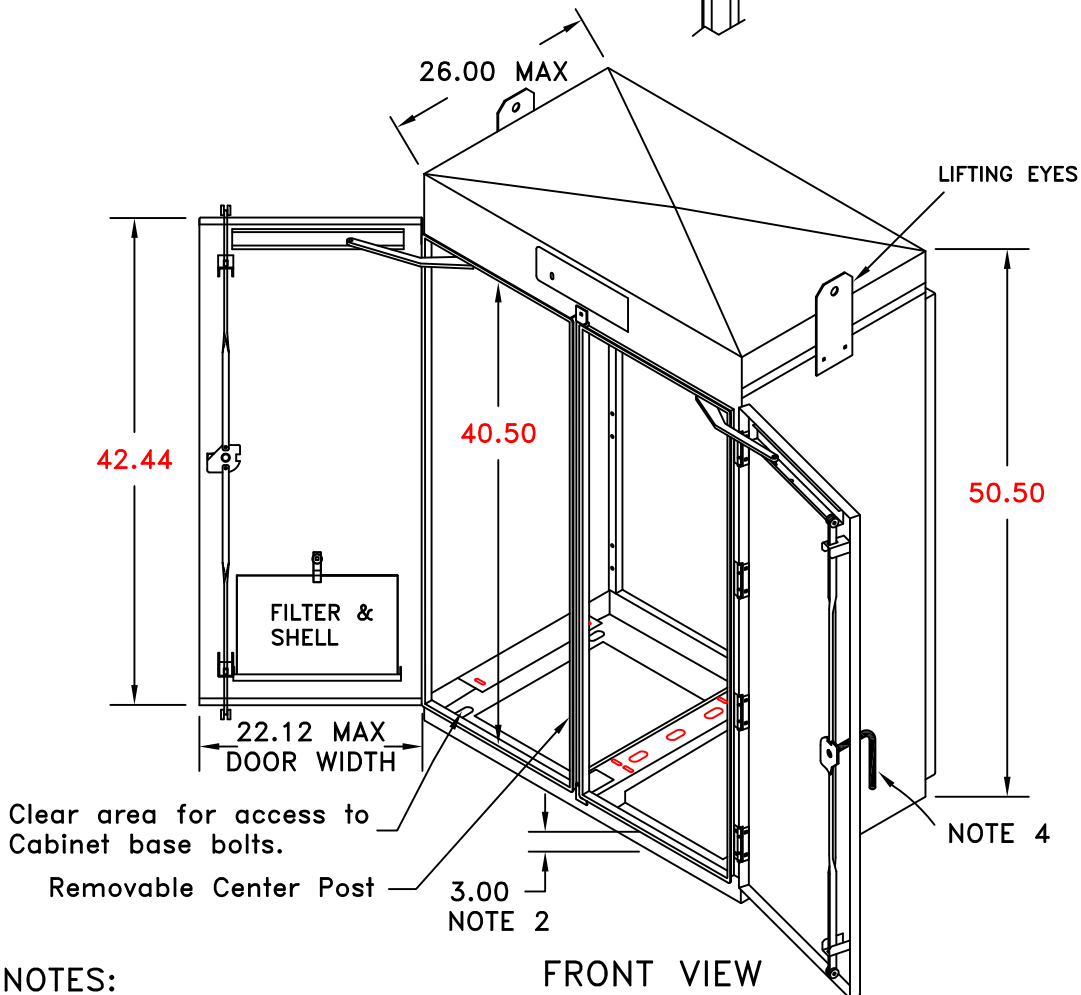
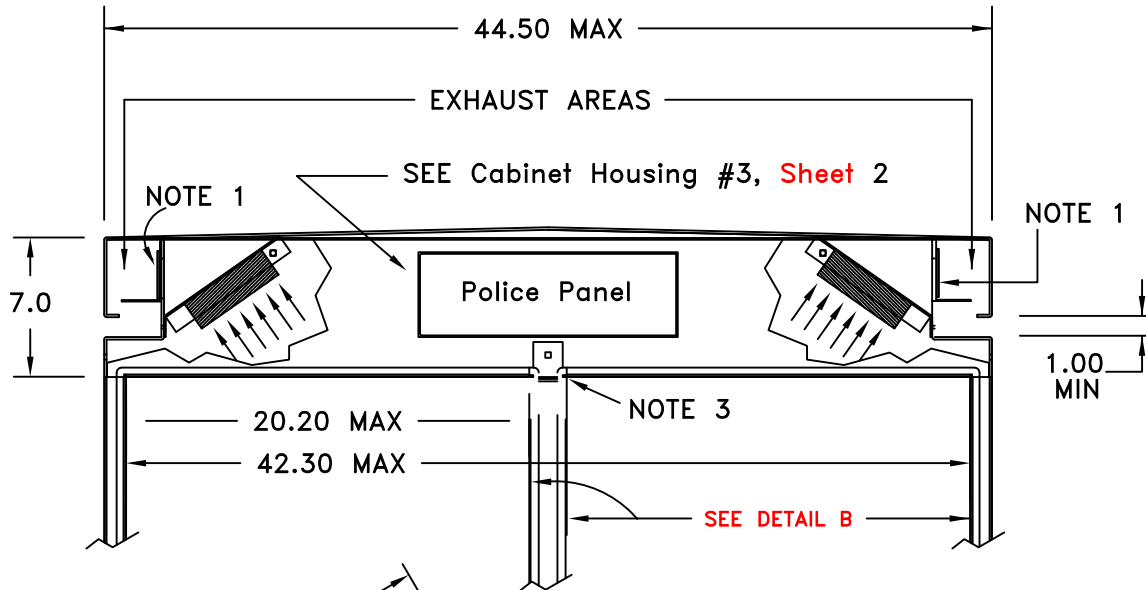
ERRATA 2

NO SCALE

TEES 2009

A6-53

EXHAUST DETAIL



NOTES:

1. Perforated Screen
2. From Cabinet base to door lip
3. After center post is installed a sealant shall be applied to prevent leakage.
4. The locks & handles shall be centered vertically on the door opposite from the hinges on both, the rear & front.

TITLE:

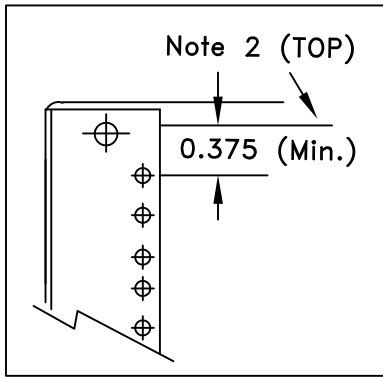
CABINET HOUSING #4 DETAILS
SHEET 5 OF 7

ERRATA 2

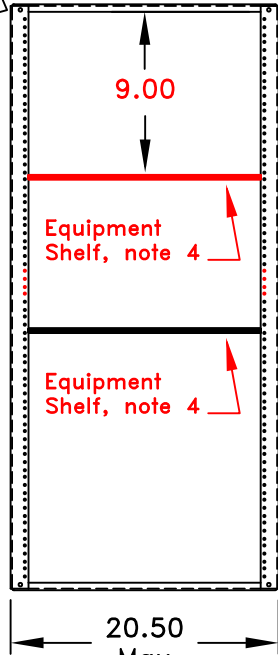
NO SCALE

TEES 2009

A6-54

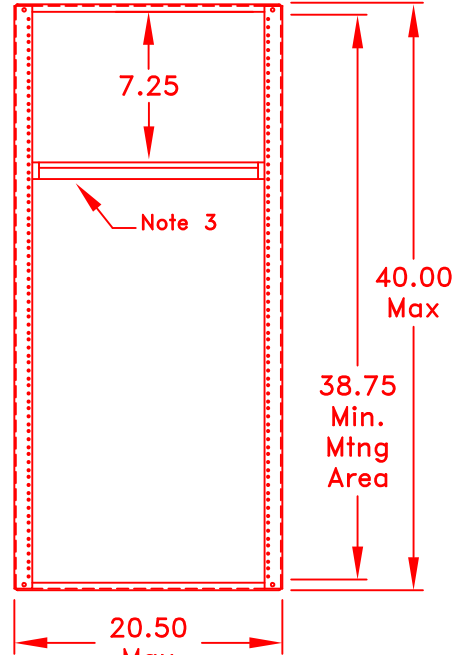


(Front & Rear Typical)
FRONT VIEW



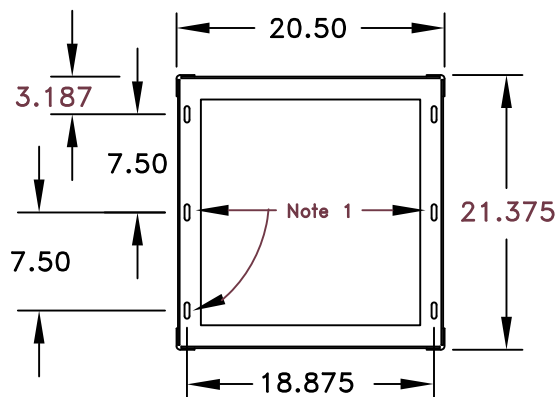
(Rack 2)

(Front & Rear Typical)
FRONT VIEW



(Rack 1)

TOP VIEW



(Rack 1 & 2)

HOLE SLOT DETAIL
B

0.375X1.250 OBOUND

NOTES

1. Hole Slot Detail B, Cage #2 details A6-2.
2. TOP, Refers to the bottom lip of the top hat.
BOTTOM, Refers to the top lip of the bottom hat.
3. Controller unit support drawer shelf assembly, A6-6.
4. Equipment shelf, A6-41.

TITLE:

CABINET HOUSING #4 DETAILS
SHEET 6 OF 7

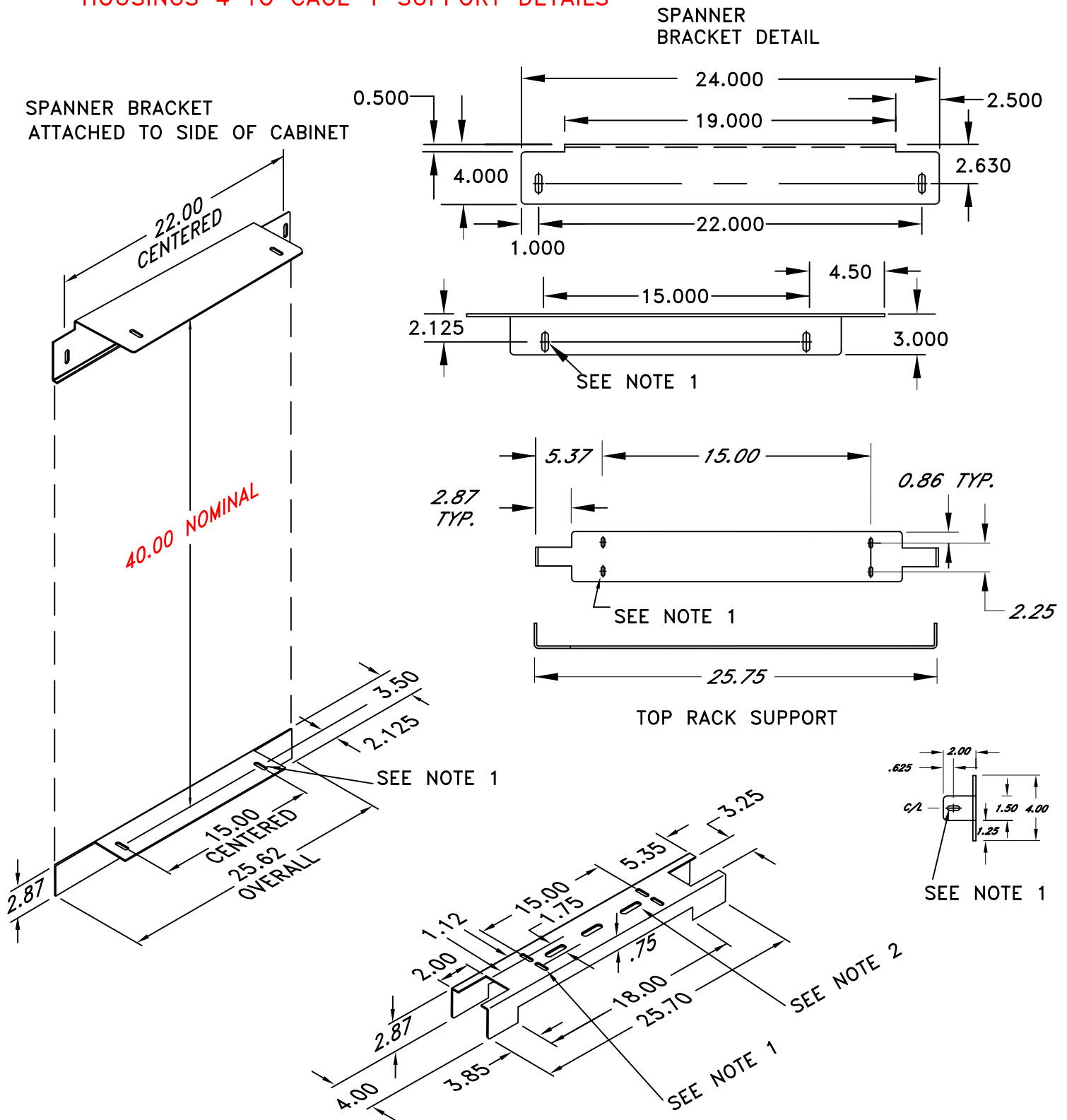
ERRATA 2

TEES 2009

NO SCALE

A6-55

HOUSINGS 4 TO CAGE 1 SUPPORT DETAILS



NOTES:

1. Hole Slot Detail B see Cabinet Housings 3 Detail 2
2. Hole Slot Detail A see Cabinet Housings 3 Detail 2
3. All dimensions shown are in inches.

CENTER CHANNEL
PART IS WELDED TO BOTTOM PLATE

TITLE:

CABINET HOUSING #4 DETAILS
SHEET 7 OF 7

ERRATA 2

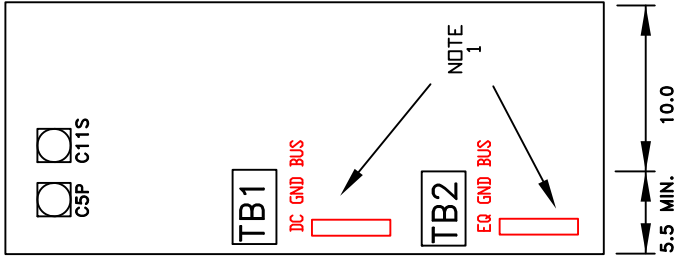
TEES 2009

NO SCALE

A6-56

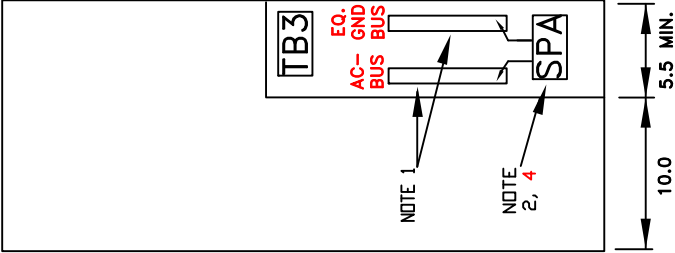
MODEL 346LX SIDE PANEL

INPUT PANEL #4



REAR VIEW
(LEFT SIDE)

SERVICE PANEL #2

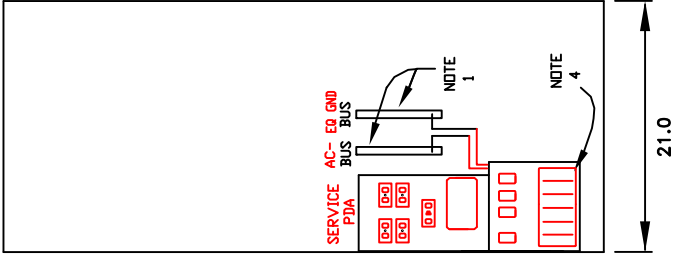


REAR VIEW
(RIGHT SIDE)

TOP OF EIA MOUNTING SURFACE

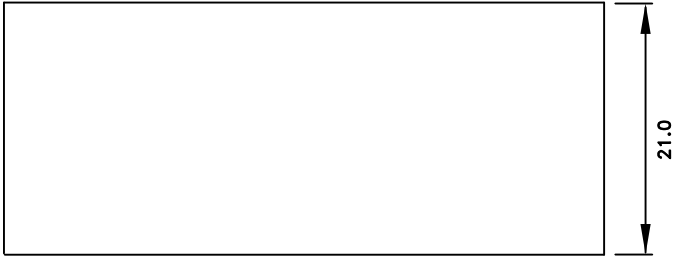
BOTTOM OF EIA MOUNTING SURFACE

SERVICE PANEL ITS



REAR VIEW
(LEFT SIDE)

ITS PANEL



REAR VIEW
(RIGHT SIDE)

NOTES:

1. 10 terminal (#8 wire) minimum copper bus.
2. The terminal block shall have terminal positions necessary to match position assignments.
3. Terminal position screws shall be 8-32 except for TBS, TB0, TB3, which shall be 10-32
4. SPA and the Service PDA shall be bolted on the Rail and firmly attached to the Service Panel.
5. All dimensions shown are in inches.

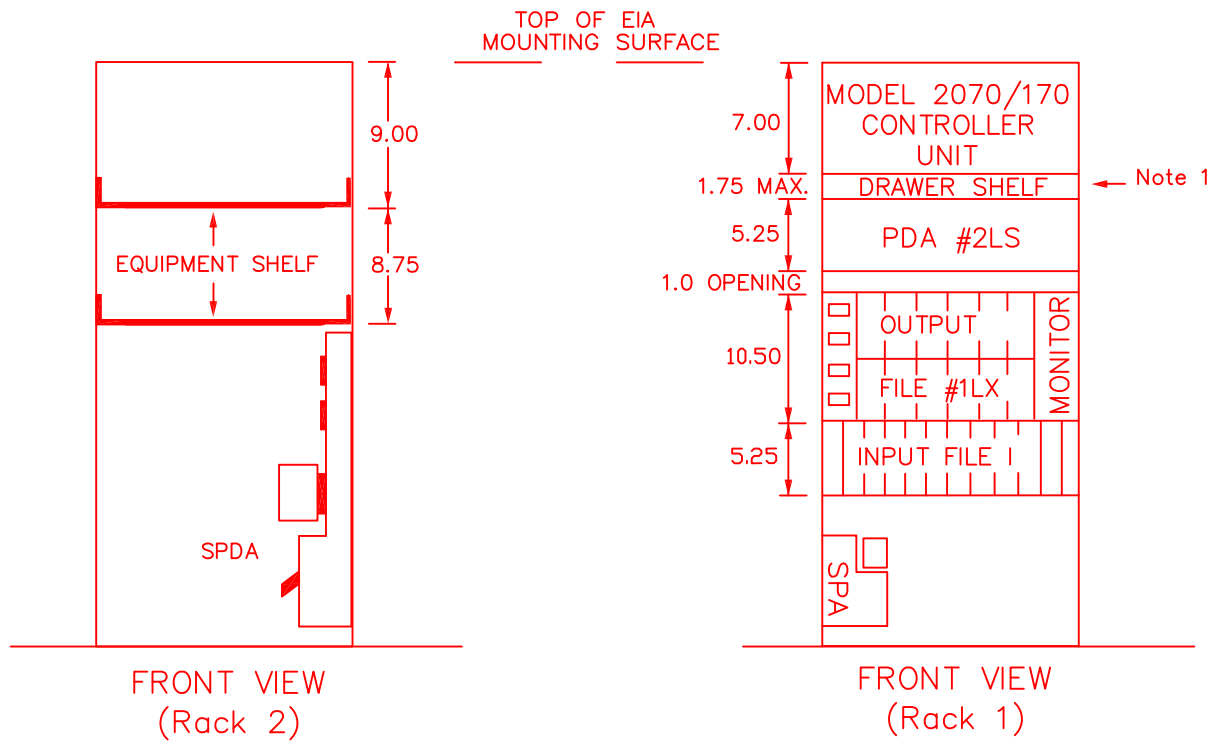
TITLE: MODEL 346LX SIDE PANEL DETAILS

NO SCALE

TEES 2009

A6-57

MODEL 346LX



NOTE:

1. Controller unit support drawer shelf assembly.
2. All dimensions shown are in inches.

TITLE:

CABINET EQUIPMENT MOUNTING DETAILS SHEET 3 OF 3

ERRATA 2

NO SCALE

TEES 2009

A6-58

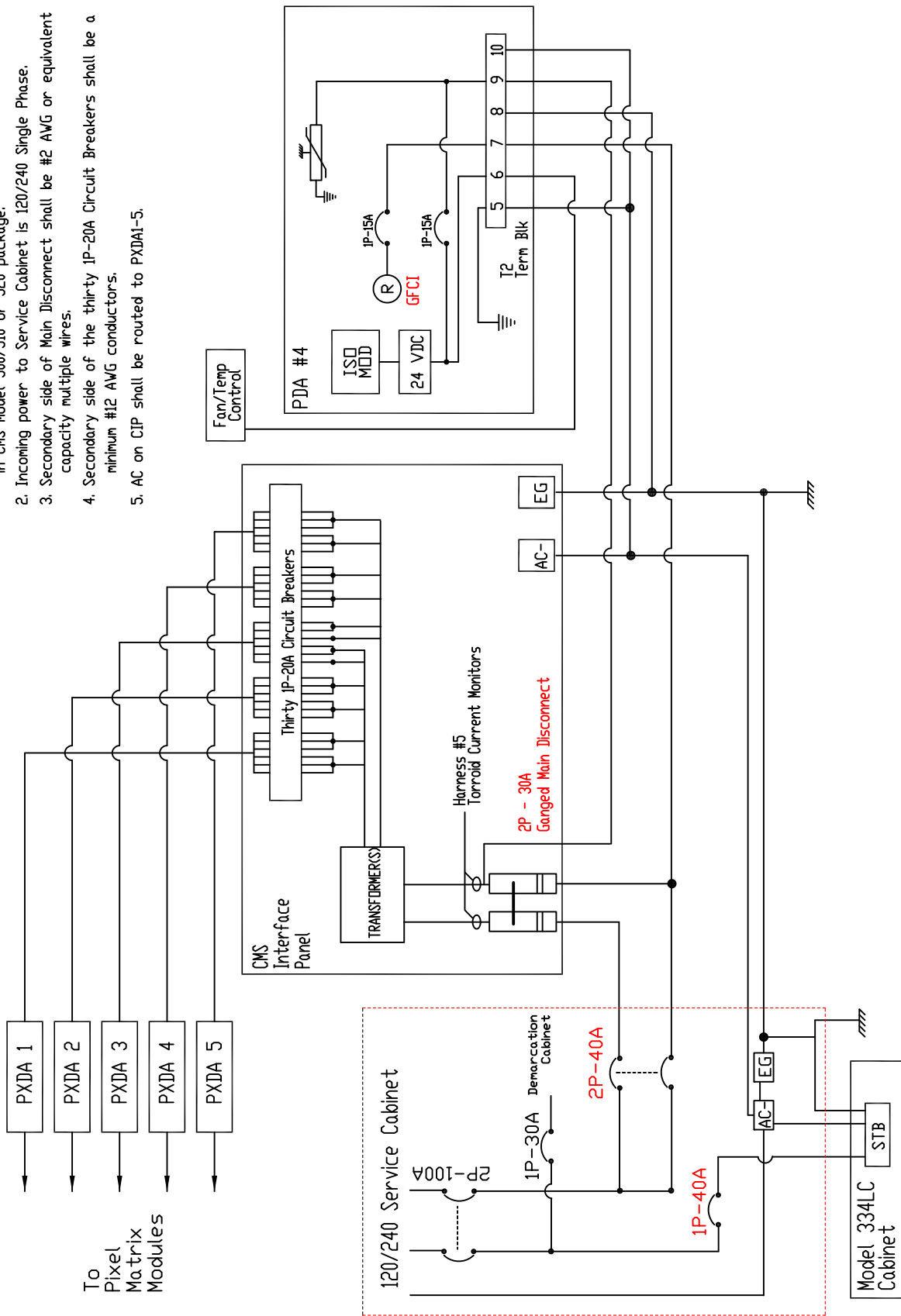
APPENDIX A8

CHAPTER 8 DETAILS

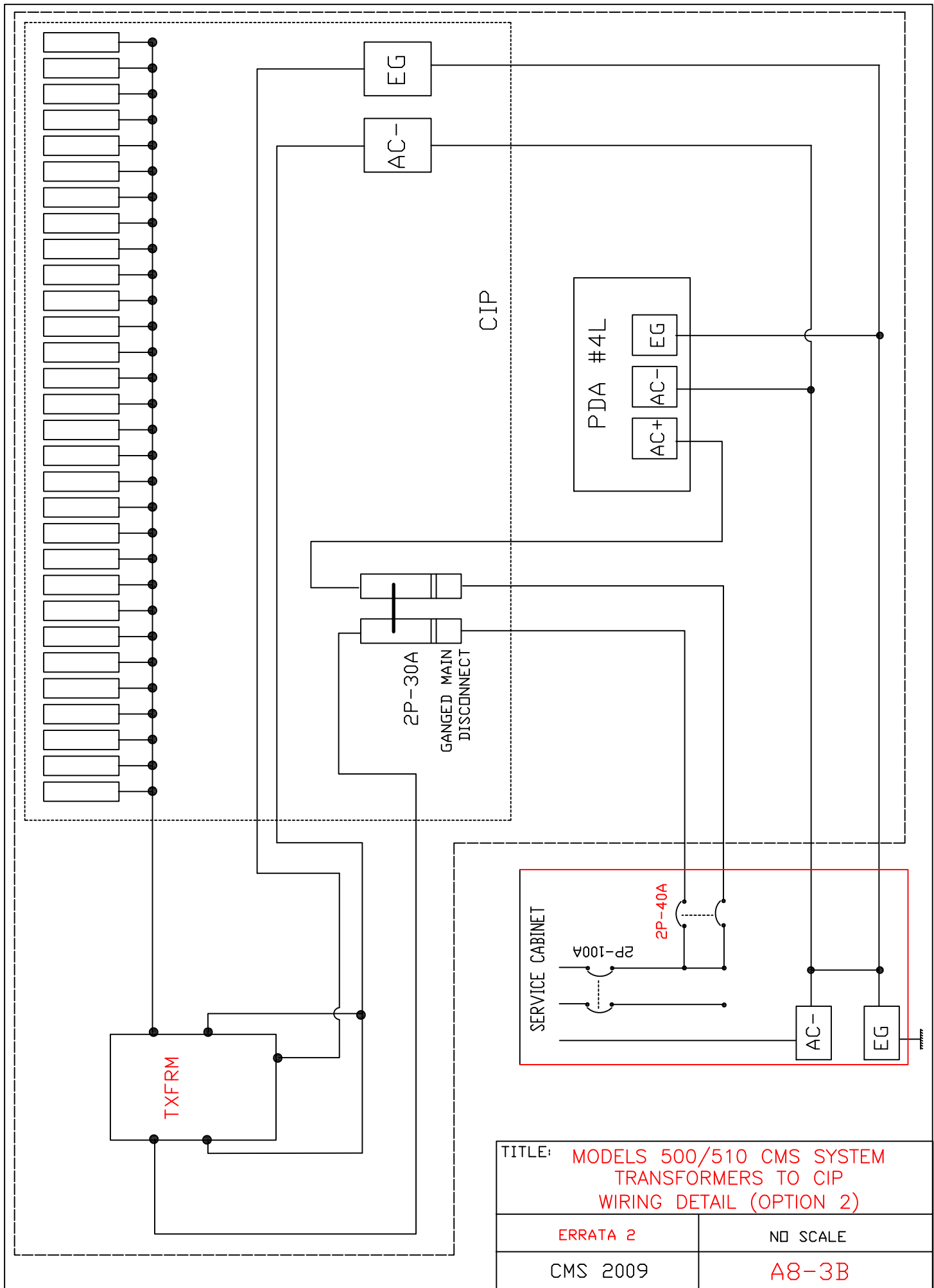
Model 500, 510 & 520 CMS System Wiring Diagram	A7-2
Model 500/510 CMS System TxFrm to CIP Wiring Detail , Option 1	A8-3A
Model 500/510 CMS System TxFrm to CIP Wiring Detail , Option 2	A8-3B

NOTES:

1. AC Service is shown only to complete diagram and is not provided in CMS Model 500/510 or 520 package.
2. Incoming power to Service Cabinet is 120/240 Single Phase.
3. Secondary side of Main Disconnect shall be #2 AWG or equivalent capacity multiple wires.
4. Secondary side of the thirty 1P-20A Circuit Breakers shall be a minimum #12 AWG conductors.
5. AC on CIP shall be routed to PXDA1-5.



TITLE:	
MODELS 500, 510 & 520 CMS SYSTEM WIRING DIAGRAM	
ERRATA 2	NO SCALE
CMS 2009	A7-2

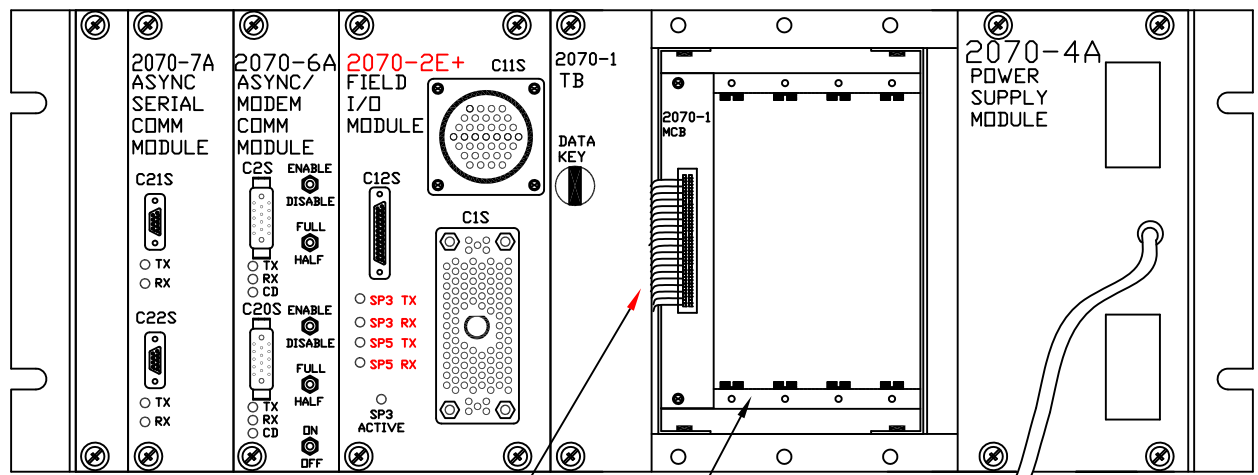


TITLE: MODELS 500/510 CMS SYSTEM TRANSFORMERS TO CIP WIRING DETAIL (OPTION 2)	
ERRATA 2	NO SCALE
CMS 2009	A8-3B

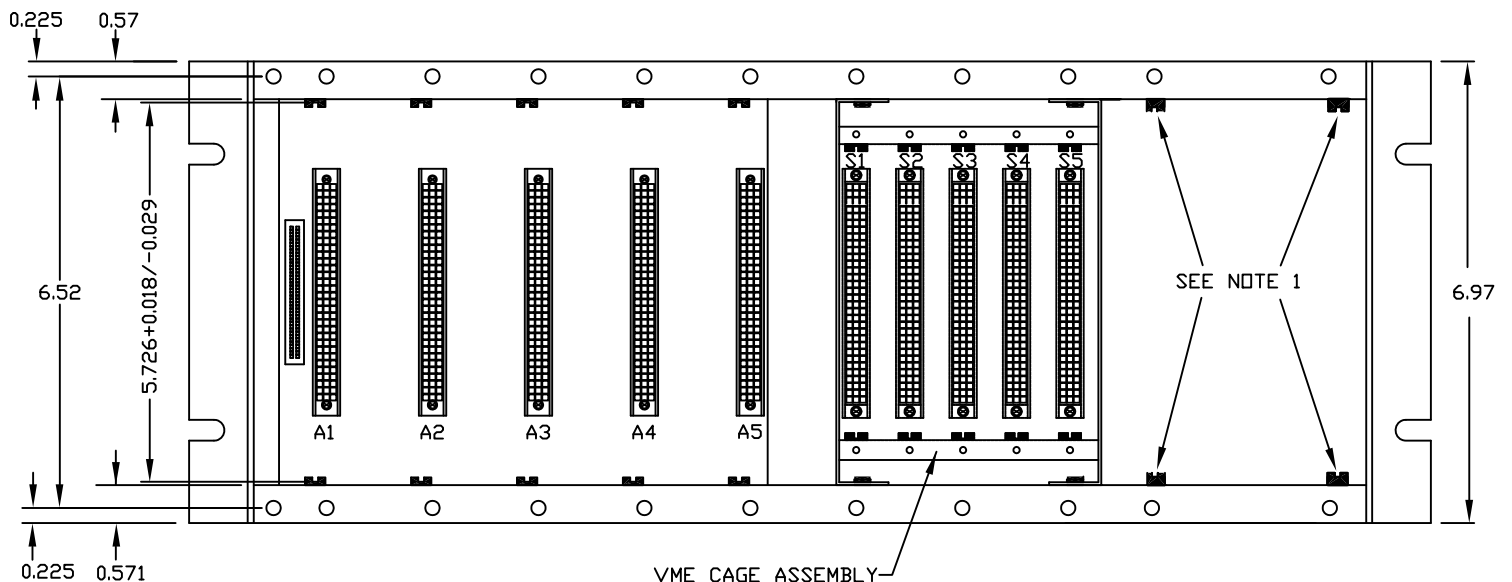
APPENDIX A9

CHAPTER 9 DETAILS

Model 2070 - Chassis Rear View	A9-2
Model 2070 - Chassis Motherboard	A9-4
Model 2070 – 2, Field I/O Module	A9-8
Model 2070 – 2E+ Field I/O Module, C1 & C11 Connectors	A9-9
Model 2070 – 4 Power Supply Module	A9-13
Model 2070 – Power Failure Reaction	A9-17



SEE NOTE 3
VME CAGE ASSEMBLY (EXPOSED)
REAR VIEW, LOADED

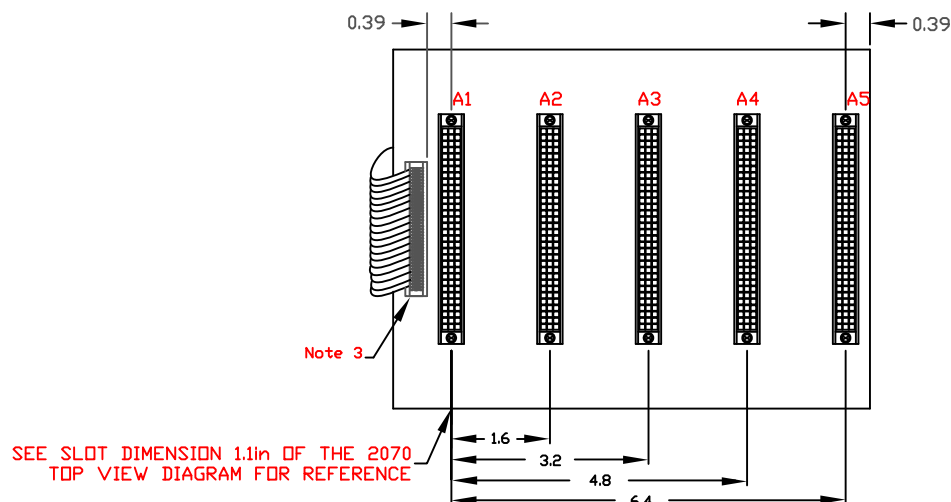


VME CAGE ASSEMBLY
REAR VIEW, UNLOADED

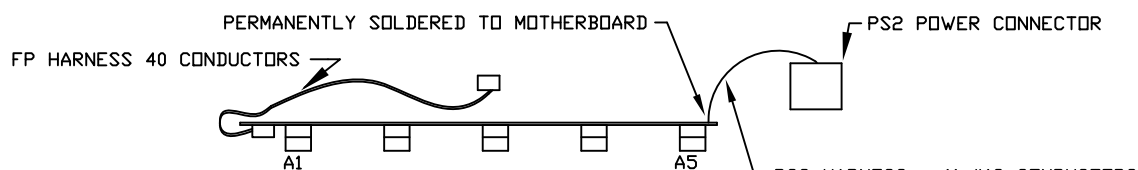
NOTES: (FOR THIS DETAIL)

1. Four permanently attached 8in long Card Guides SAE 1800F (OR EQUAL) beginning 0.51in from the backplane mounting surface.
2. TB – TRANSITION BOARD
MCB – MAIN CONTROLLER BOARD
3. Maximum length of harness shall be 4in, and shall not protrude beyond the back of the 2070 unit.
4. The VME Cage Assembly Opening shall be delivered covered by a blank panel. Matching M3 PEM fasteners shall be provided on the back plane surface for panel mounting.
5. Blank plates shall cover all unused module openings.
6. All Module Front Plates thickness shall be (0.08+0.005)
7. All dimensions shown are in inches.

TITLE: MODEL 2070-CHASSIS REAR VIEW	
ERRATA 2	NO SCALE
TEES 2009	A9-2



CONNECTOR VIEW



TOP VIEW

FP HARNESS PIN/WIRING ASSIGNMENT			
PIN	CONNECTOR ROW A	PIN	CONNECTOR ROW B
1	SP4TXD+	2	SP4TXD-
3	SP4RXD+	4	SP4RXD-
5	SP6TXD+	6	SP6TXD-
7	SP6RXD+	8	SP6RXD-
9	NA	10	NA
11	NA	12	NA
13	NA	14	NA
15	NA	16	NA
17	NA	18	NA
19	NA	20	NA
21	DCG #1	22	DCG #1
23	+12 VDC SER	24	-12 VDC SER
25	DCG #1	26	DCG #1
27	CPU LED	28	DCG #1
29	CPU RESET	30	DCG #1
31	DCG #1	32	C50 ENABLE
33	DCG #1	34	+5 VDC
35	+5 VDC	36	+5 VDC
37	+5 VDC	38	+5 VDC
39	NA	40	NA

PS2 HARNESS PIN/WIRING ASSIGNMENT	
PIN	FUNCTION
1	+5 VDC
2	+12 VDC SER
3	-12 VDC SER
4	DCG #1 (+5 VDC & 12 SER)
5	+5 VDC Standby
6	ISO +12 VDC
7	DCG #2 (ISO +12 VDC ONLY)
8	POWERDOWN
9	POWERUP
10	EG (EQUIPMENT GROUND)
11	LINESYNC
12	NA

NOTES: (FOR THIS DETAIL)

1. The Motherboard shall be a 0.125 inch minimum thickness pcb mechanically mounted in a vertical position.
2. A1 to A5 receptacle connectors shall be 96 socket contact DIN 41612 connectors (ROBINSON NUGENT #DIN 96RSC or ELCO Series 8477 Three Row Inverted Socket OR EQUAL).
3. The FP Harness shall be connected to the Motherboard via a header connector. Pin 1 shall be in the lower right hand corner.
4. Front Panel Harness Connector shall intermate with AMP 102-160-9 or equal located on Front Panel PCB.
5. Angle Brackets shall support the Motherboard to the Model 2070 chassis.
6. All dimensions shown are in inches.

TITLE:

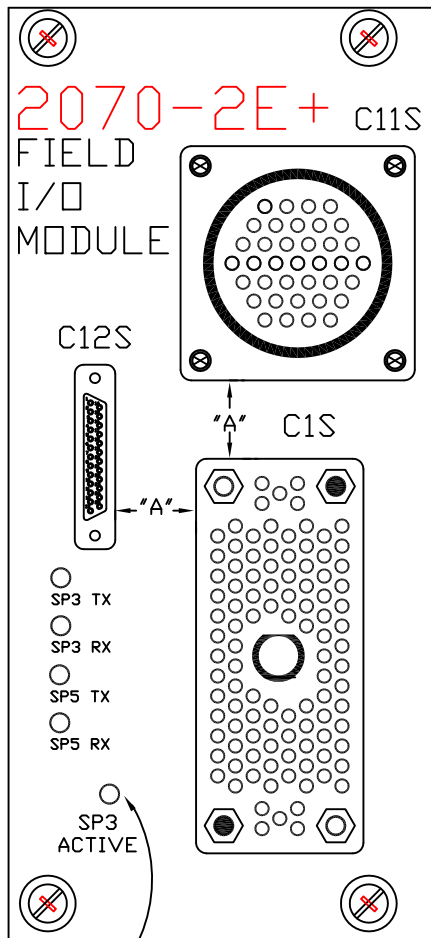
MODEL 2070
CHASSIS MOTHERBOARD

ERRATA 2

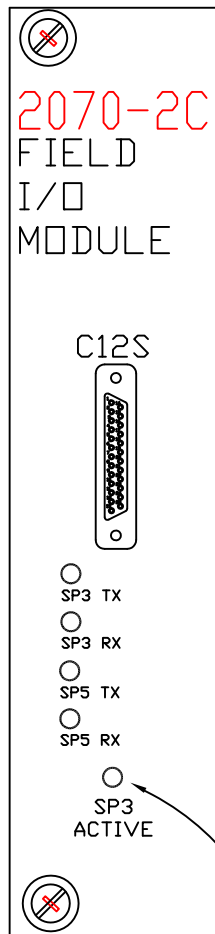
NO SCALE

TEES 2009

A9-4



FRONT VIEW



FRONT VIEW

C12S PIN ASSIGNMENT			
PIN	FUNCTION	PIN	FUNCTION
1	SP5TXD+	14	SP5TXD-
2	SP5RXD+	15	SP5RXD-
3	SP5TXC+	16	SP5TXC-
4	SP5RXC+	17	SP5RXC-
5	SP3TXD+	18	SP3TXD-
6	SP3RXD+	19	SP3RXD-
7	SP3TXC+	20	SP3TXC-
8	SP3RXC+	21	SP3RXC-
9	LINE SYNC+	22	LINE SYNC-
10	NRESET+	23	NRESET-
11	POWERDOWN+	24	POWERDOWN-
12	BIAS +5 VDC	25	EG
13	DCG #2		

FIELD I/O FACE PANELS

NOTES: (FOR THIS DETAIL)

1. **2070-2E+** Faceplate shall be 4X wide. **2070-2C** Faceplate shall be 2X wide.
(SEE SYSTEM PCB MODULE, GENERAL DETAILS.)
2. Dark Circles in the C1S Connector denote guide pin locations and opencircles denote guide socket locations.
3. Dimension "A" shall be a minimum of 0.5in.
4. C1S - M104 Type. C11S - 37-Pin Circular Plastic Type.
C12S - 25-Pin DB Socket Type
5. C12S pin 12 (BIAS +5VDC) at 50mA maximum is derived from the ISO +12 VDC Power Supply.
BIAS +5VDC refers to voltage required for a Line Terminator device.
6. EG (Equipment Ground) pin is electrically connected to the faceplate.
7. LED indicators Tx & Rx for SP3 (field site) and SP5 shall be provided.
8. C1 connector shall be bolted to the Faceplate.
9. Angle Brackets shall support main board to the Faceplate.

TITLE: MODEL 2070-2 FIELD I/O MODULES	
ERRATA 2	NO SCALE
TEES 2009	A9-8

C1S PIN ASSIGNMENT

PIN	FUNCTION NAME	PIN	FUNCTION NAME	PIN	FUNCTION NAME	PIN	FUNCTION NAME
1	DCG #2	27	Q24	53	I14	79	I44
2	Q0	28	Q25	54	I15	80	I45
3	Q1	29	Q26	55	I16	81	I46
4	Q2	30	Q27	56	I17	82	I47
5	Q3	31	Q28	57	I18	83	Q40
6	Q4	32	Q29	58	I19	84	Q41
7	Q5	33	Q30	59	I20	85	Q42
8	Q6	34	Q31	60	I21	86	Q43
9	Q7	35	Q32	61	I22	87	Q44
10	Q8	36	Q33	62	I23	88	Q45
11	Q9	37	Q34	63	I28	89	Q46
12	Q10	38	Q35	64	I29	90	Q47
13	Q11	39	I0	65	I30	91	Q48
14	DCG #2	40	I1	66	I31	92	DCG #2
15	Q12	41	I2	67	I32	93	Q49
16	Q13	42	I3	68	I33	94	Q50
17	Q14	43	I4	69	I34	95	Q51
18	Q15	44	I5	70	I35	96	Q52
19	Q16	45	I6	71	I36	97	Q53
20	Q17	46	I7	72	I37	98	Q54
21	Q18	47	I8	73	I38	99	Q55
22	Q19	48	I9	74	I39	100	Q36
23	Q20	49	I10	75	I40	101	Q37
24	Q21	50	I11	76	I41	102	Q38 DET RES
25	Q22	51	I12	77	I42	103	Q39 WDT
26	Q23	52	I13	78	I43	104	DCG #2

C11S PIN ASSIGNMENT

PIN	FUNCTION NAME	PIN	FUNCTION NAME	PIN	FUNCTION NAME	PIN	FUNCTION NAME
1	Q56	11	I25	21	I54	31	DCG #2
2	Q57	12	I26	22	I55	32	NA
3	Q58	13	I27	23	I56	33	NA
4	Q59	14	DCG #2	24	I57	34	NA
5	Q60	15	I48	25	I58	35	NA
6	Q61	16	I49	26	I59	36	NA
7	Q62	17	I50	27	I60	37	DCG #2
8	Q63	18	I51	28	I61		
9	DCG #2	19	I52	29	I62		
10	I24	20	I53	30	I63		

TITLE:

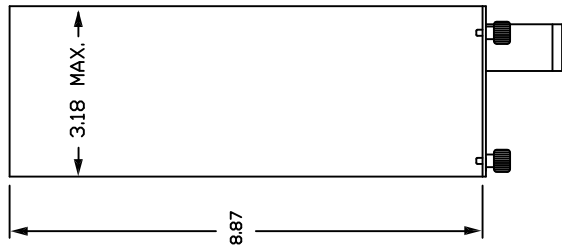
MODEL 2070-2E+
FIELD I/O MODULE
C1S & C11S CONNECTORS

ERRATA 2

NO SCALE

TEES 2009

A9-9



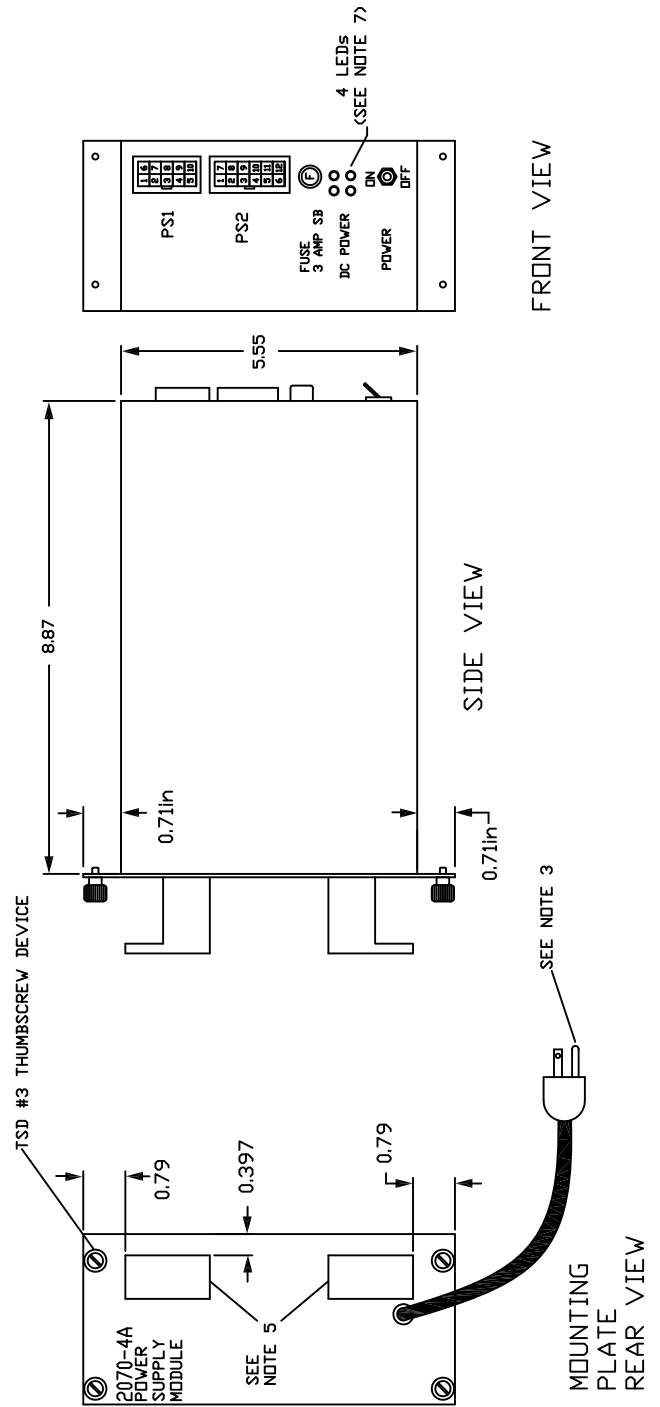
TOP VIEW

PS1 CONNECTOR PINOUT	
PIN	FUNCTION
1	+5 VDC
2	+12 VDC SER
3	-12 VDC SER
4	DCG #1 (+5 VDC & 12 SER)
5	+5 VDC Standby
6	+5 VDC SENSE
7	DCG #1 SENSE
8	AC FAIL
9	SYSRESET
10	NA

PS2 CONNECTOR PINOUT	
PIN	FUNCTION
1	+5 VDC
2	+12 VDC SER
3	-12 VDC SER
4	DCG #1 (+5 VDC & 12 SER)
5	+5 VDC Standby
6	ISO +12 VDC
7	DCG #2 (ISO +12 VDC ONLY)
8	POWERDOWN
9	POWERUP
10	EG (EQUIPMENT GROUND)
11	LINESYNC
12	NA

NOTES: (FOR THIS DETAIL)

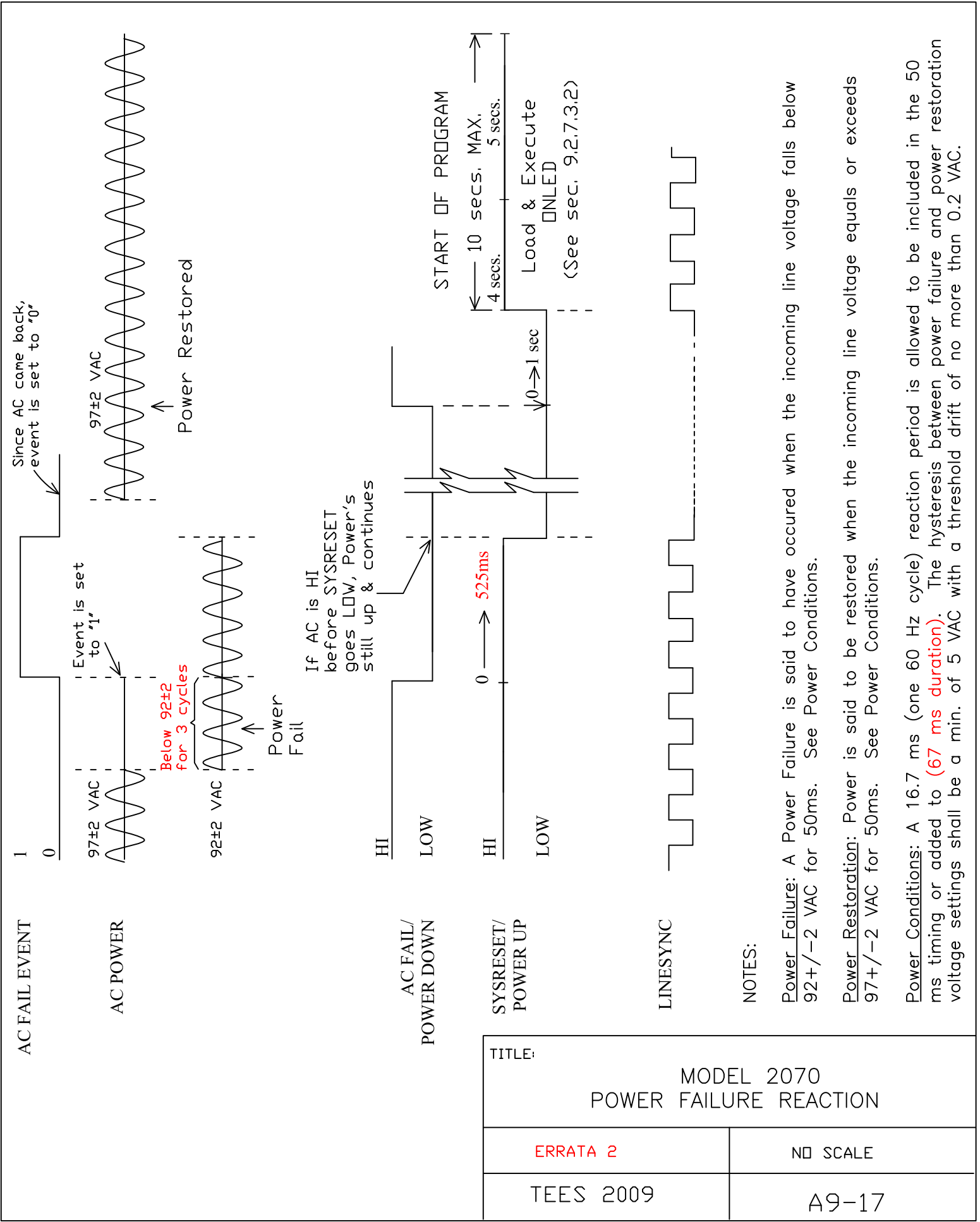
1. Power switch shall be mounted vertically. Power On shall be in the up position.
2. Fuse shall be a replaceable 3AG Slow Blow type resident in a fuse holder. Fuse label shall indicate rating.
3. Three conductor #16 power cable, **4 feet (48 inch) minimum length** and permanently attached to the Module with strain relief. The end plug connector shall be a three blade NEMA 5-15P grounding plug type.
4. PS1 and PS2 Receptacle Connectors shall be AMP Mini-Universal Double row MATE-N-LOK 2 CAP Connectors with locking latch devices (OR EQUAL).
5. PS1 connector shall be a 10 position PLUG connector. PS2 connector shall be a 12 position PLUG connector.
5. Buckeye Cord-Wrap PP-40055 device with PP-40058 Extension (OR EQUAL).
6. Mounting Plate shall conform to the 4X Wide Module dimensions.
7. A LED indicator shall be provided for each DC power source (+5, ISO +12, +12 SER, -12 SER).
8. Power Supply shall be marked as 2070-4A.
9. All dimensions shown are in inches.



FRONT VIEW

MOUNTING PLATE REAR VIEW

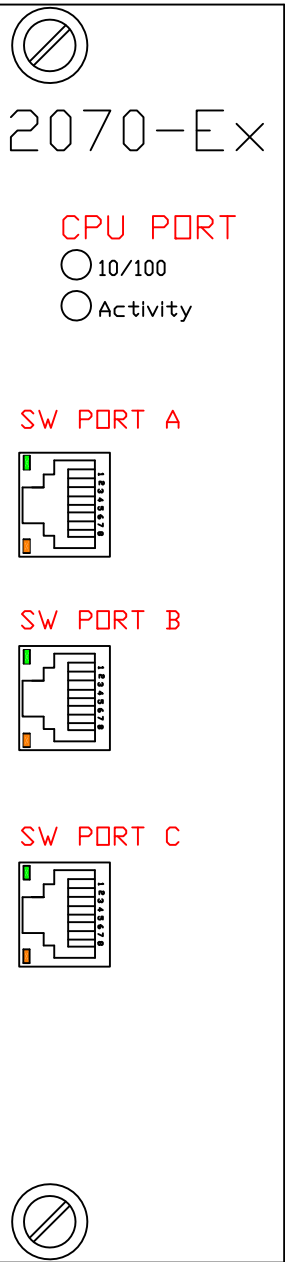
TITLE:	
MODEL 2070-4 POWER SUPPLY MODULE	
ERRATA 2	NO SCALE
TEES 2009	A9-13



TITLE: MODEL 2070 POWER FAILURE REACTION	
ERRATA 2	NO SCALE
TEES 2009	A9-17

APPENDIX A10

CHAPTER DETAILS



PORT 2, 3, 4 RJ45 PIN ASSIGNMENTS			
PIN	FUNCTION	PIN	FUNCTION
1	TX +	5	NA
2	TX -	6	RX -
3	RX +	7	NA
4	NA	8	NA

TITLE:		MODEL 2070-Ex NETWORK SWITCH MODULE	
ERRATA 2		NO SCALE	
TEES 2009		A10-10	

**CITY of LOS ANGELES
DEPARTMENT of TRANSPORTATION**

**CONNECTORS,
WIRE NUT, WATERTIGHT**

PURCHASE SPECIFICATION

**# 56-002-04
April 26, 2011**

1. DESCRIPTION:

This specification defines the minimum standards for product performance and composition relating to all watertight wire-nut style connectors, hereinafter referred to as waterproof wire-nuts.

2. GENERAL:

All waterproof wire-nuts shall be manufactured from non-hygroscopic materials and shall consist of a plastic shell with finger grip "wings", which shall contain a conical spring wire for proper electrical connection and a non seeping sealant for waterproofing. All U.L., C.S.A. and NEMA standards not mentioned in this specification shall still apply. Where there is a conflict between this specification and the U.L., C.S.A., or NEMA standards, this specification shall supersede. .

2.1 All connectors shall be rated for a maximum voltage of 600 volts.

2.2 All connectors shall have a minimum temperature rating of 221°F (105°C).

3. MATERIALS:

3.1 SHELL

3.11 Connector body shall consist of a color-coded outer shell manufactured from non-conductive, non-hygroscopic material.

3.12 Connector body shall have raised finger grips or "wings" for assisting in applying torque to ensure proper connection.

3.13 Connector body shall have a skirt or "cap" to help retain sealant fill.

3.2 SPRING

- 3.21** Connector spring shall consist of a plated, conical spring designed to draw conductors in when torque is applied and retain conductors without slippage once attached.

3.3 SEALANT

- 3.31** Sealant shall be non-conductive, non-setting, non-seeping, fire retardant silicone that eliminates the possibility of corrosion and flashover.
- 3.32** Sealant shall have no limiting shelf life.
- 3.33** Sealant shall have a useable temperature range of -45° to 400°F (-43°C to 205°C)
- 3.34** Sealant shall show no signs of seepage below 221°F (105°C) in storage or use.
- 3.35** Sealant shall comply with all specifications listed in TABLE A.

TABLE A

PROPERTY	METHOD	REQUIREMENT
COLOR	VISUAL	WHITE, OPAQUE or CLEAR
APPEARANCE	VISUAL	SMOOTH
UNWORKED PENETRATION*	ASTM D217	165mm MINIMUM
WORKED PENETRATION* 60 STROKES	ASTM 0217	165mm to 320mm
OIL SEPARATION, 24 HR @ 100°C	FTM 791 METHOD 321.2	1 %** MAXIMUM
EVAPORATION, 24 HR @ 100°C	ASTM 0972	1 %** MAXIMUM
COOPER CORROSION 24 HR @ 150°C	ASTM 04048	NO CORROSION

* Indicates the stiffness of the sealant. Determined by how far a conical shaped weight. (0.1 gram) sinks into the sealant.

** The percentages for separation and evaporation are by weight lost from the overall sample.

4. TESTING:

4.1 All waterproof wire-nuts shall be tested to U.L. specification 486C and UL 50.

5. COLORS AND SIZES:

5.1 Waterproof wire-nut connectors shall be available in the following sizes.

Wire Combinations: Cu/Cu				
<u>Manufacturer</u>	<u>Color/Model</u>	<u>SKU</u>	<u>Minimum</u>	<u>Maximum</u>
KING	Aqua/Orange	621 25/35/50	2 #14	2 #14
KING	Aqua/Red	622 25/35/50	2 #14	4 #14
KING	Aqua/Blue	623 25/35/40	2 #10	2 #8 OR 3 #10
KING	4 Yellow	10444	2 #14	1 #10 w 2 #14
KING	5 Red	10555	2 #14	1 #10 w 3 #14
KING	6 Blue	106 66/70	2 #14	1 #10 w 3 #14
KING	9 Blue	10999	2 #10	3 #8
IDEAL	Blue/Blue	60	2 #14	2 #10
IDEAL	Blue/Orange	61	2 #14	2 #14
IDEAL	Blue/Red	62	2 #14	3 #10 OR 5 #14
IDEAL	Blue/Dark Blue	63	2 #14	2 #8 OR 5 #10
IDEAL	Blue/Dark Blue	64	2 #14	3 #10
IDEAL	Blue/Blue	66	2 #10	2 #6

6. WARRANTY:

6.1 Manufacturer and Supplier shall warrant waterproof wire-nuts, including associated hardware, to be free from defects in material and manufacture for a minimum of 1 (one) year from date of test and acceptance by the City of Los Angeles, Department of transportation.

6.2 All warranty expenses including parts, labor and shipping are the responsibility of the Manufacturer or Supplier.

7. SAMPLES:

7.1 Upon request by the City of Los Angeles or any of its authorized agents, the Manufacturer or supplier shall submit for approval a minimum of five samples of each requested part.

8. CERTIFICATION:

- 8.1** Written certification that the waterproof wire-nut complies with this specification shall be prepared by an independent certified testing laboratory and maintained on file by the manufacturer.
- 8.2** The Supplier shall provide design details and drawings in sufficient detail for complete evaluation of the proposal, and comparison with these specifications.

9 APPROVAL AND WAIVERS:

- 9.1** Approval of any materials or practices not covered in this document must be requested in writing and proposed to the Signal Design group. Approval must be granted and on file with the signal design group to be valid. Approval is contract specific.
- 9.2** Waivers are contract specific and must be re-submitted for each and every individual contract. Waivers of any specification must be requested in writing and proposed to the Signal Design group. Waivers must be granted and on file with the Signal Design group to be valid.

**CITY OF LOS ANGELES
DEPARTMENT OF TRANSPORTATION
LADOT**

**SPECIFICATION
FOR
FIBER OPTIC ELECTRIC SIGNS**

Specification Number 82-049-04

May 2009

Purpose

This specification outlines the requirements for fiber optic electric sign assemblies for the city of Los Angeles, Department of Transportation (LADOT). Each electric sign will display a specific traffic control message signal to vehicular traffic. The sign will be pre configured to control traffic movements for reversible lane operation, prohibit turns during specified hours, or prohibit vehicular movements which may conflict with an approaching train or bus.

Functional Requirements

The unit shall display a pre configured message or messages as per the latest LADOT Standard Drawing Nos.

S-58.13, S-58.17, S-58.18, S-58.19, S-58.21, S-58.23

The sign display shall be clearly visible at a minimum distance of 300 feet. At full intensity, the message will be highly visible anywhere within a minimum 20-degree cone centered about the optic axis. When the sign is not energized, the sign shall blank-out and the legend or phantom symbols shall not be visible under ambient light conditions. The display assembly shall sustain an average 100,000 hour life.

The message and symbols shall be formed by an arrangement of fiber optic bundles (pixel points) illuminated by solid state LED lamps of appropriate color to create the colors specified in the drawing. The bundled fibers transmitting the light shall be manufactured only from high quality step index glass. Plastic fiber **SHALL NOT** be used. The lamps shall be accessible for replacement without removal of the sign from the housing.

Large Enclosure

All components shall be readily accessible for maintenance from the front of the sign and without the use of tools. The overall dimensions of the sign housing shall be as defined in the Standard Drawing.

The large housing shall be constructed of 0.125 inch aluminum alloys all around with 0.063 inches flat aluminum back plate welded into the housing. The finish of the sign enclosure shall be two coats of flat black exterior enamel applied after the surface material is acid-etched and primed with zinc chromate primer.

Drainage shall be provided by four 0.25 inch diameter drain holes at the four corners of the housing bottom. The weight of the enclosure, including the internal components and mounting bracket, shall not be in excess of 75 pounds.

Door

The sign face door shall be attached with a continuous full length stainless steel “piano” hinge along the left side of the enclosure and joined to the sign face in such a manner as to maintain a rain-tight and dust-resistant seal.

Three “over center snap” lock-able style, stainless steel latches shall be installed on the right side of the enclosure to hold the sign face door in the closed position. A door stop arm shall be installed on the top left side of the enclosure to prevent the sign face door from swinging more than 90 degrees to the sign enclosure.

The sign face door shall be provided with a 0.1875 inches by 1-inch neoprene door gasket to provide a weatherproof seal.

Visor and Lens

A visor shall be installed over the sign face to enhance readability. The entire sign face shall be protected by a 0.125 anti-glare matte/clear polycarbonate lens mounted into the door frame.

The visor assembly shall be fastened securely to the front frame of the sign by using #8 x 0.375 inch stainless steel hex head indented sheet metal screws. The visor shall be made of 0.063 inch aluminum. The finish shall be two coats of flat black exterior enamel applied after the surface material is acid-etched and primed with zinc chromate primer.

Mounting

Sign mounting shall be facilitated by a 2-inch hole centrally located at the top and at the center bottom of the aluminum housing to accommodate the brackets, see LADOT Standard Drawing No. S-63.1.4, item “D” for Pelco Astro Bracket or equivalent. Two bracket reinforcement plates shall be provided, each consisting of an aluminum 4.5 inch x 4.5 inch x 0.25 inch plate with a 2-inch hole in the center and a 0.2 inch x 0.4 inch slot on each side of the 2-inch hole. See detail “A” of LADOT Std. Dwg. No. S-58.21. This reinforcement plate will be fastened to the housing by four stainless steel 0.3125 inch x 1.0 inch hex head machine screws, two stainless steel flat washers, one lock washer and hex nut per screw. The 2-inch hole in the plate shall match the 2-inch hole on the top and bottom of the sign housing as the openings for bracket installation.

Small Enclosure

The smaller sign shall be mounted in a standard pedestrian housing using the appropriate mounting hardware as per the plan and the Standard Drawing. The eggcrate style visor shall not be used. The entire sign face shall be protected by a 0.125 anti-glare matte/clear polycarbonate lens mounted into the door frame.

Electrical Requirements

A 60 Hz magnetic transformer with a Class 'A' insulation rating shall provide power for each combination of the solid state LED lamps. The number and configuration shall be such as to provide adequate power for the number of LEDs being driven and designed to maintain sign legibility in the event of failure of one unit. The transformer shall be impregnated with a double coating of epoxy resin or lacquer so as to preclude the intrusion of moisture. The nominal primary input control voltage shall be 120 VAC with the secondary output of 12 VAC under load conditions. Each transformer shall be rated no larger than 25 VA and mounted in such a manner as to distribute the sign weight as evenly as possible.

A linear or switching type power supply may be substituted in the place of transformers providing that at least two are included in the design to provide redundancy and to maintain sign legibility in the event of failure of one unit. The power supply shall be of such design as to allow power input to the sign, and the resultant sign display, to clearly transition from a on state to a off state at a one herz rate with a 50% duty cycle.

The primary control power shall be distributed from one terminal block source mounted within the sign enclosure on the rear panel. All conductors shall enter the enclosure through the mounting fixture.

Environmental Requirements

The sign shall be capable of continuous operation over a range in temperatures from -35 degrees to +140 degrees Fahrenheit (-37 to +60 degrees Celsius) and unaffected by harsh outdoor weather conditions.

Fiber Optic Bundles

The fiber optic modules and associated components shall be assembled directly to the sign face and shall have an inside back cover to provide protection for the modules. The message shall be formed by an arrangement of fiber optic bundles (pixel points). The fibers transmitting the light shall be manufactured only from high quality step index glass. Plastic fiber **SHALL NOT** be used. The fiber optic bundle ends shall be ground smooth and optically polished for maximum light transmission.

Each fiber optic bundle to each pixel shall be protected to prevent damage from handling or vibration. Each fiber optic light guide shall contain a convergence cone to produce a small emission controlled angle and increase light output intensity axially. Each fiber optic harness in each sign shall contain spare bundles equivalent to 5 percent of the total bundles.

Two or more light sources shall provide illumination. Each light source shall provide illumination to each message point. Bundles shall be bifurcated so that if one lamp fails, the message will be illuminated at 50% light output at each bundle. Bundles shall be arranged so that in the event of failure of one light source, the other shall continue to provide a discernible message. The fiber optic stroke width is shown on each drawing. The space center to center shall be 0.50 inches.

Solid State LED Lamps

The sign shall be illuminated by solid state LED light sources equivalent to the Opto Technology, Inc., Endura Bright series. The lamps shall integrate a high power, thermally heat-sinked LED light source with a nominal 10 degree angle of displacement in a traditional MR-16 form factor. The lamps shall have a minimum 40,000 hour life and adhere to the color, light and power requirements outlined in the following tables.

Electrical/ Environmental Characteristics

Nominal Voltage	Power Consumption	Maximum Operating Temperature
12V AC/DC	7 Watts Maximum	-40 to +50 degrees Celsius

Photometric Requirements

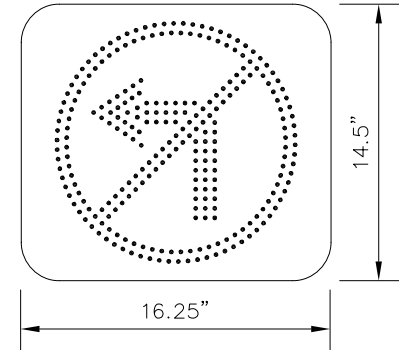
Color	Dominant Wavelength			Spectral Half Width (nm)	Typical Luminous Flux (lm)	Typical Intensity (cd)
	Min	Typ	Max			@ 10 deg viewing angle
White	4500	6500K	10000K	-	85	1128
Red	620.5	627	645	20	-	-
Green	520	530	550	35	-	-
Amber	584.5	590	597	14	-	-

Guarantee

The sign, except for the lamps, shall be unequivocally guaranteed for parts, labor, workmanship and functionality for a period of three years from date of receipt of the sign. In case of failure the manufacturer is fully responsible for all expenses involved (including shipping) for repair and/or replacement of the sign. Replacement for repair of the sign shall not exceed 45 days from the date the failure is reported to the manufacturer. The solid state lamps shall be guaranteed for a period of one year from the date of receipt of the sign.

DRAWINGS

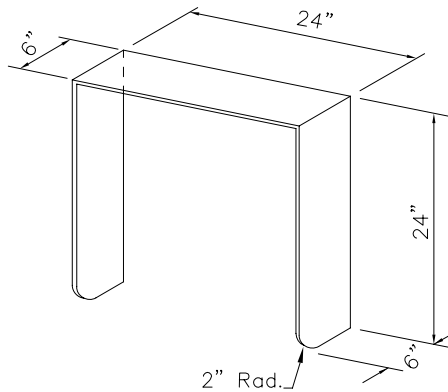
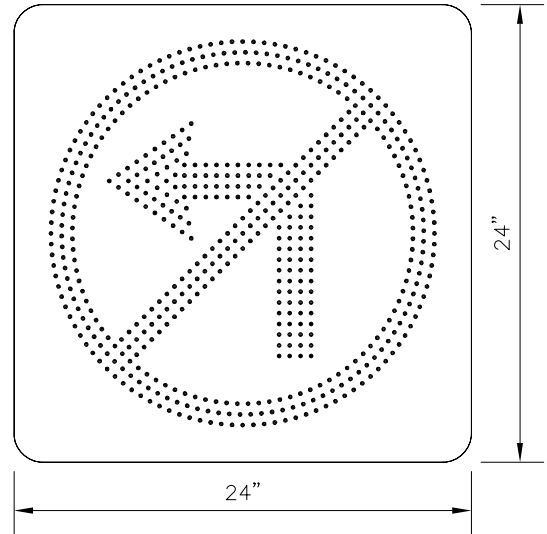
The fiber optic signs shall comply with the latest LADOT Standard Drawings and Special Provisions. Any reference to individual LED pixel indications shall be ignored and fiber optic bundles substituted.



(Pedestrian Head Sign)

SIGN FACE

Not To Scale

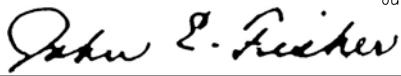


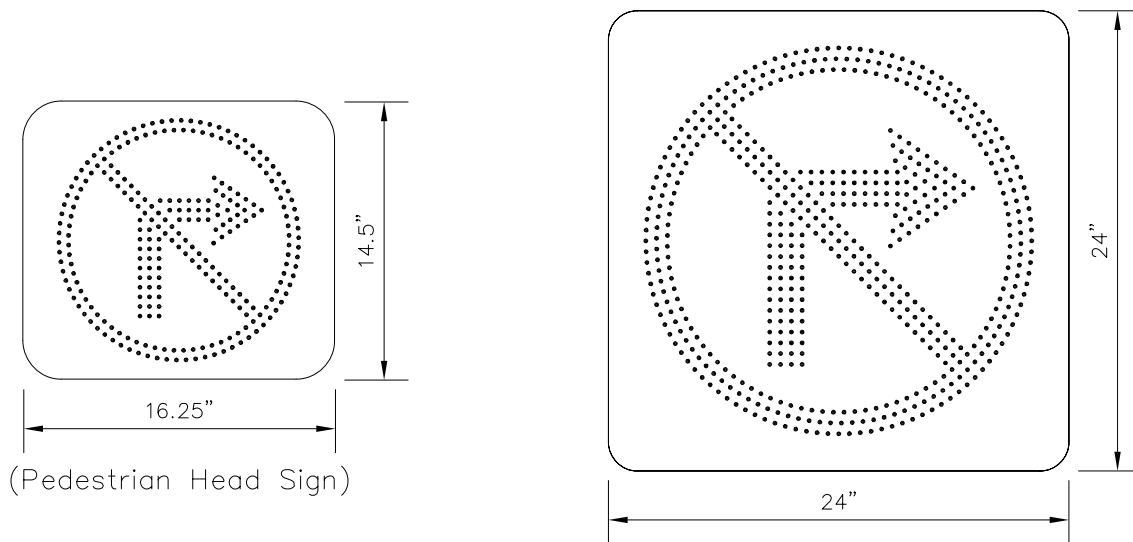
VISOR ENCLOSURE

Not To Scale

Notes:

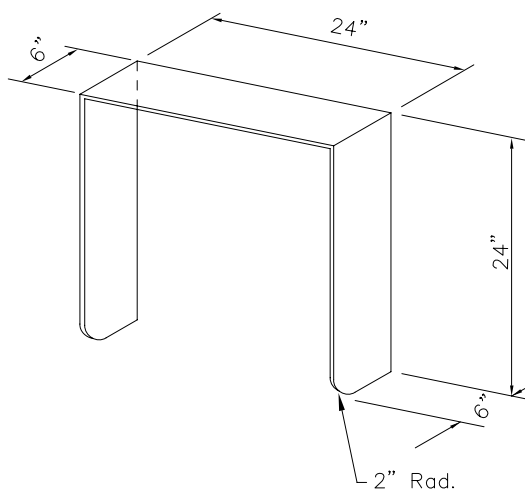
- Sign shall be capable of displaying the following messages:
R3-1 (No Left Turn symbol), R3-2 (No Right Turn symbol)
Message Colors:
Red – Circle & Diagonal. Width of Circle and Diagonal – 1.5 " stroke – 3 pixel
Lunar White – Left Arrow or Right Arrow. Width of Arrow – 2" stroke – 4 Pixel
- The "NO LEFT TURN" and "NO RIGHT TURN" symbols shall be formed by rows of fiber optic bundles spaced 0.50 inch (center to center).
- Fiber optic bundles shall alternate between two or more lamp sources so that in the event of a lamp failure the sign shall continue to display a discernible and readable message.
- Refer to LADOT STD. DWG. No. S-63.1.4 for mounting assembly.
- Sign shall conform to LADOT Specification No. 82-049-03.
- For housing description, see LADOT STD. DWG. S-58.21
- 24" X 24" electric sign shall include a visor enclosure as shown.
- Lamps shall be solid state, 7W maximum.

DWN	MT	9-13-07	Title NO LEFT & NO RIGHT TURN ELECTRIC SIGN	
CKD				
T. E.				
Sr. T. E.				
Pr. T. E.	SS	6-26-08	CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION	
Approved  for Rita L. Robinson, General Manager			June 26, 2008 Drawing No. S-58.13	



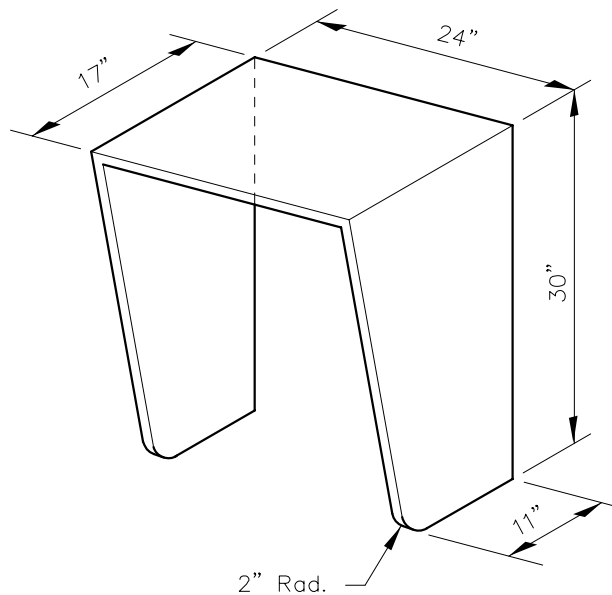
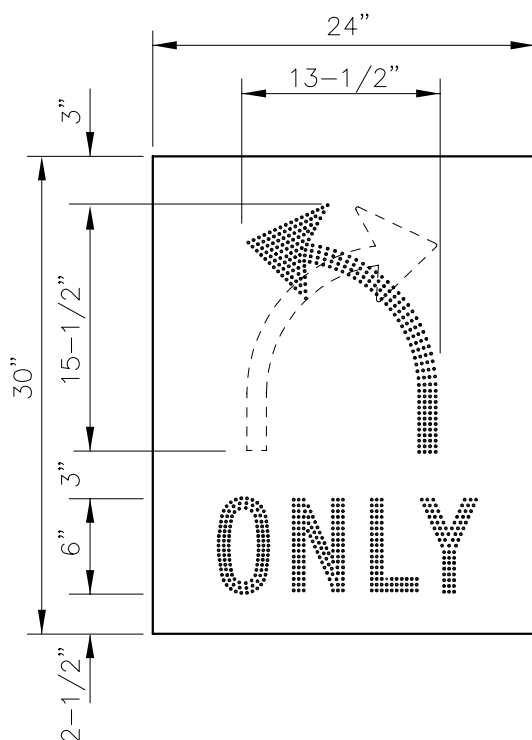
SIGN FACE

Not To Scale



VISOR ENCLOSURE

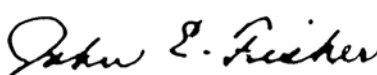
Not To Scale

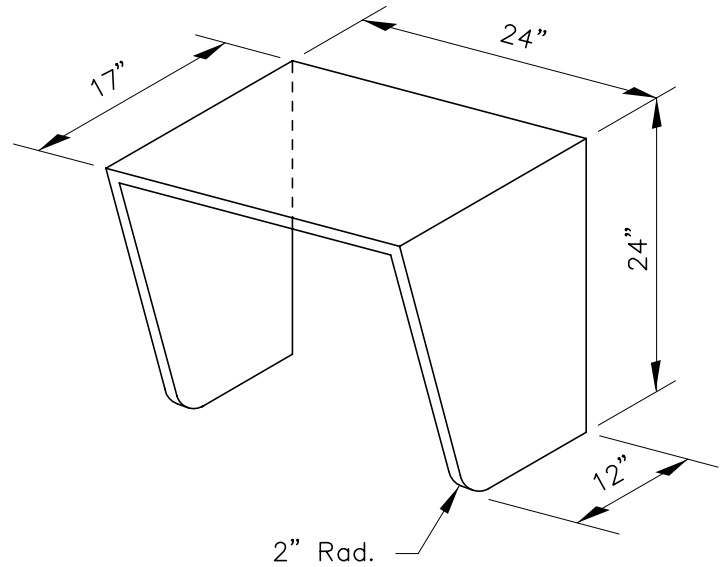
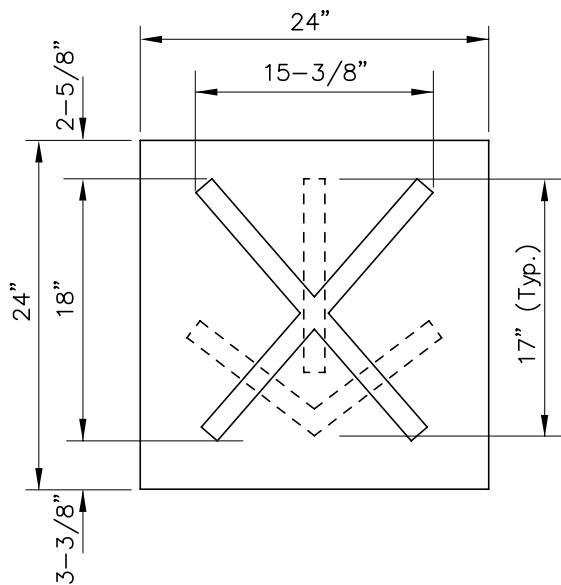


VISOR ENCLOSURE

NOTES:

- SIGN SHALL BE CAPABLE OF DISPLAYING THE FOLLOWING MESSAGES:
A: LUNAR WHITE - R3-5L (LEFT ARROW W/ONLY). WIDTH OF ARROW - 1.5" STROKE
B: LUNAR WHITE - R3-5R (RIGHT ARROW W/ONLY). LETTERS ARE SERIES "C", 1" STROKE
- MESSAGES SHALL BE FORMED WITH ROWS OF FIBER OPTIC BUNDLES.
SPACED 0.50 INCH (CENTER TO CENTER).
- FIBER OPTIC BUNDLES SHALL ALTERNATE BETWEEN TWO OR MORE LAMP SOURCES SO THAT IN THE EVENT OF A LAMP FAILURE THE SIGN SHALL CONTINUE TO DISPLAY A DISCERNABLE AND READABLE MESSAGE.
- SIGN SHALL COMPLETELY BLANK OUT WHEN NOT ENERGIZED.
- DOOR FRAME, FACE PLATE, AND INTERIOR OF HOUSING AND VISOR SHALL BE PAINTED FLAT BLACK NON-REFLECTIVE FINISH.
- VISOR ENCLOSURE SHALL BE FASTENED SECURELY TO THE FRONT FRAME OF THE SIGN.
- REFER TO LADOT STD. DWG. NO. S-63.1.4 FOR MOUNTING ASSEMBLY.
- SIGN SHALL CONFORM TO LADOT SPECIFICATION NO. 82-049-03.
- FOR HOUSING DESCRIPTION, SEE LADOT STD. DWG. NO. S-58.21.

DWN	MT	7-08-08	Title R3-5 ELECTRIC SIGN 
CKD	RAR	7-09-08	
T. E.	JV	7-09-08	
Sr. T. E.	JW	7-09-08	
Pr. T. E.	SS	7-09-08	
Approved 			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION
for Rita L. Robinson, General Manager			Drawing No. S-58.17

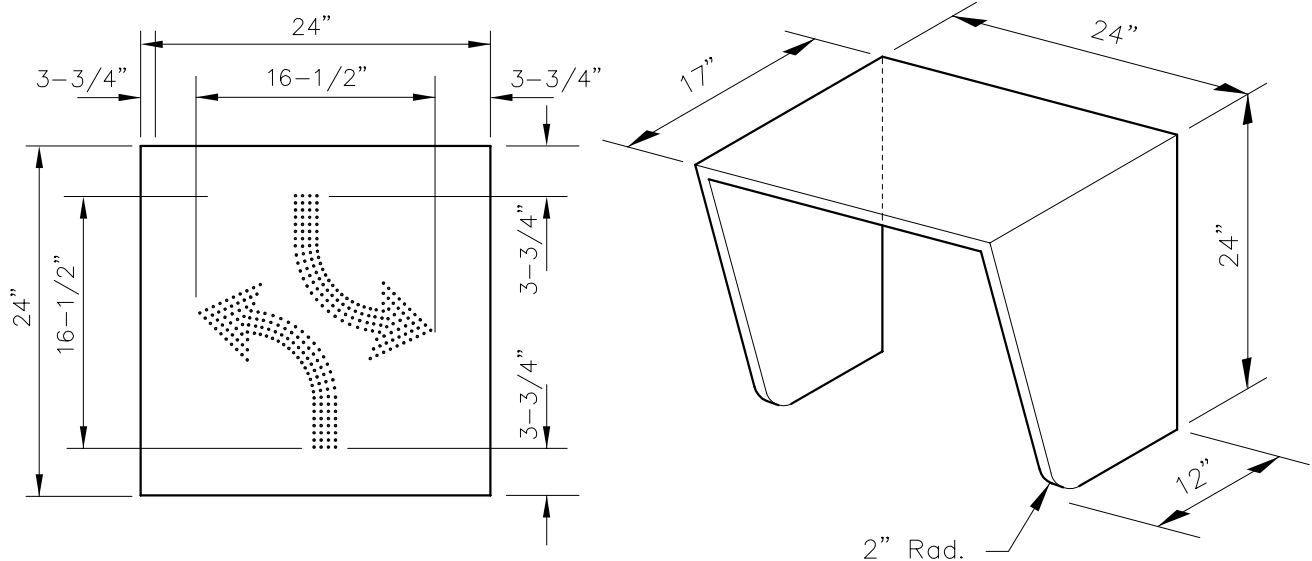


VISOR ENCLOSURE

NOTES:

- SIGN SHALL BE CAPABLE OF DISPLAYING THE FOLLOWING MESSAGES:
A: RED - "X" WIDTH OF "X" - 1.5" STROKE
B: GREEN ARROW (↓) WIDTH OF ARROW - 1.5" STROKE
- THE RED "X" SHALL BE FORMED WITH ROWS OF FIBER OPTIC BUNDLES SPACED 0.50 INCH (CENTER TO CENTER). THE GREEN DOWN ARROW SHALL BE FORMED WITH ROWS OF FIBER OPTIC BUNDLES, SPACED 0.50 INCH (CENTER TO CENTER).
- FIBER OPTIC BUNDLES SHALL ALTERNATE BETWEEN TWO OR MORE LAMP SOURCES SO THAT IN THE EVENT OF A LAMP FAILURE THE SIGN SHALL CONTINUE TO DISPLAY A DISCERNABLE AND READABLE MESSAGE.
- SIGN SHALL COMPLETELY BLANK OUT WHEN NOT ENERGIZED.
- DOOR FRAME, FACE PLATE, AND INTERIOR OF HOUSING AND VISOR SHALL BE PAINTED FLAT BLACK NON-REFLECTIVE FINISH.
- VISOR ENCLOSURE SHALL BE FASTENED SECURELY TO THE FRONT FRAME OF THE SIGN.
- REFER TO LADOT STD. DWG. NO. S-63.1.4 FOR MOUNTING ASSEMBLY.
- SIGN SHALL CONFORM TO LADOT SPECIFICATION NO. 82-049-03.
- FOR HOUSING DESCRIPTION, SEE LADOT STD. DWG. NO. S-58.21.

Drawn By	LR/HM	8-08-00	Title LANE USAGE CONTROL ELECTRIC SIGN	
Checked By	ERA	8-08-00		
Supervised By				
Reviewed By	GO	11-02-00		
Revisions			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION FRANCES T. BANERJEE, General Manager	
			Approved 11-03-00 Frances T. Banerjee General Manager	DRAWING NO. S-58.18

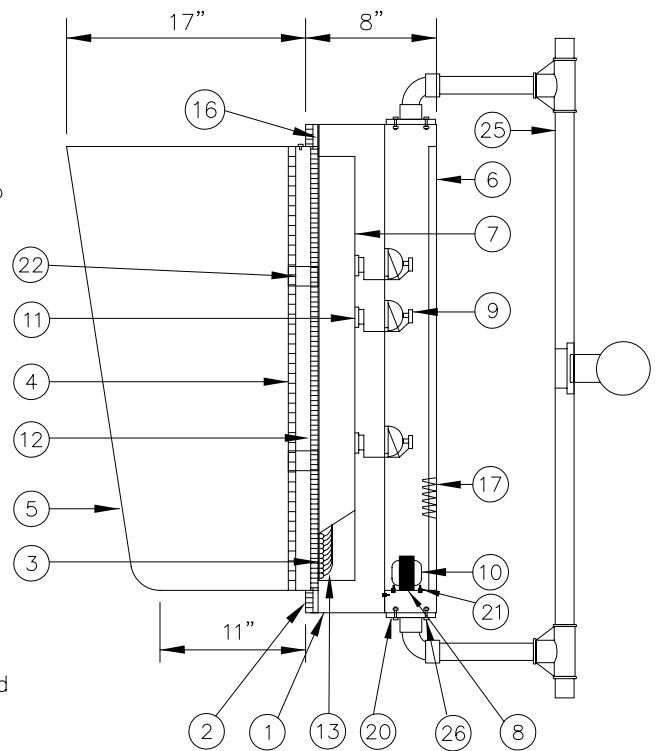
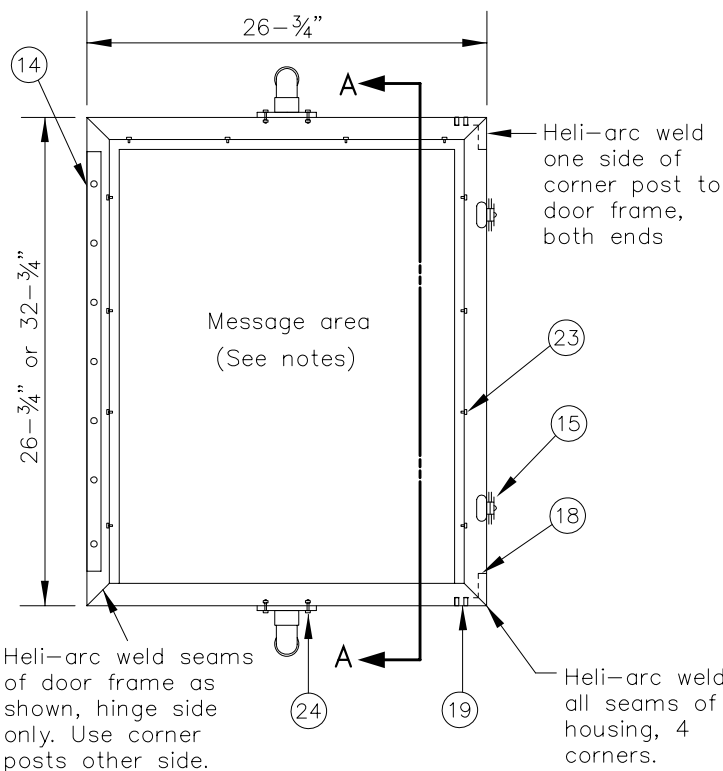


VISOR ENCLOSURE

NOTES:

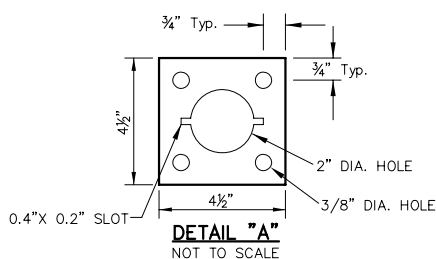
1. SIGN SHALL BE CAPABLE OF DISPLAYING THE FOLLOWING MESSAGES:
A: LUNAR WHITE – R3-9a (LEFT ARROWS) WIDTH OF ARROWS – 1.5" STROKE
2. MESSAGES SHALL BE FORMED WITH ROWS OF FIBER OPTIC BUNDLES. SPACED 0.50 INCH (CENTER TO CENTER).
3. FIBER OPTIC BUNDLES SHALL ALTERNATE BETWEEN TWO OR MORE LAMP SOURCES SO THAT IN THE EVENT OF A LAMP FAILURE THE SIGN SHALL CONTINUE TO DISPLAY A DISCERNABLE AND READABLE MESSAGE.
4. SIGN SHALL COMPLETELY BLANK OUT WHEN NOT ENERGIZED.
5. DOOR FRAME, FACE PLATE, AND INTERIOR OF HOUSING AND VISOR SHALL BE PAINTED FLAT BLACK NON-REFLECTIVE FINISH.
6. VISOR ENCLOSURE SHALL BE FASTENED SECURELY TO THE FRONT FRAME OF THE SIGN.
7. REFER TO LADOT STD. DWG. NO. S-63.1.4 FOR MOUNTING ASSEMBLY.
8. SIGN SHALL CONFORM TO LADOT SPECIFICATION NO. 82-049-03.
9. FOR HOUSING DESCRIPTION, SEE LADOT STD. DWG. NO. S-58.21.

DWN	MT	7-01-08	Title R3-9a ELECTRIC SIGN 1 1
CKD	RAR	7-09-08	
T. E.	JV	7-09-08	
Sr. T. E.	JW	7-09-08	CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION
Pr. T. E.	SS	7-09-08	
Approved <i>John E. Fisher</i> for Rita L. Robinson, General Manager			July 9, 2008 Drawing No. S-58.19

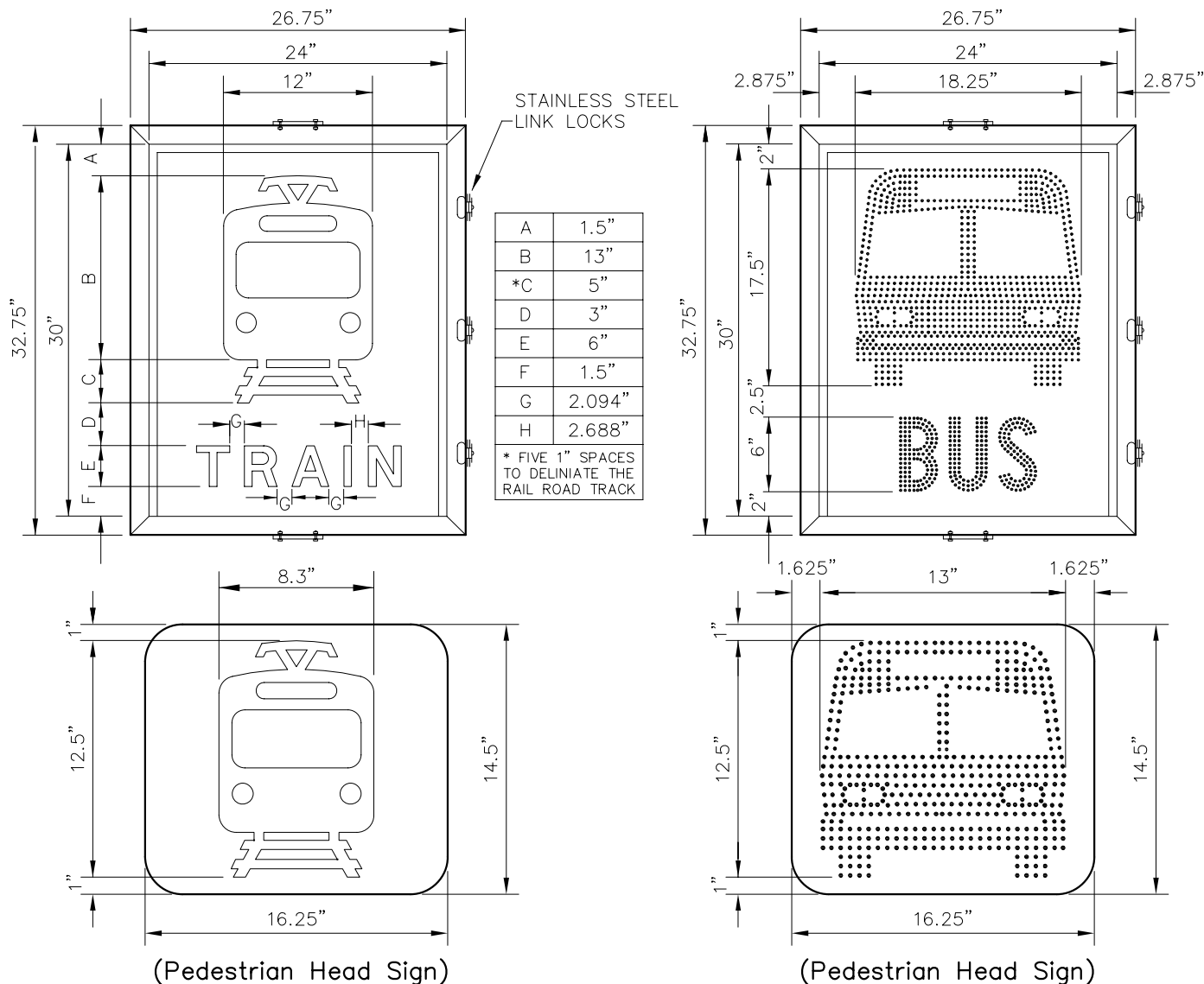


SECTION A-A

ITEM	DESCRIPTION	QTY.
1	HOUSING, .125" EXTRUDED ALUMINUM	1
2	DOOR FRAME, .125" EXTRUDED ALUMINUM	1
3	FACE PLATE, .08" ALUMINUM	1
4	MATTE/CLEAR POLYCARBONATE LENS, .125" THICK	1
5	VISOR .063" ALUMINUM	1
6	BACK PLATE, .063" ALUMINUM	1
7	OPTICS ENCLOSURE, .02" ALUMINUM	1
8	TRANSFORMER SHELF, .063" ALUMINUM	1
9	LAMPS, SOLID STATE 7W MAX.	AS REQ.
10	TRANSFORMERS, 120 VAC PRI., 12 VAC 25 VA SEC.	AS REQ.
11	COMMON ENDS (LIGHT INPUT), ALUMINUM	AS REQ.
12	END TIPS (LIGHT OUTPUTS), NYLON	AS REQ.
13	FIBER OPTIC GLASS BUNDLES, DIA. VARIES	AS REQ.
14	CONTINUOUS HINGE, 1-1/4" (OPEN) X .040" STAINLESS STEEL	1
15	1/4-TURN LINK LOCKS, STAINLESS STEEL	3
16	DOOR GASKET, 1" X 3/16" NEOPRENE (ALL SIDES CONTINUOUS)	1
17	TERMINAL BLOCK (3 PT.)	1
18	CORNER POSTS, ALUMINUM	2
19	#8 X 5/16" SLOTTED PAN HEAD SCREWS, STAINLESS STEEL	AS REQ.
20	4 1/2" X 4 1/2" X 1/4" REINFORCEMENT ALUMINUM PLATE (SEE DETAIL "A")	2
21	#8 -32 X 3/4" SLOTTED ROUND HEAD MACHINE SCREW, HEX NUTS & LOCK WASHERS (STAINLESS STEEL)	32
22	LENS STIFFENER BLOCKS, ACRYLIC	2
23	5/16" X 1-1/4" HEX HEAD MACHINE SCREW BOLT & HEX NUT VISOR SCREWS (STAINLESS STEEL)	12
24	5/16"X 1" HEX HEAD MACHINE SCREW BOLT & HEX NUT & LOCK WASHERS (STAINLESS STEEL)	8
25	MOUNTING BRACKET	1
26	1/2" WIRE ENTRY BUSHING	1

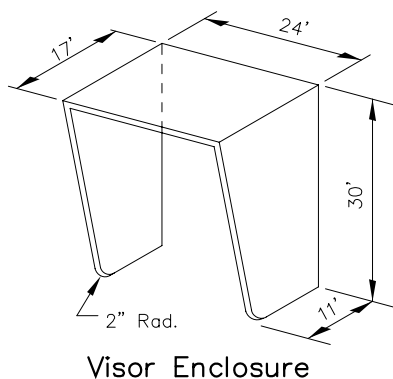


DWN	MT	11-07-07	Title SIGN ENCLOSURE
CKD			
T. E.			
Sr. T. E.			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION
Pr. T. E.	SS	6-26-08	
Approved <i>John E. Fisher</i> for Rita L. Robinson, General Manager			June 26, 2008 DRAWING NO. S-58.21

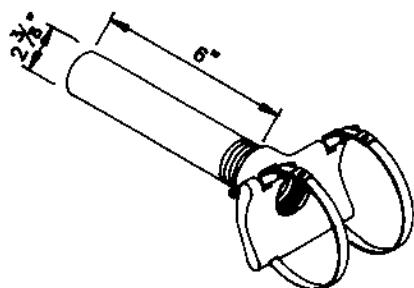


NOTES:

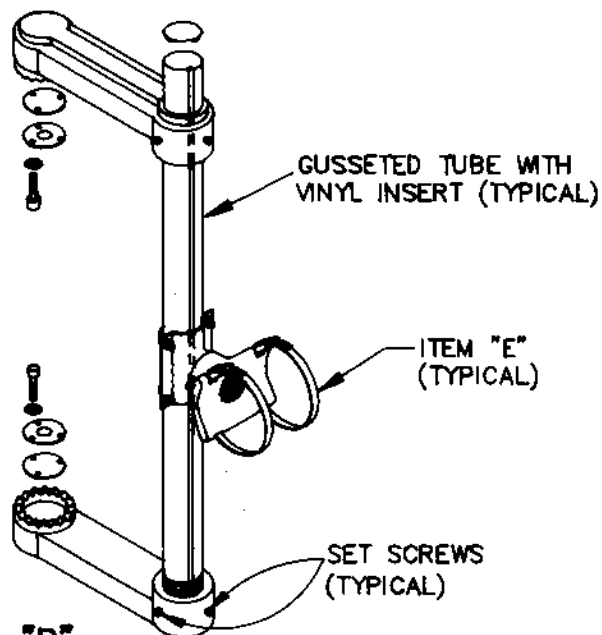
1. MESSAGES SHALL BE FORMED BY ROWS OF FIBER OPTIC GLASS BUNDLES.
2. DUAL ROWS OF FIBER OPTIC BUNDLES SHALL BE USED TO FORM THE WORD "TRAIN". LETTERS IN THE BUS WARNING SIGN MESSAGE SHALL HAVE A BRUSH STROKE OF 1-INCH. BUS SYMBOL AND LETTERS SHALL ALSO CONFORM TO THE LATEST EDITION OF THE FHWA STANDARD HIGHWAY SIGNS BOOK.
3. THE FRONT VIEW OF THE TRAIN OR BUS SHALL BE SOLID FORMED BY ROWS OF FIBER OPTIC GLASS BUNDLES.
4. THE COLOR OF THE MESSAGES SHALL BE YELLOW. THE SIGN BACKGROUND SHALL BE BLACK.
5. FIBER OPTIC GLASS BUNDLES SHALL ALTERNATE BETWEEN TWO OR MORE LAMP SOURCES. IN THE EVENT OF A LAMP FAILURE, THE SIGN SHALL CONTINUE TO DISPLAY A READABLE AND DISCERNABLE MESSAGE.
6. SIGN HOUSING SHALL BE EQUIPPED WITH FOUR (4) 3/16" DRAIN HOLES AT THE BOTTOM.
7. THE VISOR ENCLOSURE SHALL BE FASTENED SECURELY TO THE FRONT FRAME OF THE SIGN.
8. HOUSING SHALL CONTAIN 4 1/2" X 4 1/2" X 1/4" REINFORCEMENT PLATE LOCATED ON THE TOP AND BOTTOM FOR USE WITH THE PELCO ASTRO SIGN-BRAC INSTALLATION.
9. REFER TO STD. DWG. NO. S-63.1.4 FOR THE MOUNTING ASSEMBLY (T=46", L=29").
10. SIGN SHALL CONFORM TO LADOT SPECIFICATION No. 82-049-03.
11. FOR HOUSING DESCRIPTION SEE LADOT STD. DWG. NO. S-58.21



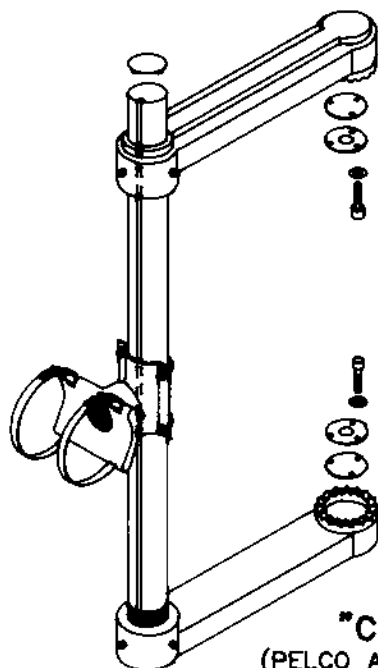
DWN	MT	4-16-08	Title
CKD			ELECTRIC TRAIN & BUS WARNING SIGN
T. E.			CITY OF LOS ANGELES
Sr. T. E.			DEPARTMENT OF TRANSPORTATION
Pr. T. E.	SS	6-26-08	
Approved			June 26, 2008
for <i>John E. Fisher</i>			DRAWING NO.
Rita L. Robinson, General Manager			S-58.23



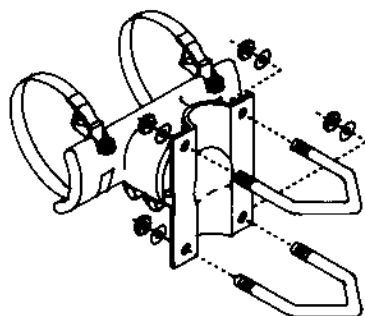
"A"
(PELCO AB-3008)



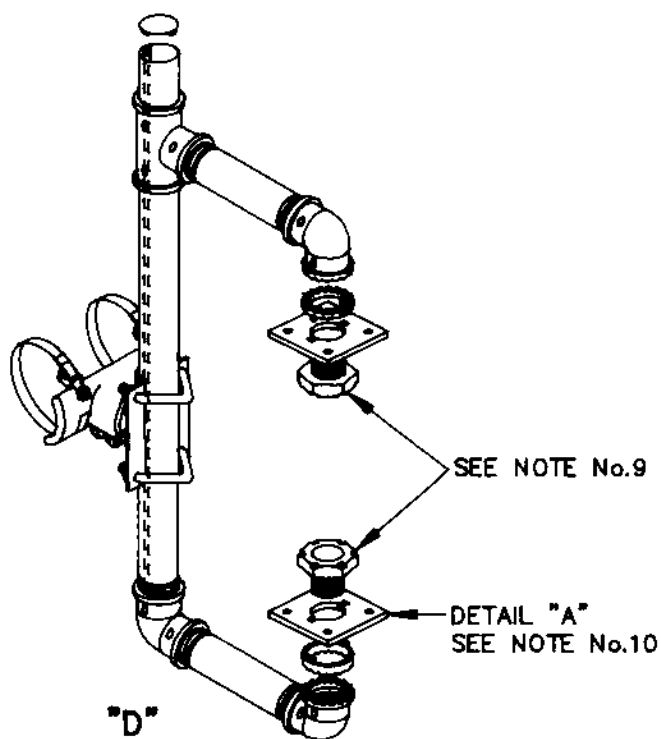
"B"
(PELCO AB-116)



"C"
(PELCO AB-103)



"E"
(PELCO AB-3004)

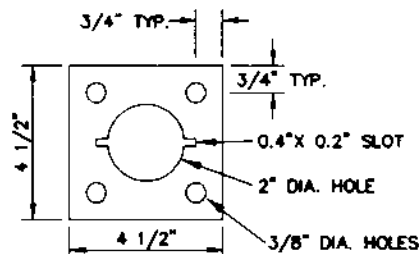


"D"
(PELCO AB-0129 T-L)
(MODIFIED)

Drawn By	AC	5-12-98	SPECIAL MAST ARM MOUNTINGS 1/2
Checked By	AM	5-12-98	
Supervised By	AM	5-12-98	
Construction By	BAL	5-22-98	
Revisions			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION THOMAS K. CONNER, General Manager Approved <u>MAY 21, 1998</u> <u>Thomas Conner</u> General Manager
			DRAWING NO.
			S-63.1.4

NOTES:

1. ITEM "A" IS THE BASIC MOUNTING DESIGN FOR MOST MAST ARM SIGNAL INSTALLATIONS WHEN STANDARD TENON LOCATION ON THE MAST ARM CANNOT BE UTILIZED. IT USES A 6" TENON LENGTH WITH $2\frac{3}{8}$ " OUTSIDE DIAMETER FOR PLUMBIZER MOUNTING.
2. ITEM "B" IS USED FOR INSTALLATION OF TRAFFIC SIGNAL HEADS, EXCEPT PROGRAMMED VISIBILITY (P.V.) HEADS, WHEN IT IS DESIRED TO MOUNT THEM HORIZONTALLY OR TO ADJUST THE HEIGHT VERTICALLY BY MOVEMENT OF ITEM "E".
3. ITEM "C" IS USED FOR INSTALLATION OF HORIZONTAL OR VERTICAL PROGRAMMED VISIBILITY (P.V.) HEADS. IT IS EQUIPPED WITH 14" ARMS WHICH ALLOW FOR REPLACEMENT OF SIGNAL LAMPS LOCATED IN THE REAR OF THE SIGNAL HEAD.
4. ITEM "D" IS USED FOR INSTALLATION OF ELECTRIC SIGNS.
5. ITEM "E" IS A STANDARD CLAMP KIT DESIGNED TO BE USED FOR FASTENING ITEMS "B", "C", AND "D" TO MAST ARMS OR POLES IN A VERTICAL OR HORIZONTAL POSITION.
6. THE BOTTOM ARMS IN ITEMS "B", "C", AND "D" ARE STATIONARY AND ARE HELD IN PLACE WITH PIPE THREADS AND SET SCREWS. THE UPPER ARMS SLIDE ALONG THE SHAFT AND ARE HELD IN PLACE WITH SET SCREWS.
7. THE STANDARD 29" BAND FOR ITEM "A" AND "E" FITS A 4" TO 8.6" DIAMETER. BAND LENGTHS UP TO 56" CAN BE USED FOR LARGER DIAMETER INSTALLATIONS.
8. ITEMS "A" THROUGH "E" ARE AVAILABLE FROM PELCO PRODUCTS INC. OR EQUIVALENT.
9. THE $1\frac{1}{2}$ "X $1\frac{1}{2}$ " ALUMINUM LOCK NUT SHOWN WITH ITEM "D" IS COMMONLY USED FOR SIGNAL HEAD & PEDESTRIAN HEAD INSTALLATIONS.
10. THE $4\frac{1}{2}$ "X $4\frac{1}{2}$ "X $\frac{1}{4}$ " ALUMINUM PLATE IS USED FOR SIGN BOX REINFORCEMENT AT BRACKET INSTALLATION LOCATION AND MUST BE SPECIALLY FABRICATED.



DETAIL "A"
 $4\frac{1}{2}$ "X $4\frac{1}{2}$ "X $\frac{1}{4}$ "
ALUMINUM PLATE
 NOT TO SCALE

Drawn By	AC	5-7-98	Title SPECIAL MAST ARM MOUNTINGS 2/2
Checked By	AM	5-7-98	
Supervised By	AM	5-7-98	
Construction By	Jp	5-22-98	
Revisions			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION THOMAS K. CONNER, General Manager
Approved _____ General Manager			DRAWING NO. S-63.1.4

CITY OF LOS ANGELES
DEPARTMENT OF TRANSPORTATION
Dynamic Speed Feedback Signs
PURCHASE SPECIFICATION
82-051-02
February 2012

Purpose

This specification provides performance requirements for a Dynamic Speed Limit Sign or also referred to as a “Radar Speed Feedback Sign” assembly. The scope of services shall include, but not be limited to, the following:

- Furnish Radar Speed Feedback Signs
- Furnish mounting brackets
- Furnish and install desktop software
- Provide on-site technical assistance to City forces during sign installations.

Physical

Radar Speed Feedback Signs shall display letters and numerals using amber (592 nm) LED clusters.

- Signs shall display numerical numbers (a.k.a. “Lower Display”) using numbers that are at least 16" (H) x 9" (W) amber LED's. The numeric digital range shall be 0 to 99 MPH with two numerals capable of displaying zero to nine.
- Sign dimensions shall be at least 45" (h) x 28.5" (w) x 4.5" (d).
- Sign power shall be 150 Watts or less. Sign amperages shall be less than 3 amps @ 12 VDC (0.36 kW/hr.), less than 4 amps @ 24 VDC (0.96 kW/hr), or less than 1.2 amps @ 120 vac.(.144 kW/hr). Voltages shall be 12 VDC, 24 VDC, or 120 VAC.
- Sign frame shall be made of heavy duty (.090 gauge) welded aluminum with a painted gloss black powder coat.

Display

Signs shall be able to display the optional messages “SPEED LIMIT”, “YOUR SPEED”, and “SLOW DOWN” (a.k.a. “Upper Display”) using letters that are 6" (H) x 4" (W) in amber LED's.

Operation

- Communicable data shall include, but not be limited to, time-of-day schedules, vehicular traffic counts, and vehicular speeds.
- Signs shall be able to count and store data for 100,000 cars per day for a 30-day period.
- Signs shall be able to have five shutdown times per day.
- Signs shall be capable of displaying to the motoring public:
 - “SPEED LIMIT” setting conforming with MUTCD No. R2-1 sign. This setting shall display a static message.
 - “YOUR SPEED” setting displaying a vehicle's actual speed. Signs shall have built-in radar units and dynamic numeric displays. The “YOUR SPEED” portion of the signs shall be static and the numeric portion of the signs shall be able to change according to the speeds of oncoming vehicles.
 - “SLOW DOWN” setting displaying the message “SLOW DOWN” when a vehicle exceeds a programmed limit. Signs shall be programmable to function based on a user-defined programmed limit.
 - “BLANK-OUT” setting displaying no message or numerals.

- The Controller and radar device should be able to collect data even when the display to the driver is “BLANK-OUT” or dark.

Data Collection / Computer interface

Vendor shall provide a Centralized WEB based Programming, DATA collection, sign management system.

Data collection shall be accessible in a single database to allow reports to be retrieved on demand within user-specified date ranges. This data collection should also allow the user to prepare Graphs and Calculations, PERCENTILE GRAPHS, TIME OF DAY GRAPHS, that could be used if the agency (LADOT) needs to request Law Enforcement measures

It is requested that the software also include a configuration simulator to allow the “programmer” to demonstrate the functionality to others prior to deployment.

Data collection should be automatically obtained via connect and download from and IP modem (wireless).

Contractor shall be responsible for furnishing appurtenant items including, but not limited to, connection kits and mounting brackets.

Contractor shall furnish technical support in the form of a technician present at all sign installations.

All parts and software shall be under warranty for one year after acceptance of work.

If a vendor has several models of a Radar Speed Feedback Sign (e.g., solar-powered sign vs. non-solar-powered sign), the vendor may submit several bids per model.

Measurement and Payment - Full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all of the work in compliance with this specification for the “Radar Speed Feedback Sign,” including but not limited to installing software, furnishing signs and appurtenant items such as connection kits and mounting brackets, furnishing handheld programming devices, and furnishing and installing software on handheld and desktop devices, shall be included in the per each unit price for:

**CITY OF LOS ANGELES
DEPARTMENT OF TRANSPORTATION
May 1982**

Specification No. 92-039-03**For: Cable, 7 Conductor, Communications Type****I. PURPOSE**

The purpose of this specification is to describe insulated cable for use in communications between traffic signal installations.

II. CABLE ARRANGEMENT

The cable shall be made up of 7 conductors, each of 18 gauge 19 strands tinned copper wire. The cabling shall be done on a planetary type helical cabling machine in such a manner that no twist is introduced into the individual cable members.

III. PROTECTION AND INSULATION**A. Sheath. (Outer Jacket)****1. Material**

The outer jacket of the cable shall be of black polyethylene per LP-390C, Type III, Class L, Grade 3.

2. Thickness

Thickness of the outer jacket shall be .045 inches + .003 inches.

B. Tape Barrier

A tape barrier shall be provided, constructed of Mylar Tape in accordance with Mi 1-1-631 Class G specification.

C. Insulation**1. Material**

Insulation shall be 1/64 inches thick, 105 degrees C, PVC, in accordance with Mil-W-16878 D Type C specification.

2. Voltage

Insulation breakdown voltage shall be greater than 8,000 volts AC RMS, 60 CDC.

3. Leakage Resistance

Insulation leakage resistance shall be 100 Megohms/1000 ft. min. at 500 VDC from any conductor to all else in cable or better.

IV. TEMPERATURE RANGE

The usable temperature range of the cable shall be suitable for continuous use from + 1050 C to - 550 C.

V. COLOR CODE

The color code of the individual conductors shall be in accordance with Mil-Std-681 specification:

Conductor No.	Body Color	Stripe
1	White	None
2	Red	None
3	Orange	None
4	Black	None
5	Red	Black
6	Orange	Black
7	Blue	Black

VI. TRACERS

Base color and tracer shall be clearly distinguishable in normal sunlight from a distance of six (6) feet.

Tracers shall be molded or applied in such a manner so that the tracer cannot be removed by scraping or removed with oil or thinner.

VII. SAMPLING, INSPECTION, AND ACCEPTANCE

A. General

1. Inspection and tests shall be made prior to shipment and at the place of manufacture.
2. The manufacturer shall, when requested by the purchaser at time of placing each order, furnish the purchaser in suitable form, a certified report of the tests made on the cable to show compliance with this specification, a letter of certification shall not be acceptable in lieu of the Certified Test Report.

3. If the purchaser prefers factory inspection by his own inspector, this shall be indicated by the purchaser when placing the order and the manufacturer shall notify the purchaser sufficiently in advance of completion of the cable to permit arrangement for the customer's representative to be present at the inspection.
4. The manufacturer shall afford the inspector, without charge, all reasonable facilities to satisfy him that the cable is being furnished in accordance with this specification.
5. The purchaser, at his option, may make the various tests on samples in his own laboratory or elsewhere, but such tests shall be made at the expense of the purchaser.
6. A seventy-two (72) inch sample of each single conductor, to be used in any given cable, shall be provided for approval by the purchaser prior to construction of the complete cable.

B. Tests

1. Tests on entire cable. The individual conductors of each length of completed cable shall meet the -voltage and insulation resistance requirements of Section IV Insulation, International Municipal Signal Association, Inc., Specification number 20-2...1973 (or later), except that the final electrical test on multi-conductor cable may be made without immersion in water. Each conductor of a multi-conductor cable shall be tested against all other conductors and shield if present.
2. Sample tests. One sample for establishing conformity to this specification shall be taken from each 3,000 feet of cable or reel.

In case a sample fails to meet the specification requirements, two additional samples shall be selected from the cable and the reel shall be accepted if retests are both satisfactory.

However, in case of any failure on the retest, the reel shall be rejected.

C. Re-inspection

The manufacturer may re-examine rejected material and submit it for re-inspection at his option.

VIII. MARKING FOR SHIPMENT AND CABLE PACKING

Cable shall be provided in minimum single lengths of 3,000 feet on each reel. Reels shall be non-returnable, substantially constructed, and in good condition. Essentially, the following information shall be plainly and permanently marked in one-inch letters on both sides of each reel - the name "City of Los Angeles"; the words "Cable, 7 Conductor Communications Type; the purchase order number; the purchase order date; the number of feet of cable actually on the reel.

Cables shall be suitably protected. Each end shall be available for testing, properly sealed, and protected against injury. Cables shall be furnished in continuous lengths without a joining or joint made by splicing of any conductor.

IX. IDENTIFICATION

Each shipping length of cable shall have the name of the manufacturer, the name "City of Los Angeles", and the year in which the cable is manufactured, applied to the outer surface of the jacket. Additionally, the name "City of Los Angeles" shall be applied about every five feet on the outer surface of the jacket.

X. GUARANTEE

The manufacturer of cable under this specification shall agree to replace any length of cable found to be defective in workmanship or material within one year from date of installation, but not more than two years from the date of delivery to the user. All replacement costs for materials and transportation shall be born by the manufacturer.

CITY OF LOS ANGELES
DEPARTMENT OF TRANSPORTATION
August, 1982

Specification No. 92-044-04

For: Cabinet, Traffic Signal Control Type M (Formerly Type C-5A)

I. PURPOSE

The purpose of this specification is to describe the general and specific requirements for a Traffic Signal Control Cabinet, Type M (formerly a Type C-5a).

II. CONSTRUCTION

The cabinet shall be fabricated of No 14 U.S.S. gauge sheet steel or a high-grade aluminum sheet not less than 0.125 inch thick. The welding of the corners, sides and top of the cabinet shall be water tight and of equal or greater thickness than the base metal after the grinding and smoothing is completed. The name "City of Los Angeles" shall be molded, cast, or scribed in quarter inch letters on the outside, top center area, of the cabinet door. A hinged door shall include substantially the full area of the front of the cabinet. The door and gasket of the cabinet shall be waterproof and dust tight. The door hinge pins shall be made of stainless steel. The cabinet door shall be equipped with a three point keyed tumbler lock that accepts a No.2 key and a door latching handle capable of being locked by a padlock. Handle shall not extend beyond the leading edge of the door when the handle is in either the locked or unlocked position. The auxiliary police door shall have a lock that accepts a standard police key with a shaft that is 1-3/4 inches long. Two sets of keys are to be included with each cabinet. A door stop shall be provided with a catch which will operate when the door is moved to its 90° and 180° open position. The stop and catch shall hold the door securely in place until the catch is manually released.

III. SIZE

The cabinet size shall be as shown on Department of Transportation Drawing No. S-75.5.3~ It shall be designed to mount on a Department of Transportation Type F-12A foundation as shown on Department of Transportation Drawing S-52.1.2B. Two anchor bolts shall be furnished. They shall be 5/8 inches in diameter, 16 inches long, plus a two inch angle extension.

IV. VENTS AND FAN

Each cabinet shall have louvered vents with a replaceable glass fiber air filter near the bottom which will permit the fan to pass 100 cubic feet of air per minute minimum. A fan shall be mounted at the top of the cabinet capable of exhausting a minimum of 100 cubic feet of air per minute. The fan shall be thermostatically controlled and adjustable from 90°F to 150°F with a differential of not more than 10°F between turn-on and turn-off. The cabinet fan circuit shall be fused at 125% of the maximum current rating of the motor installed. The fan shall be equipped with ball or roller bearings. The fan and vent shall be located with respect to each other so as to direct the bulk of the air flow over the controller unit (or through the ventilating holes of the controller unit, where such holes exist), and the load switches. The fan shall be covered by protective screenings.

V. FINISH

The exterior shall be silver gray and the interior gloss white. The finish shall be an enamel or a polymeric coating system. All coating shall be commercially smooth, free of flow lines, paint washout, streaks, blisters, or other defects that would impair serviceability or detract from general appearance. The minimum hardness of the coating should be equal to the hardness of an HB Eagle Turquoise Pencil.

VI. SHELVES

Each cabinet shall be equipped with two shelves. The shelves shall be 11 inches + one inch deep and extend the full width of the cabinet. All shelves shall be adjustable and capable of supporting a load of 200 pounds. The shelf adjustment increment shall be two inches maximum, and the shelves shall be adjustable from 20 inches above the cabinet base to within 10 inches from the top of the cabinet. The shelf adjustments shall consist of channel-lock clamps, or by key-hole bolting. Machine screws and bolts shall not protrude beyond the outside wall of the cabinet.

VII. SAMPLES

Bidders shall be required to furnish for inspection, prior to the awarding of bids, a detail drawing and a sample of the cabinets they bid on.

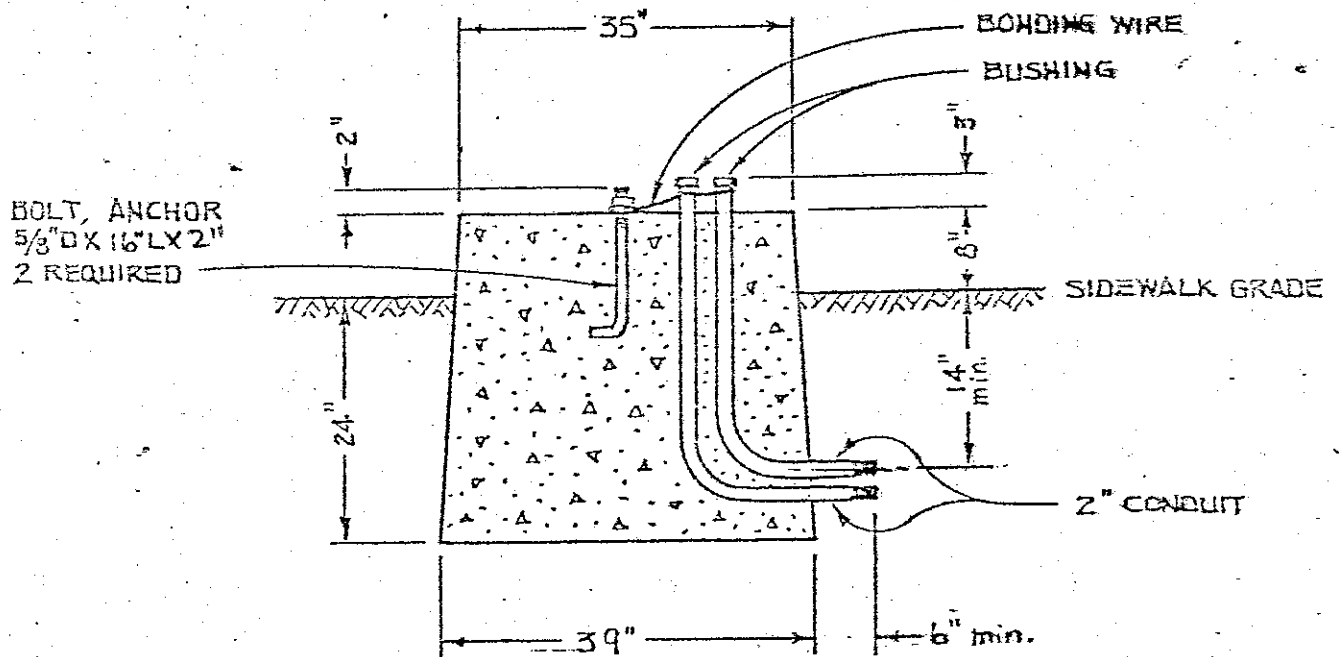
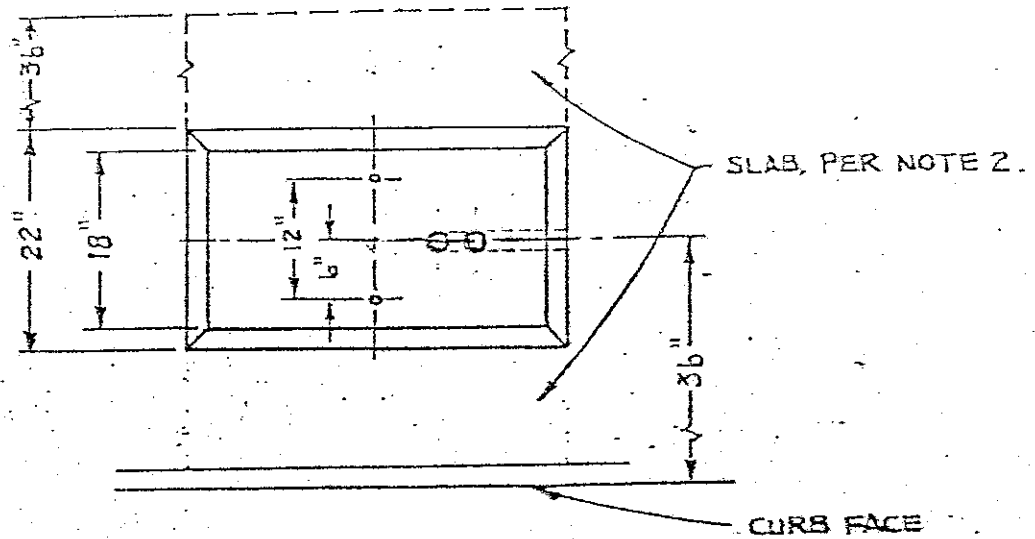
After award of contract, and before delivery of the entire order, one cabinet shall be furnished for inspection as to design, workmanship, and compliance with this specification. Upon acceptance of the sample, the remainder of the order shall be delivered.

VIII. DELIVERY AND WARRANTY

All cabinets shall be delivered to the City of Los Angeles Department of Transportation, General Shop. All deliveries to be made during the hours of 9:00 AM and 2:00 PM any working day, except Friday. The cabinet will be checked by the Signal Shop prior to acceptance and payment. Any deviation from the original approved sample can be considered a failure to comply with specification. The supplier shall be responsible for removing a rejected cabinet from the Signal Shop. The cabinet shall carry a warranty for a period of one (1) year from the date of test and acceptance by the City of Los Angeles, Department of Transportation.

The warranty shall cover all manufacturer's defects, parts, labor, and shipping costs. The warranty for each unit of equipment which requires repair by the vendor shall be extended by the length of time the unit is out of service for warranty reasons.

Attachments: Drawings S-52.1.2B, 5-75.5.3



NOTE:

1. CONDUIT CONSISTS OF (2) 2" NOMINAL SIZE UNLESS OTHERWISE SPECIFIED
2. SLAB SHALL BE CONSTRUCTED AS PER STANDARD SPECIFICATION FOR PUBLIC WORKS CONSTRUCTION, SECTION 307, 1979 EDITION OR LATEST EDITION.

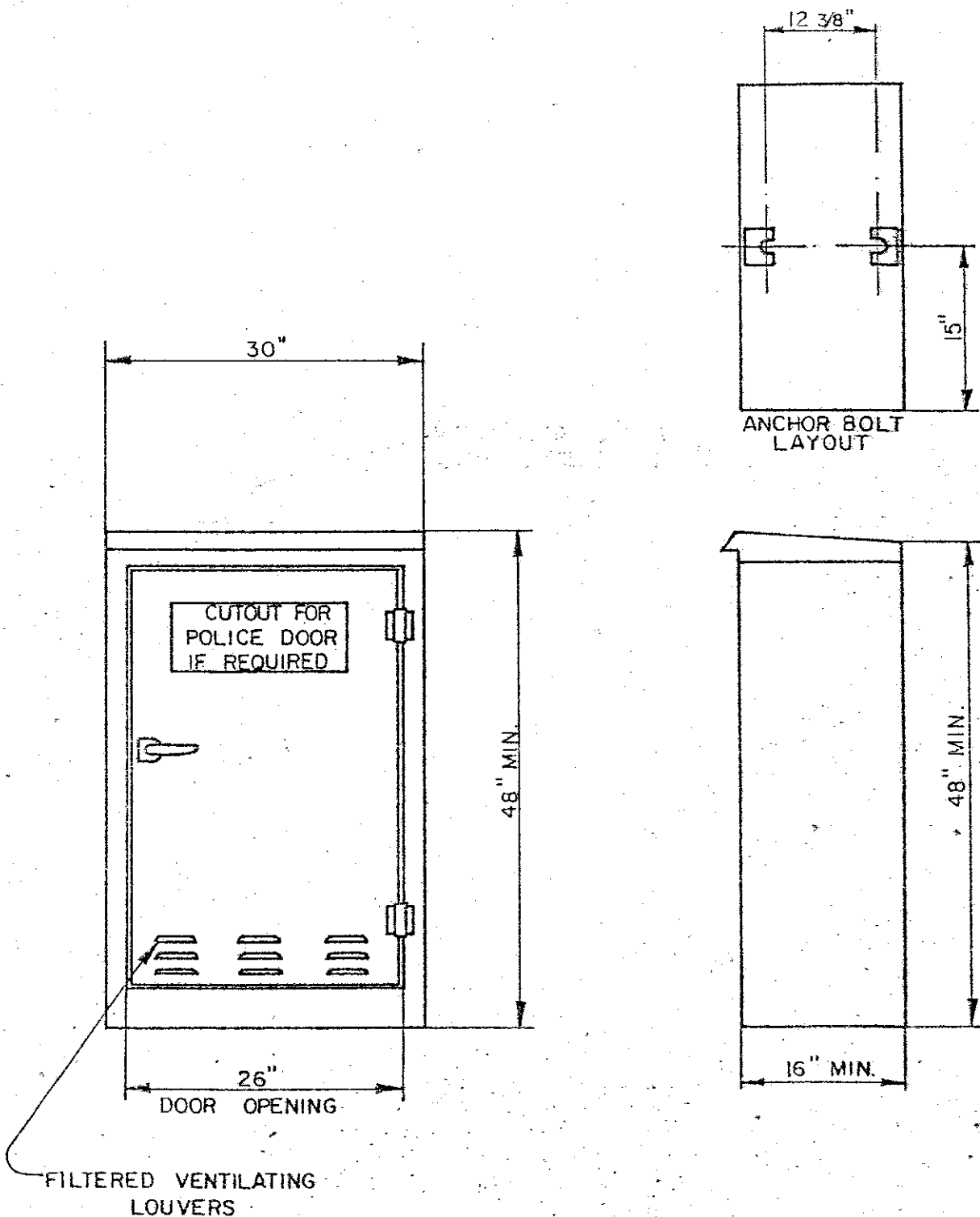
Drawn By	M.T.	11-18-80
Checked By	RD	12-22-80
Supervised By	W.H.	12/29/80
Reviewed By	HC	12/29/80
Revisions		

FOUNDATION, TYPE F-12A

CITY OF LOS ANGELES
DEPARTMENT OF TRANSPORTATION
DONALD R. HOWERY, General Manager

Approved: DEC 30, 1980
Donald R. Howery
General Manager

DRAWING NO.
S-52L2F



SPECIFICATION No. 92-044-04

Drawn By	FAS	7-22-82	Title	CABINET, CONTROLLER TYPE M		
Checked By	RD	7-29-82				
Supervised By	JF	8-2-82				
Reviewed By	MC	8-2-82				
Revisions			CITY OF LOS ANGELES			
			DEPARTMENT OF TRANSPORTATION			
			DONALD R. HOWERY, General Manager			
			Approved	August 2, 1982	DRAWING NO.	
			Donald R. Howery		S-75.5.3	
			General Manager			

**CITY of LOS ANGELES
DEPARTMENT of TRANSPORTATION**

Pedestrian Pushbutton Housing

PURCHASE SPECIFICATION

92-052-04

February 2012

This specification outlines the requirements of the City of Los Angeles Department of Transportation (LADOT) for the purchase of a **Pedestrian Pushbutton Housing** without sign or pushbutton assembly. The Pedestrian Pushbutton Assembly and pushbutton signs are covered under separate specifications and shall not be furnished as part of this contract.

General

The housing frame shall be an adjustable design (universal mount) that will conform to standard specified diameters of traffic signal poles and a flat surface. See attached drawings LADOT S-51.7 and S-72.0A

The housing and top plate shall be die-cast or permanent mold cast aluminum with a powder coat finish, black or dark green in color.

The housing shall provide (2) pre threaded holes for 1/4-20 machine screws to attach the top plate onto a 2.5 inch diameter Type 7 pushbutton standard. The top plate and its mounting hardware shall be available as a separate line item.

The housing shall be designed for installation of an ADA compliant, 50-millimeter pushbutton assembly.

The housing design shall incorporate stainless steel threaded inserts to accommodate 8-32 machine screws corresponding to specified sign and pushbutton assembly mounting hole patterns as shown in the attached layout drawing.

Required Hardware

Each Pedestrian Pushbutton Housing shall be provided with the following hardware:

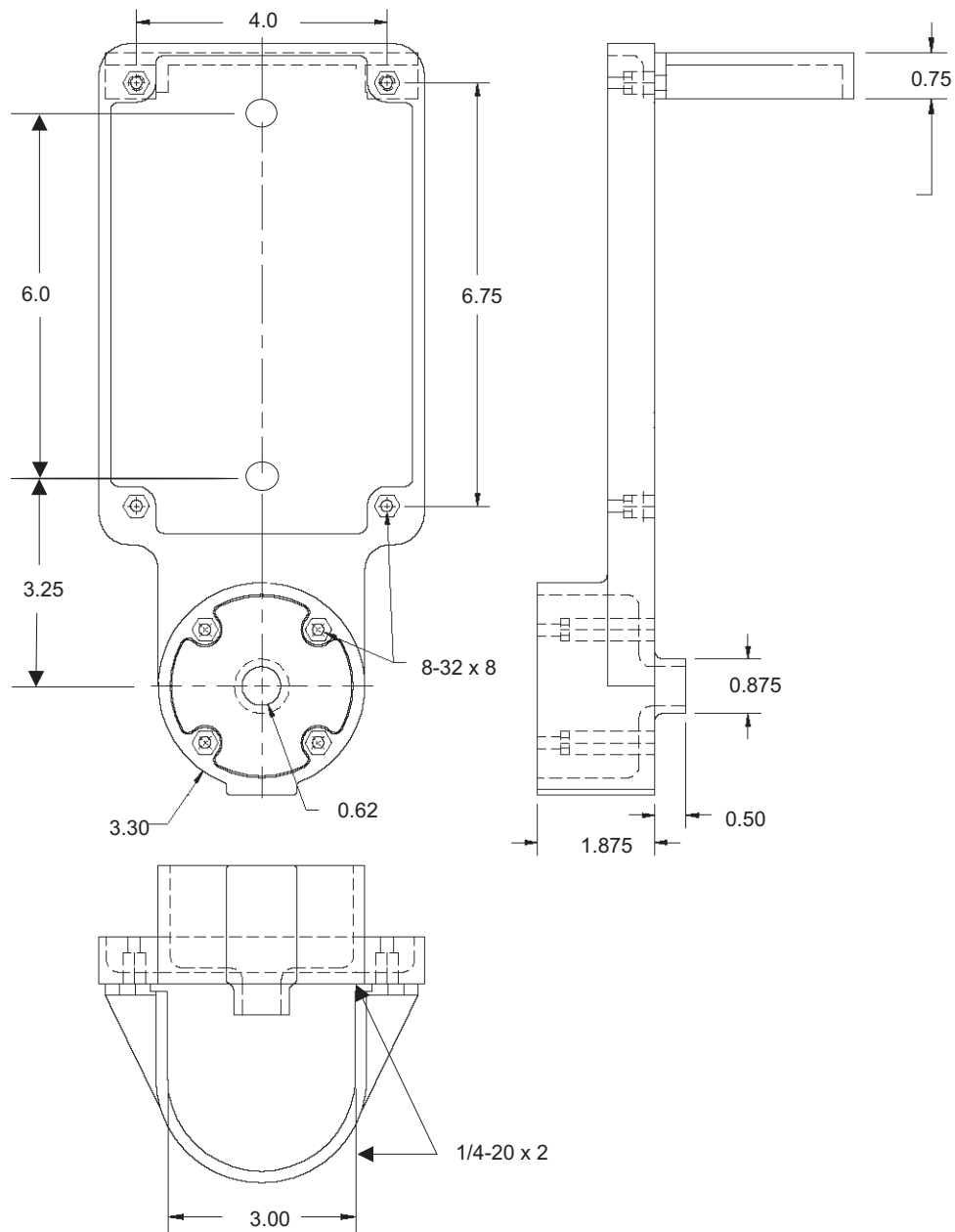
- (2) 1/4-20 #302/303 stainless steel, hex head machine screws, one inch in length for mounting the housing to the signal standard.
- (4) #8-32 x 1/2 inch stainless steel, TORX T15, pan head tamper proof machine screws for attaching a sign to the housing.

- (2) 1/4-20 #302/303 stainless steel, phillips head machine screws furnished with each top plate
- Each housing kit shall include (2) 2-gram pouches of anti-seize gel “Loctite” part number 51299 or equivalent.

Product Samples

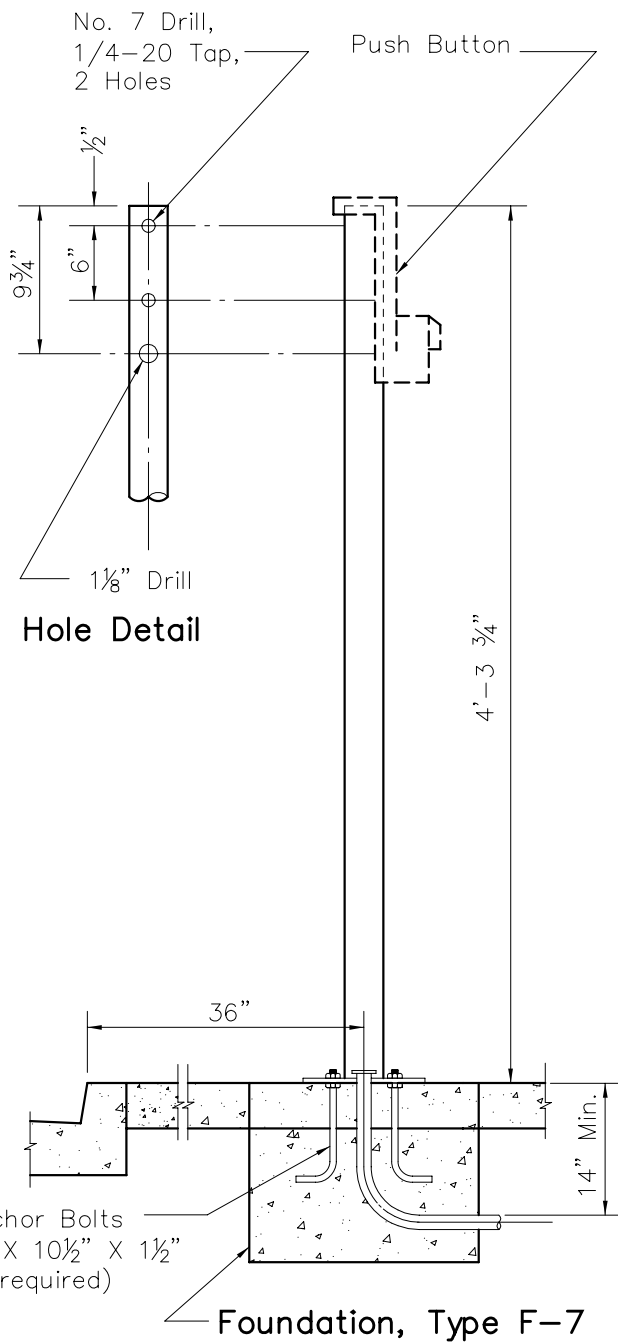
Product samples for bid proposals must be submitted to the LADOT Signal Lab for evaluation and compliance testing. The manufacturer/bidder shall make all arrangements and cover all costs for shipping of samples to and from the LADOT Signal Lab.

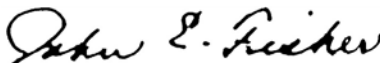
LADOT Signal Lab
555 Ramirez Street, Space 100
Los Angeles, CA 90012

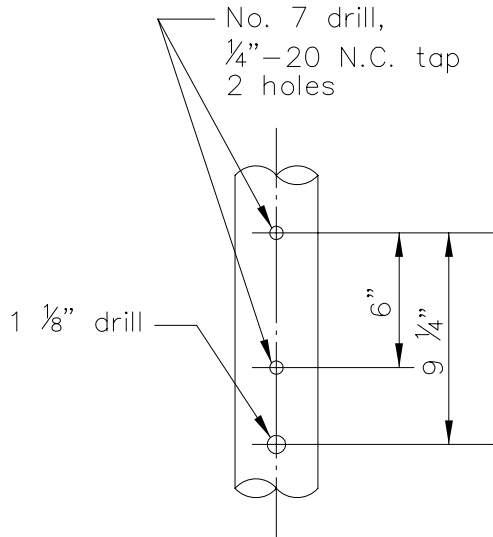


**Ppb Housing
General Layout**

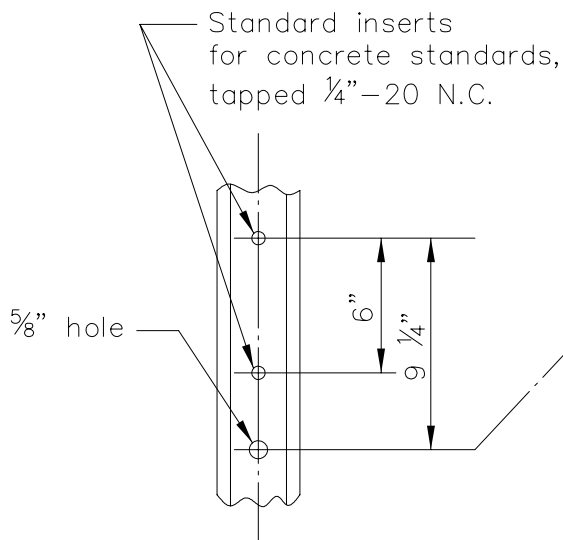
1. Shaft Material: 2½" Std. Schedule 40 Pipe.
2. Finish: Hot dip galvanize after fabrication per ASTM spec. A-120



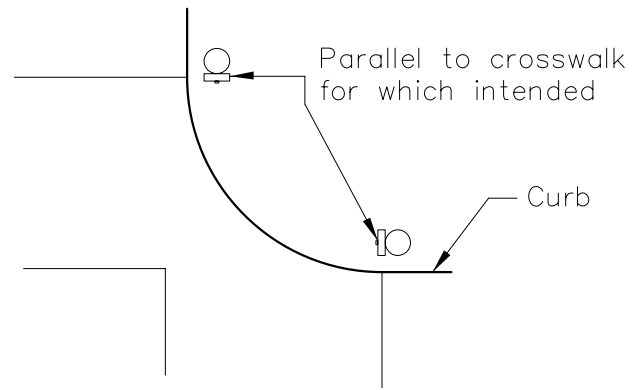
DWN	MT	7-09-07	Title
CKD	RAR	2-05-08	
T. E.	JV	2-11-08	
Sr. T. E.	JW	2-13-08	CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION
Pr. T. E.	SFS	2-13-08	
Approved			June 26, 2008
			Drawing No.
for Rita L. Robinson, General Manager			S-51.7



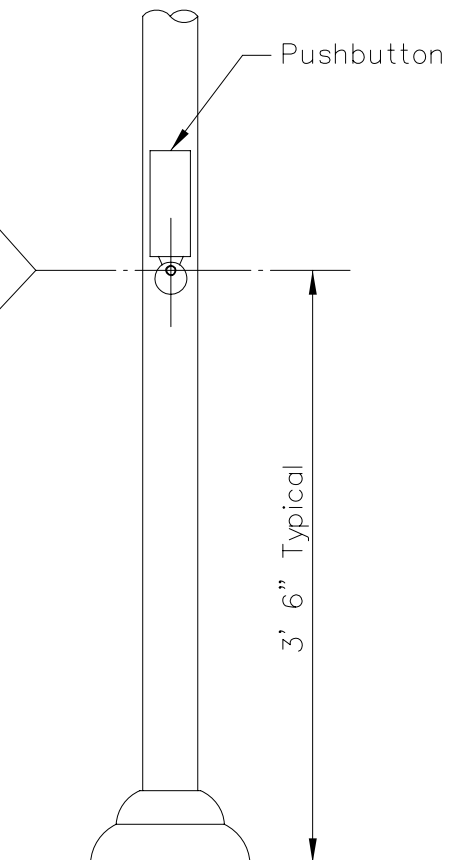
STEEL STANDARDS



CONCRETE STANDARDS



Typical arrangement



Drawn By	RLC	11/72	Title	PUSHBUTTON, INSTALLATION	
Checked By					
Supervised By					
Reviewed By					
Revisions				CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION	
UPDATED	RO	JAC	12-22-82	Donald R. Howery, General Manager	
				Approved March 5, 1973	DRAWING NO.
				Donald E. Bass	S-72.0A
				Sr. Design Engineer	

**CITY OF LOS ANGELES
DEPARTMENT OF TRANSPORTATION**

Pedestrian Pushbutton Assembly

SPECIFICATION

92-053-04

February 2012

Purpose

This specification defines performance requirements for a Pedestrian Push-Button assembly, known hereafter as PPB. The PPB is intended for retrofit of existing Pedestrian Push-Button assemblies onto standard pushbutton housings.

Physical

- PPB and flange body shall install onto existing housings without modification to the housing.
- The flange body shall accommodate bolt centers ranging from 2.550 inches to 2.650 inches.
- PPB shall fit securely on any approved PPB housing.
- PPB shall connect directly to # 14 AWG solid wires.
- PPB actuator face shall be domed with a centered divot to allow actuation by use of a stylus.

Environmental

- PPB shall be rated for intermittent use in the ambient temperature range of:
- 40°C (- 40°F) to +71°C (+160°F).
- PPB shall seal to the housing with a neoprene gasket and in general be protected against dust and moisture intrusion.
- PPB shall withstand direct sunlight exposure without exhibiting evidence of either physical or mechanical deterioration for a minimum of five years.

Construction

PPB shall be a self-contained device not requiring on site assembly.
PPB shall be able to withstand mechanical shock and vibration.

Materials

- PPB shall be manufactured from ultraviolet stabilized, self extinguishing structural plastic.

Color

- PPB flange body shall be green in color conforming to color number 14062 or black conforming to color number 17038, 27038 or 37038 of federal standard 595B.
- PPB actuator shall be yellow in color conforming to color number 13655 or 22544 of federal standard 595B.

Identification

PPB Shall be inscribed, embossed, marked indelibly or permanently labeled stating a manufacturer's name, part number, lot number or date code, input voltage range, polarity (if necessary) and function of terminals.

Electrical

- The PPB shall be a piezo design and have a minimum life of ten million electrical operations.
- The PPB shall operate over the normal voltage range of 8 to 30 VDC
- The quiescent state of the PPB shall be normally open and a button actuation of 50 milliseconds or greater shall constitute an output contact closure capable of sinking a maximum of 50 milliamps.

Mechanical

- The PPB actuator shall be 2.0 +/- 0.1 (1.9 – 2.1) inches in diameter.
- Actuating force shall be 3.0 +/- 1.0 (2.0 – 4.0) Lbs.
- Actuator movement shall be between .100 and .250 inches
- PPB shall sustain a minimum of ten million actuations.

Hardware

The PPB shall attach to an approved PPB housing using stainless steel #8-32 x 3/4 inch, pan head TORX T15 tamper-proof machine screws. The machine screws shall be provided by the manufacturer and packaged with each unit.

Warranty

The PPB shall be warranted against physical or mechanical deterioration for two years from the date of purchase. Repair or replacement and shipping of defective units shall be the manufacturer's responsibility.

**CITY OF LOS ANGELES
DEPARTMENT OF TRANSPORTATION**

**VEHICLE SIGNAL HEAD
8 AND 12 INCH
GLASS FILLED POLYCARBONATE**

PURCHASE SPECIFICATION

92-061-06

November 2005

1 DESCRIPTION

- 1.1** This document defines minimum standards for product performance and composition relating to all VEHICLE SIGNAL HEADS, POLYCARBONATE, hereinafter referred to as VSH-P.

2 GENERAL

- 2.1** All VSH-P major components shall be manufactured from glass reinforced POLYCARBONATE material. The housing/sections shall be weatherproof and dust- tight. The signal shall provide sections to accommodate, but not include, modular LED indications of red, yellow, or green - balls or arrows, the configuration to be determined by contract requirements. The VSH-P assembly shall contain either 8 or 12-inch sections or a combination of both without incandescent hardware, i.e. reflectors, sockets and lenses. The VSH-P shall operate directly from a 120-volt, 60 Hz power source. The Manufacturer is responsible for supplying all hardware for assembly and mounting, including wiring, lens mounting hardware, visors, back plates and brackets as required. All VSH-P components including wiring and materials used in the construction of VSH-P assemblies shall meet or exceed all applicable ITE Specifications.

3 CONSTRUCTION

3.1 MATERIAL

- 3.11** All major signal components, excluding visors, shall be one-piece molded, manufactured from Ultra-Violet stabilized, 10% glass reinforced new POLYCARBONATE resin. Regrind material is NOT acceptable.
- 3.12** The material formulation used in the manufacture of the major signal components shall meet or exceed the minimum standards listed below:

<u>Property</u>	<u>Required</u>	<u>Method</u>
Tensile strength, yield, 0.125"	9600 psi	ASTM D638
Flexural strength, yield, 0.125"	15,000 psi	ASTM D790
Flexural Modulus, 0.125"	500,000 psi	ASTM D790
Impact strength, notched, 73 degrees Fahrenheit	2.5 – 15.0 ft-lb/inch	ASTM D256
Fall Dart, 73 degrees Fahrenheit	75 – 125 ft-lb/inch	ASTM D3029
Heat Deflection Temperature 264 psi, 0.250", unannealed	270 – 288 Fahrenheit	ASTM D648

3.2 COLOR

- 3.21** All signal housing components shall be colored BLACK with a lusterless finish.
- 3.22** Black shall match Color No. 17038, 27038 or 30738 of Federal Standard 595A.
- 3.23** Color shall be completely impregnated in the resin material so that scratches will not expose uncolored material.

3.3 HOUSING

- 3.31** Each housing section shall be one-piece molded, manufactured from Ultra-Violet stabilized, 10% glass reinforced, new POLYCARBONATE resin.
Regrind material is NOT acceptable.
- 3.32** The housing shall be a minimum of .090 inch thick.
- 3.33** The housing shall utilize ribbing to produce the strongest possible assembly while reducing weight.
- 3.34** The top and bottom exterior of the housing shall be parallel to insure perfect alignment of assembled sections.
- 3.35** The top and bottom of the housing shall have an opening to permit the entrance of 1-1/2 inch (38.1 mm) N.P.T. fittings and standard traffic signal mounting hardware.
- 3.351** The top opening of each housing section shall have a raised serrated type boss integrally cast to allow proper joining of stacked sections and to marry with a recessed serrated type boss.

- 3.352** The bottom opening of each housing section shall have a recessed serrated type boss integrally cast to allow proper joining of stacked sections and to marry with a raised serrated type boss.

The dimensions of the boss shall be:

Outside diameter:	2.625 inches
Inside diameter:	1.970 inches
Number of teeth:	72
Angle of teeth:	90 degrees
Depth of teeth:	0.050 inches

The teeth shall be clean and sharp. The radial angular grooves of the serrated fittings shall provide positive positioning of the entire signal head to eliminate rotation or misalignment.

- 3.36** The top and bottom openings of the housing shall have a common vertical centerline.

3.37 IDENTIFICATION

- 3.371** "CITY OF LOS ANGELES" shall be inscribed or embossed in 1/4 inch (.025) high letters on the outside back lower portion of each housing/section.

- 3.372** Lettering shall be distinct, aligned and aesthetically pleasing.

3.4 DOOR ASSEMBLY

- 3.41** The door shall be one-piece molded, manufactured from Ultra-Violet stabilized, 10% glass reinforced, new POLYCARBONATE resin. Regrind material is NOT acceptable.
- 3.42** The door shall have two (2) integral hinge lugs and required latch slots.
- 3.421** 8-inch sections shall have one centered latch slot.
- 3.422** 12-inch sections shall have two evenly spaced latch slots.
- 3.43** The door shall pivot from the left side on stainless steel hinge pins.
- 3.44** The door shall latch at the right side using stainless steel hardware.
- 3.45** The door shall have brass or stainless steel threaded inserts for retaining the LED module and visor.
- 3.46** The door shall form a dust and moisture resistant seal between the door and housing.
- 3.47** The door shall safely and securely retain any standard LED traffic signal module.

3.5 VISORS

- 3.51** Visors shall be manufactured from Ultra-Violet stabilized, POLYCARBONATE resin (glass fill not required).
- 3.52** Visors shall be full circle.

- 3.53** Visors shall have four (4) integral screw tab slots to provide secure attachment to the door assembly.
- 3.54** Visors shall provide a downward tilt between three (3) and seven (7) degrees.
 - 3.541** 8-inch section visors shall be a minimum of seven (7) inches in length.
 - 3.542** 12-inch section visors shall be a minimum of nine and one half (9½) inches in length.

4 ELECTRICAL

TERMINAL STRIP

Each unit shall be provided with a terminal block to provide a convenient connection point for external wiring to each of the signal section modules.

- 4.1** The terminal block shall be cinch barrier series 142, type 6-142 or equal, to accommodate up to 14 AWG wire on each of the six terminals.
- 4.2** Terminal block hardware shall be #8-32 x 5/16 (.3125) inch long binder head screws.

5 ENVIRONMENTAL

- 5.1** The VSH-P, when assembled, shall be weather-proof and dust tight.
- 5.2** The VSH-P shall pass a “High Temperature Test”, conducted by the manufacturer, as follows:

Test:

A complete VSH-P assembly shall be subjected to a 150 degrees Fahrenheit (65 degrees Celsius) ambient temperature for a period of 30 days. The VSH-P shall be thoroughly inspected after the test to insure that no signal component exhibits any degradation as a result of this test. Any degradation constitutes failure of this test.

- 5.3** The Manufacturer and/or Supplier shall maintain on file the results of the described test and shall supply this document when requested.

6 HARDWARE

- 6.1** All materials used in hardware for traffic control equipment shall be BEST QUALITY first run material.
- 6.2** Recycled materials, in part or in full, shall not be used in the manufacture of hardware for mounting traffic control equipment.
- 6.3** All hardware, including but not limited to pins, bolts, screws, lugs, clips, etc., shall be type 302, 304, or 305 stainless steel.
- 6.4** Threaded inserts, when cast into the housing or other assemblies, may be manufactured from brass.

6.5 DOOR LATCH HARDWARE

- 6.51** The door assembly shall attach to the housing assembly and shall pivot from the left side using stainless steel hinge pins.
- 6.52** The door assembly shall require tools to facilitate removal from the housing assembly.
- 6.53** The door assembly shall be retained such that it is not able to accidentally become detached from the housing assembly.
- 6.54** The door assembly shall latch to the housing assembly utilizing two (2) stainless steel eye-bolts, with washers and wing-nuts., permanently attached to the housing and shall pivot from the left side using stainless steel hinge pins.
- 6.55** The stainless steel eye-bolts shall be permanently attached to the housing assembly and shall pivot freely.
- 6.56** The washers and wing-nuts on the eye-bolts shall be retained on the eye-bolt and shall not be able to become detached from the eyebolt itself.

6.6 MOUNTING ASSEMBLIES

- 6.61** Mounting assemblies shall comprise of brackets made from standard 1-1/2 inch steel pipe and/or LADOT approved one piece casting with LADOT approved coating.
- 6.62** Raintight terminal compartments, lock ring adapters, slip fitters, pole plates and 4" post top mount shall be cast from malleable iron, bronze or 356-T6 aluminum alloy.

6.7 COATINGS

- 6.71** All non stainless steel hardware shall be coated with an ultra-violet resistant polyester powder.
- 6.72** Coating shall be black in color.
- 6.73** Areas Coated:
Prior to final assembly of the VSH-P, pipe assemblies, fittings, and terminal compartments shall be powder coated by an LADOT approved process. The minimum requirements are as follows:

- 1. A 3-5 stage pre-treated consists of:
 - a. An acid etch DEGREASING bath.
 - b. A clean water RINSE.
 - c. An iron PHOSPHATE adhesion bath.
 - d. A clean water RINSE.
 - e. A non Chromate acidulated SEAL bath.

NOTE: items a and c can be combined and thereby make this a three (3) stage process.

- 2. A dry off cycle for at least 10 minutes at 300 to 400 degrees F.
- 3. Electrostatically applied power at 75 - 90KV.
- 4. Thermal setting cycle for 20 minutes at 400 degrees F.

7 WARRANTY

7.1 Manufacturer and Supplier shall warrant VSH-P, including associated hardware, to be free from defects in material and manufacture for a minimum of one (1) year from date of test and acceptance by the City of Los Angeles, Department of Transportation.

7.11 All warranty expenses including parts, labor and shipping are the responsibility of the Manufacturer or Supplier.

8 TESTING

8.1 During the term of the contract, The City of Los Angeles, Department of Transportation, may exercise its option and test the VSH-P including all associated hardware for compliance with this specification. An independent laboratory may be retained for such testing. In the event that the VSH-P or the associated hardware are found not to meet or exceed this specification, the contract between the supplier and the City of Los Angeles, Department of Transportation, may be terminated. The supplier shall bear all costs related to testing in instances where the supplied VSH-P does not meet this specification.

9 SAMPLES

9.1 Upon request by the City of Los Angeles or any of its authorized agents, the Manufacturer or supplier shall submit for approval, one (1) sample of each different VSH-P assembly as required by the contract.

9.2 Units submitted for evaluation must reflect the units that will be supplied per the contract.

9.3 Units submitted for evaluation must include all back plates, visors, brackets, wiring and hardware that will be provided as required by the contract.

A CERTIFICATION

A.1 At the time of the bid, the supplier shall provide verification of the formulation of the POLYCARBONATE resin material used in the construction of the VSH-P. Verification of the material formulation may be provided in the form of a material information sheet from the material manufacturer stating the material is Glass Filled and Ultra-Violet Stabilized along with invoices for the material described, and run dates the material was used in the manufacture of the VSH-P.

A.2 The Supplier shall provide design details and drawings in sufficient detail for complete evaluation of the proposal, and comparison with these specifications.

A.3 Written certification that the VSH-P complies with this specification may be required. If requested, a report shall be prepared by an independent certified testing laboratory and maintained on file by the manufacturer showing all specifications set forth in this document have been met or exceeded.

B APPROVAL AND WAIVERS

- B.1** Approval of any materials or practices not covered in this document must be requested in writing and proposed to the Signal Design group. Approval must be granted and on file with the Signal Design group to be valid. Approval is contract specific.
- B.2** Waivers are contract specific and must be re-submitted for each and every individual contract. Waivers of any specification must be requested in writing and proposed to the Signal Design group. Waivers must be granted and on file with the Signal Design group to be valid.

C ASSEMBLY: (If required by contract)

- C.1** Units shall be assembled as defined in the contract
- C.2** Units that are supplied assembled shall be wired with sufficient color-coded wire for connecting between VSH-P terminal block and mounting compartment terminal block.

TRAFFIC SIGNAL HEADS



8" Signal



12" Programmed
Visibility Signal



12" Signal



Pedestrian Signal Head



Fitting 7
Pole Clamp



Bracket Mount with Strap



Fitting 4
Elevator Plumbizer



Fitting 3
Terminal Compartment

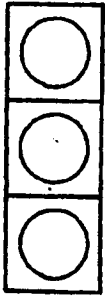


Fitting 1
Offset Slipfitter



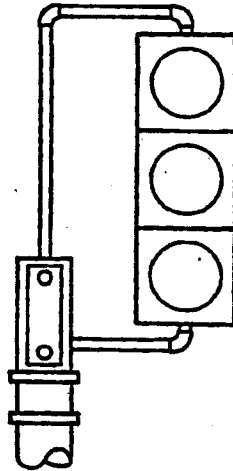
Fitting 2
Slipfitter - Terminal
Compartment

TRAFFIC SIGNAL HEADS			



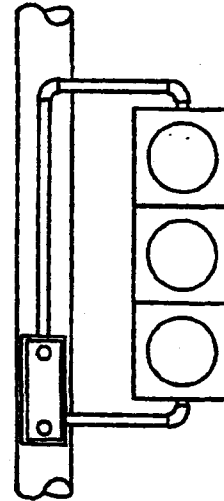
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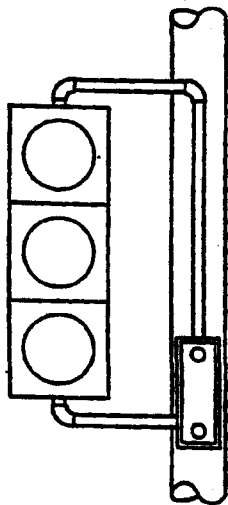
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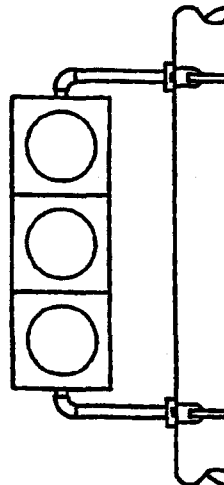
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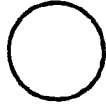
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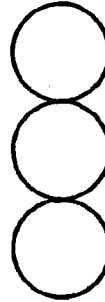


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TRAFFIC SIGNAL HEADS

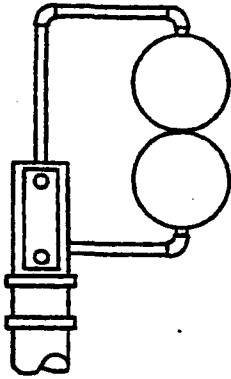


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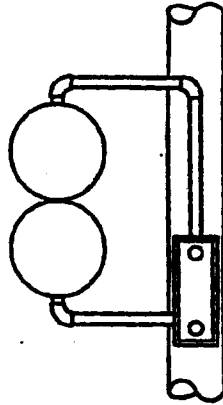


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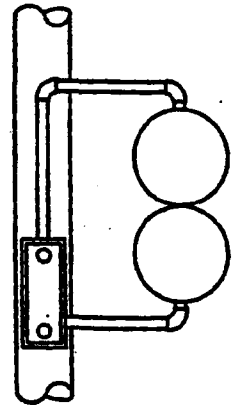
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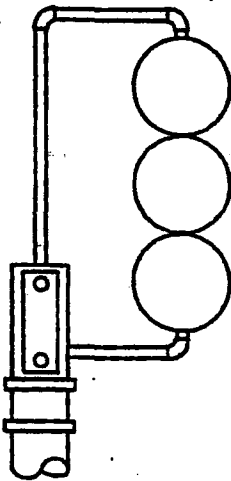
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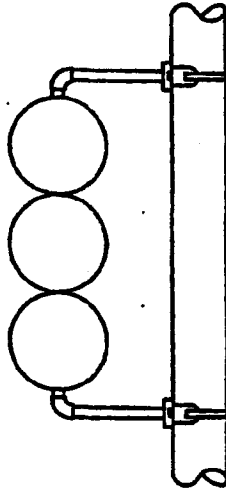


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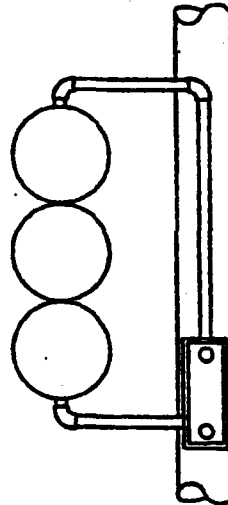


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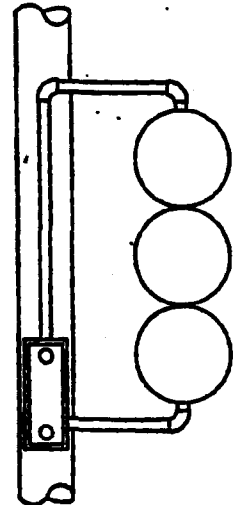


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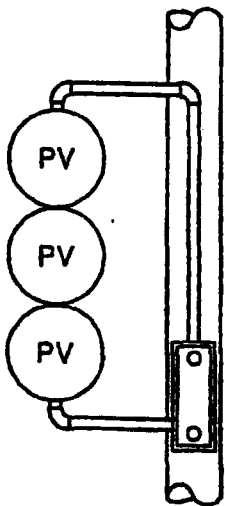
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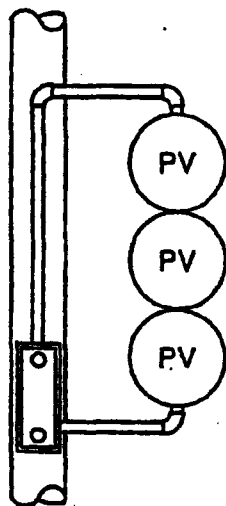
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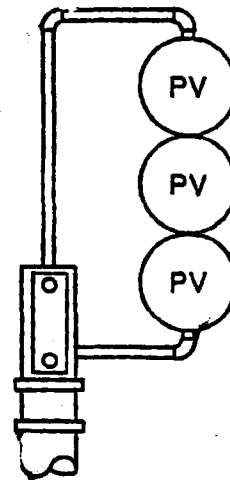
TRAFFIC SIGNAL HEADS			



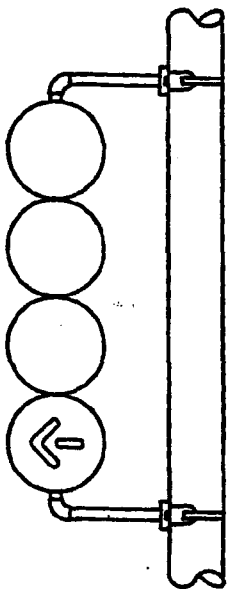
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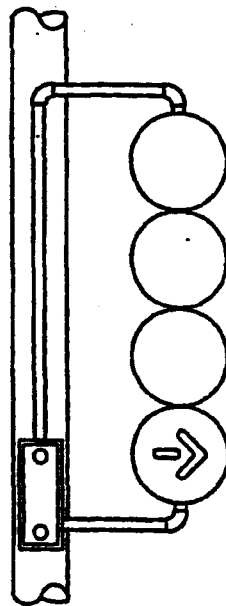
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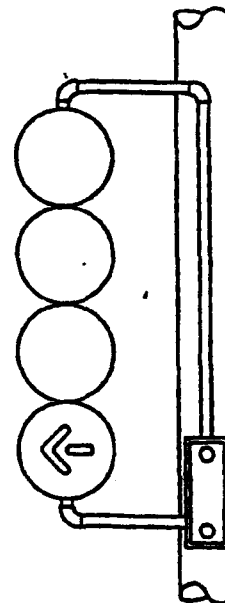
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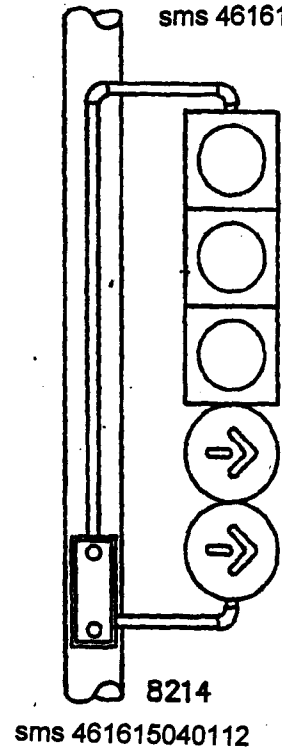
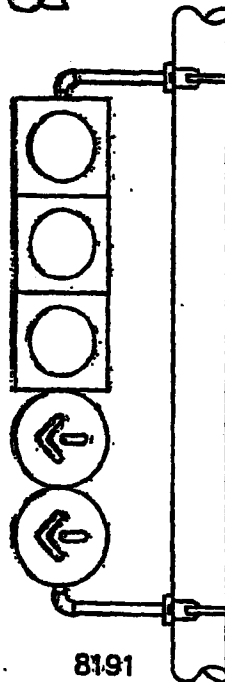
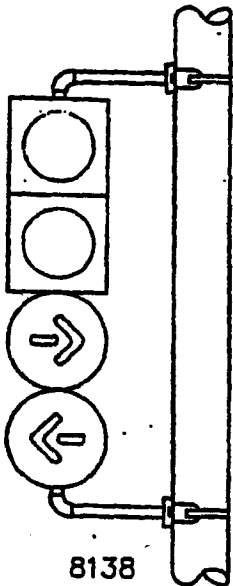
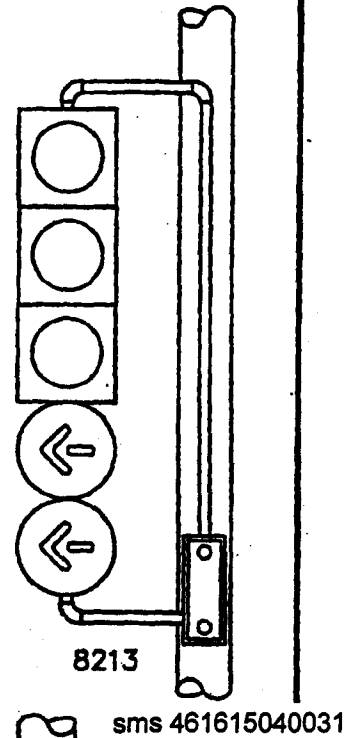
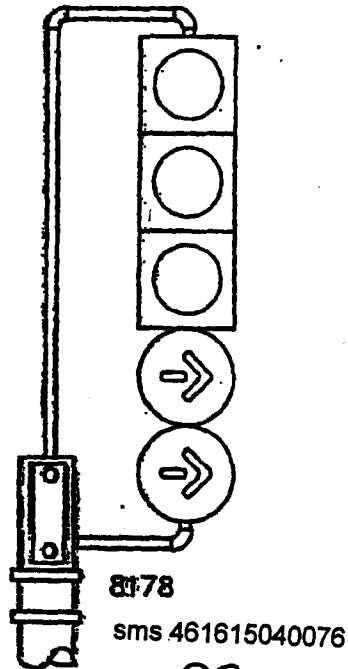
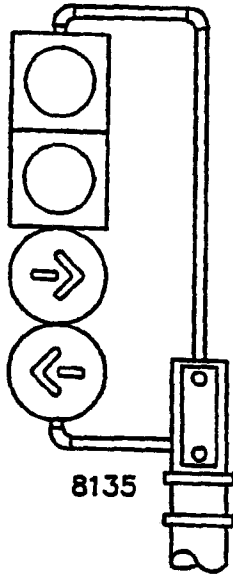


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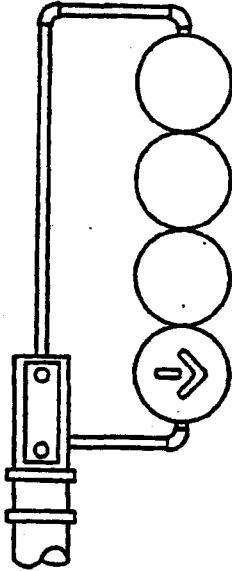


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TRAFFIC SIGNAL HEADS

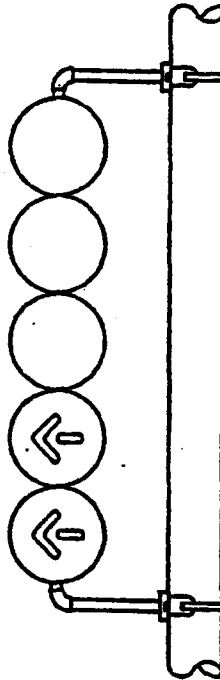


TRAFFIC SIGNAL HEADS			



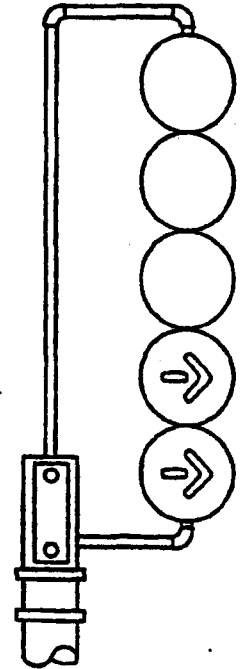
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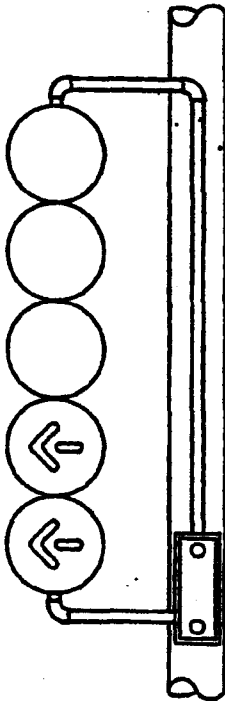
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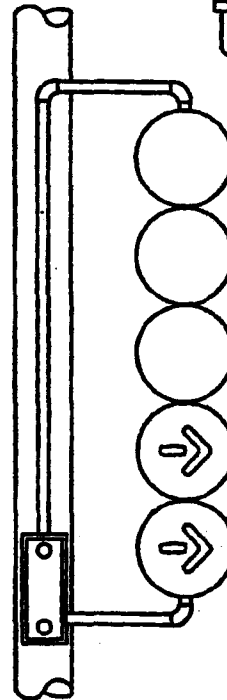
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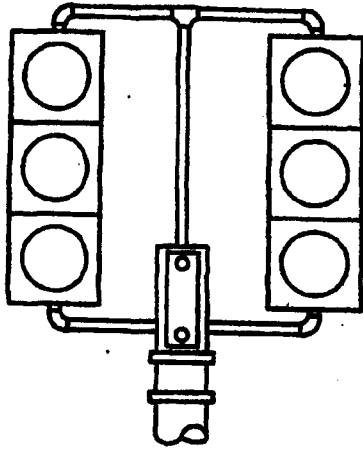
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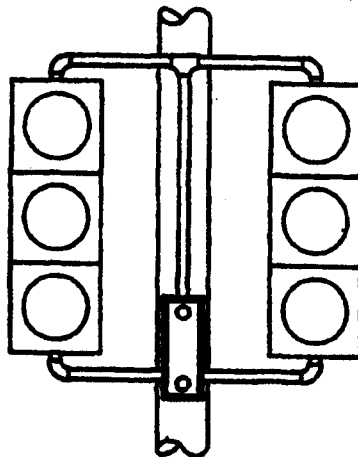
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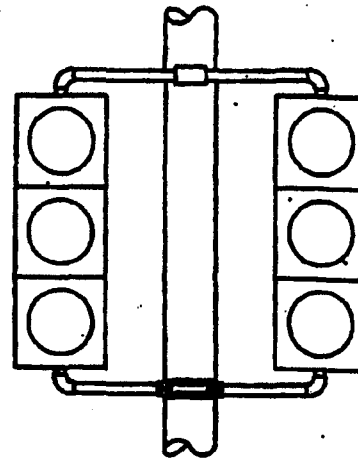
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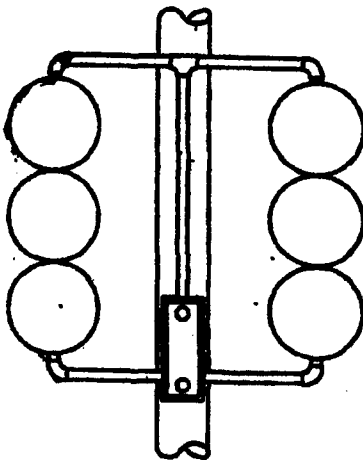
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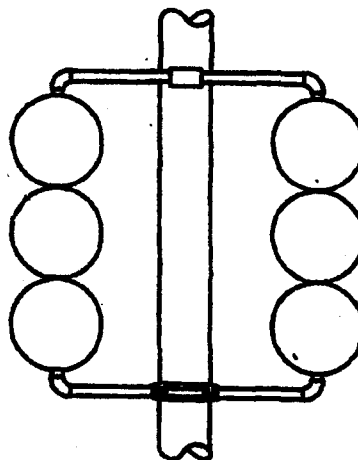
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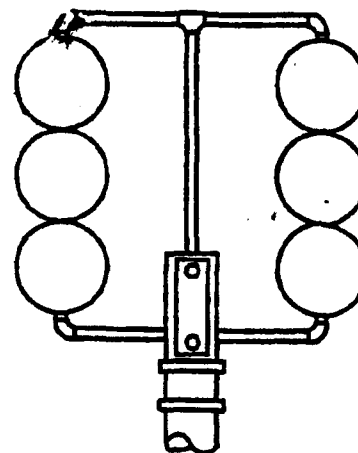
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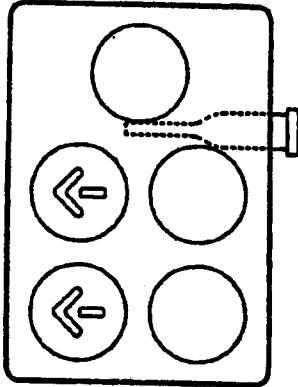
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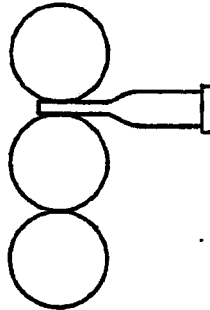
TRAFFIC SIGNAL HEADS

MAST ARM HEADS



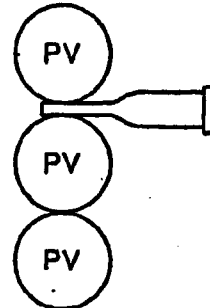
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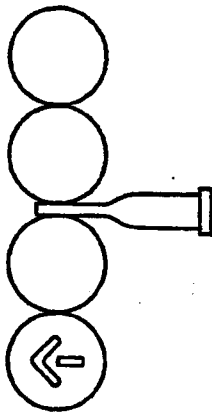
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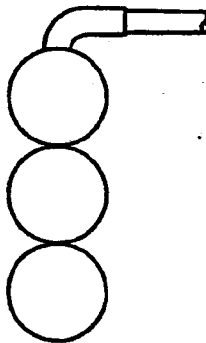


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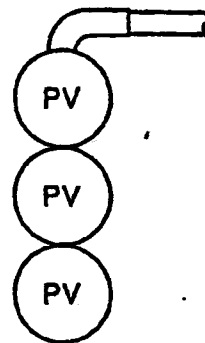
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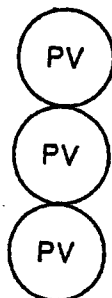
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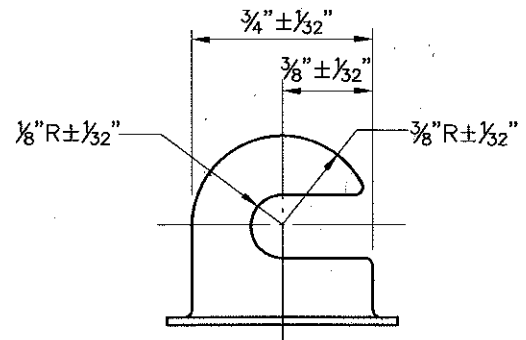
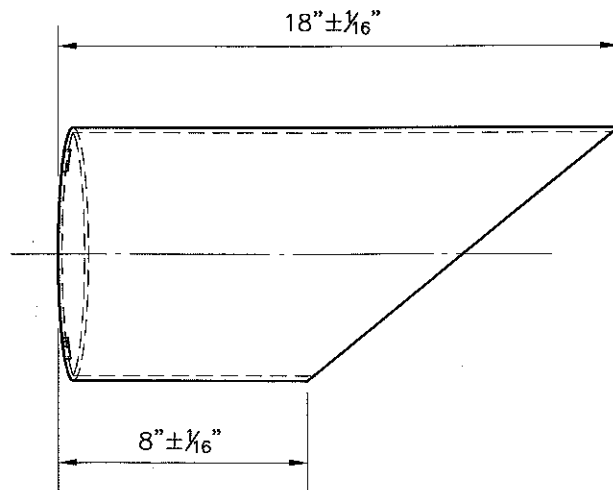
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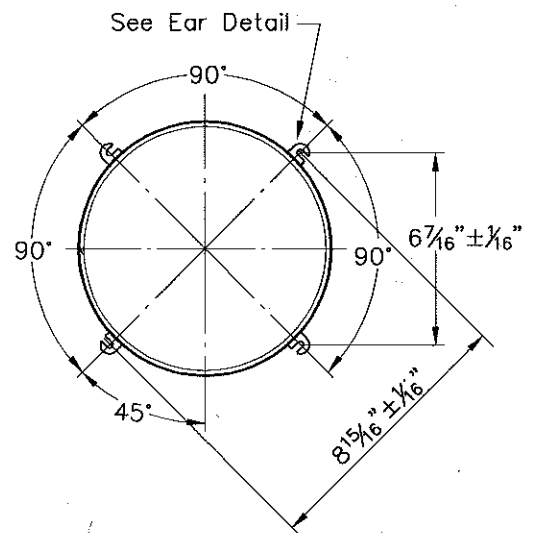
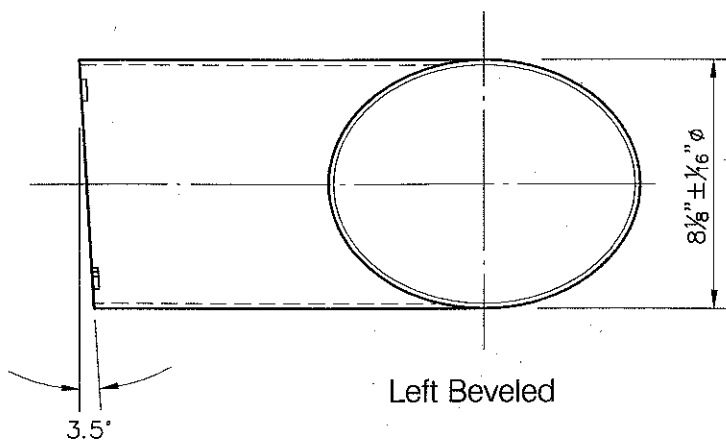
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sms 461615040389



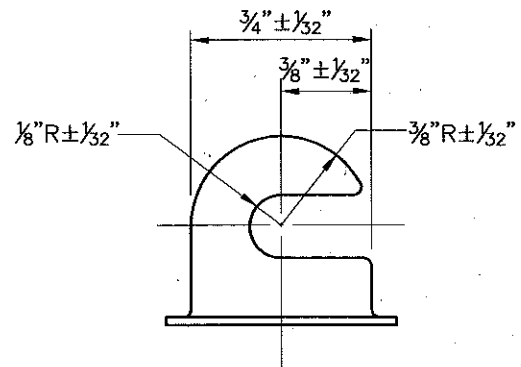
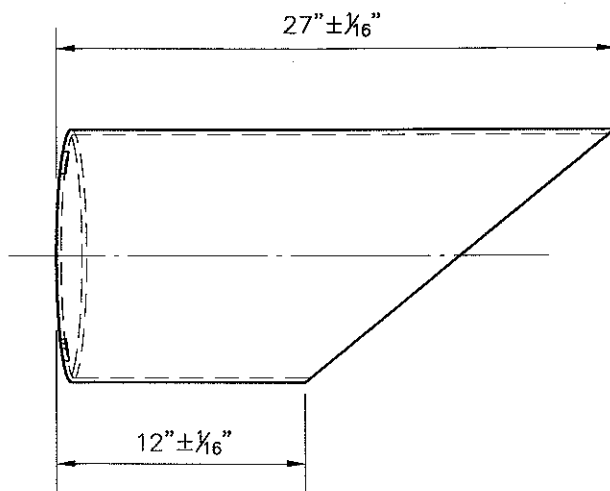
Ear Detail



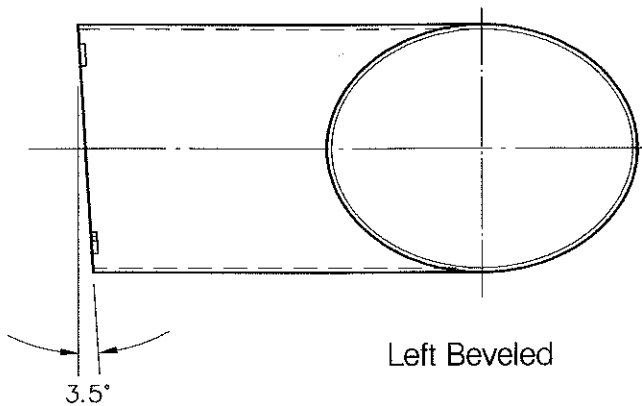
Note:

Bevel opposite side for Right Beveled Visor. Refer to LADOT Purchase Specification # 92-061-06 for all other details.

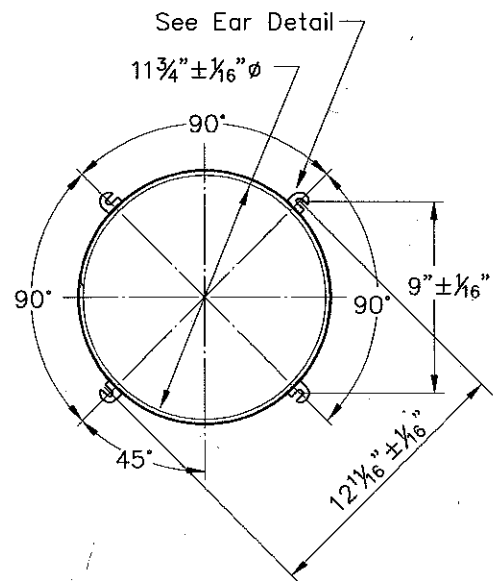
DWN	MT	1-04-11	Title VISOR, 8" DIA., BEVELED
CKD	RSM	1-26-11	
T. E.			
Sr. T. E.			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION
Pr. T. E.			
Approved <i>January 26, 2011.</i> <i>John E. Fisher</i> Amir Sedadi, Interim General Manager			Drawing No. S-76.3



Ear Detail



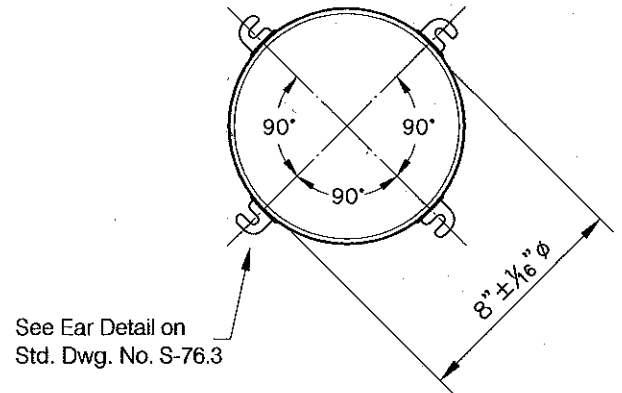
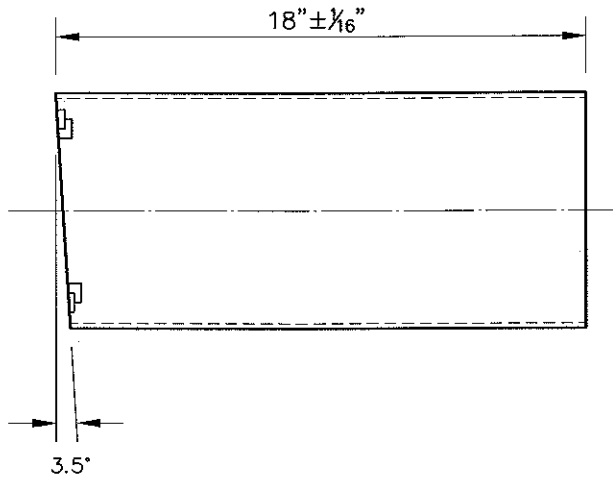
Left Beveled



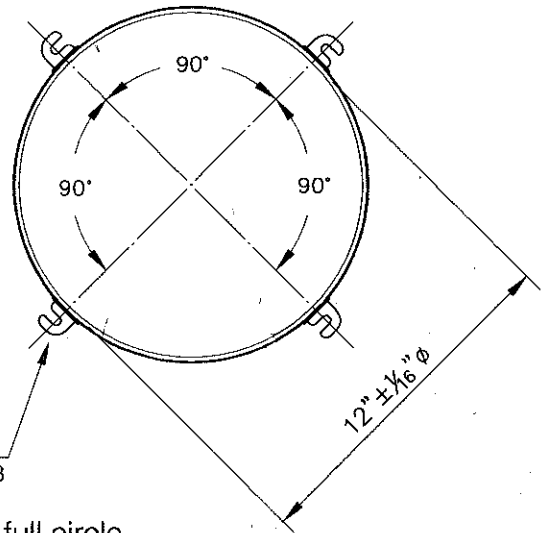
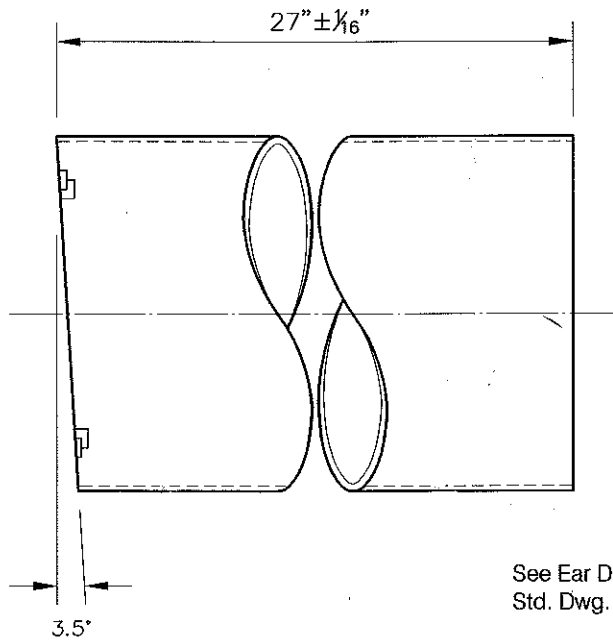
Note:

Bevel opposite side for Right Beveled Visor. Refer to LADOT Purchase Specification # 92-061-06 for all other details.

DWN	MT	1-05-11	Title VISOR, 12" DIA., BEVELED
CKD	RSM	1-26-11	
T. E.			
Sr. T. E.			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION
Pr. T. E.			
Approved <i>January 26, 2011</i> <i>John E. Fisher</i> for Amir Sedadi, Interim General Manager			Drawing No. S-76.6



Long Visor, 8" X 18" full circle
Not to Scale

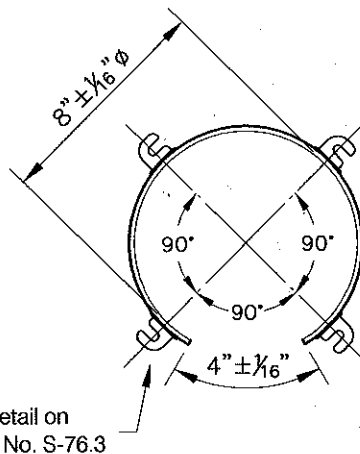
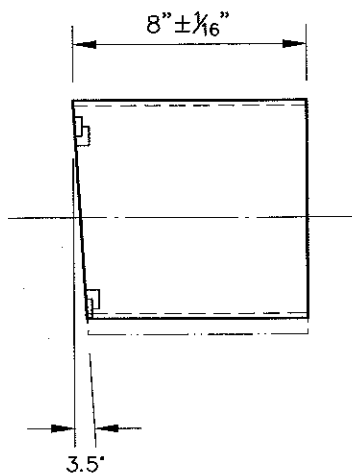


Long Visor, 12" X 27" full circle
Not to Scale

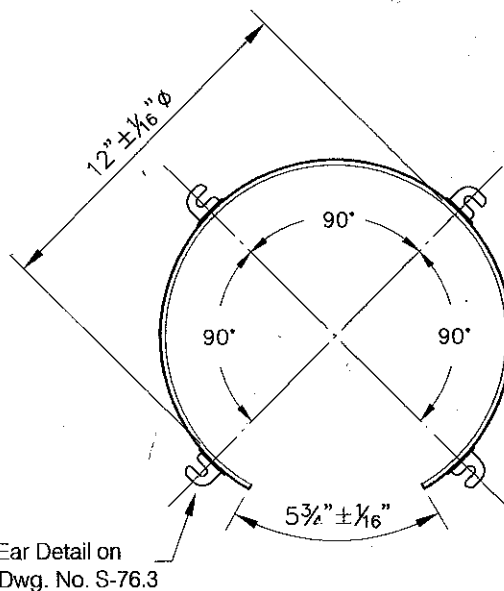
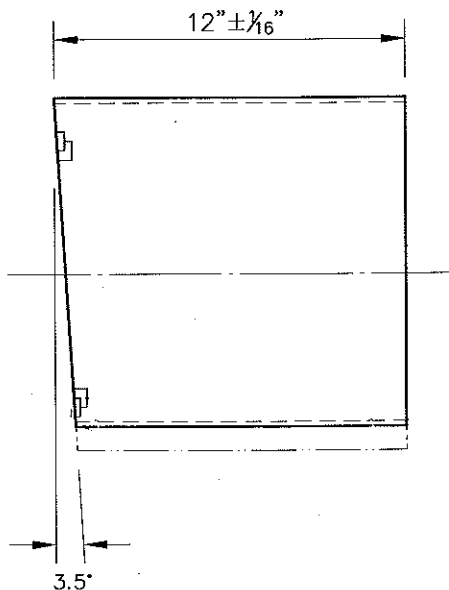
Note:

Bevel opposite side for Right Beveled Visor. Refer to LADOT Purchase Specification # 92-061-06 for all other details.

DWN	MT	1-05-11	Title LONG VISOR 8" & 12" DIAMETER FULL CIRCLE
CKD	RSM	1-26-11	
T. E.			
Sr. T. E.			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION
Pr. T. E.			
Approved <i>January 26, 2011</i> <i>John E. Fisher</i> Amir Sedadi, Interim General Manager			Drawing No. S-76.7



Visor, 8" X 8" Tunnel
Not to Scale

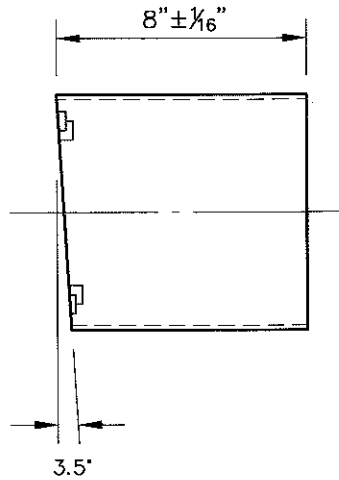


Visor, 12" X 12" Tunnel
Not to Scale

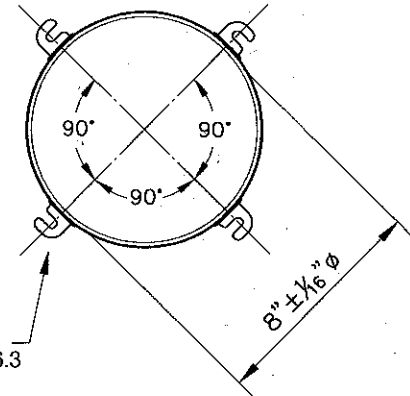
Note:

Bevel opposite side for Right Beveled Visor. Refer to LADOT Purchase Specification # 92-061-06 for all other details.

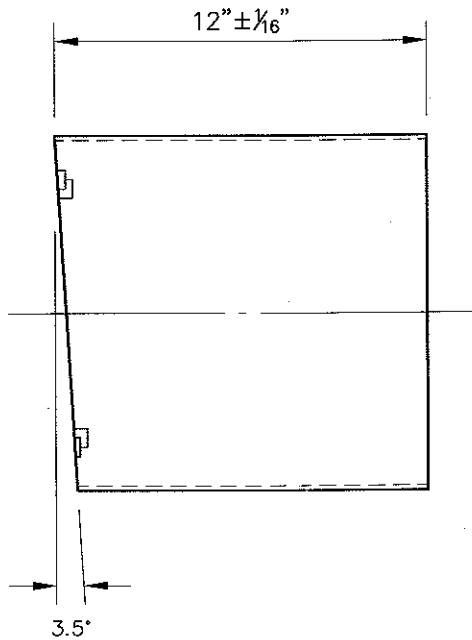
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CKD	RSM	1-26-11	
T. E.			
Sr. T. E.			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION
Pr. T. E.			
Approved <i>January 26, 2011</i> <i>John E. Fisher</i> for Amir Sedadi, Interim General Manager			Drawing No. S-76.8



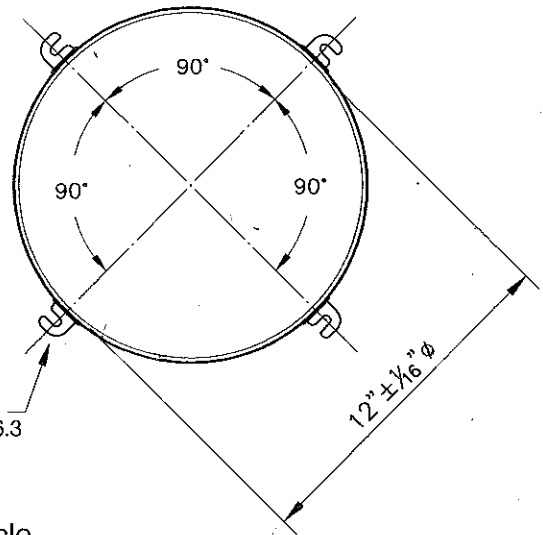
See Ear Detail on
Std. Dwg. No. S-76.3



Visor, 8" full circle
Not to Scale



See Ear Detail on
Std. Dwg. No. S-76.3



Visor, 12" full circle
Not to Scale

Note:

Bevel opposite side for Right Beveled Visor. Refer to LADOT Purchase Specification # 92-061-06 for all other details.

DWN	MT	1-05-11	Title VISOR 8" & 12" DIAMETER FULL CIRCLE
CKD	RSM	1-26-11	
T. E.			
Sr. T. E.			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION
Pr. T. E.			
Approved <i>January 26, 2011</i> <i>John E. Fisher</i> for Amir Sedadi, Interim General Manager			Drawing No. S-76.9

**CITY OF LOS ANGELES
DEPARTMENT OF TRANSPORTATION**

**PEDESTRIAN SIGNAL HOUSING
POLYCARBONATE
AND
MOUNTING HARDWARE**

PURCHASE SPECIFICATION

92-064-06

April 2008

This document defines minimum standards for product performance and composition for all POLYCARBONATE PEDESTRIAN SIGNAL HOUSINGS, hereinafter referred to as IPPSH, and associated mounting hardware and assemblies.

1. GENERAL

All IPPSH components shall be manufactured from LEXAN polycarbonate material. The housing shall be weather-proof and dust-tight. The signal housing shall accommodate any LED pedestrian signal module specified by the LADOT and delivered with mounting hardware as specified in the contract. IPPSH shall operate directly from a 120 volt, 60 Hz power source. All hardware for make-up and mounting shall be supplied by the Manufacturer.

2. HOUSING

Each housing shall be one piece, manufactured from LEXAN polycarbonate resin material. Regrind material is NOT acceptable. The housing shall be a minimum of .090 inches thick. The housing shall utilize ribbing to produce the strongest possible assembly while reducing weight. The top and bottom exterior of the housing shall be parallel to insure perfect alignment of assembled sections. The top and bottom of the housing shall have an opening to permit the entrance of 1-1/2 inch (38.1 mm) N.P.T. fittings and mounting hardware.

2.1 The bottom opening of the housing shall have a serrated type boss integrally cast. The dimensions of the boss shall be:

Outside diameter:	2.625 inches
Inside diameter:	1.970 inches
Number of teeth:	72
Angle of teeth:	90 degrees
Depth of teeth:	0.050 inches

The teeth shall be clean and sharp. The radial angular grooves of the serrated fittings shall provide positive positioning of the entire signal head to eliminate rotation or misalignment. The top opening of the housing shall be smooth. The top and bottom openings of the housing shall have a common vertical centerline.

2.2 COLOR

All signal components shall be colored BLACK with a lusterless finish. Color shall be completely impregnated in the resin material so that scratches will not expose uncolored material.

2.3 PHYSICAL

The overall dimensions, when assembled, shall not exceed 19 (nineteen) inches high, by 19 (nineteen) inches wide, by 11 (eleven) inches deep (485 mm x 485 mm x 280 mm), excluding visors and hinges.

2.4 IDENTIFICATION

"CITY OF LOS ANGELES" shall be inscribed or embossed in 1/4 inch (.025) high letters on the outside back lower portion of the housing. Lettering shall be distinct, aligned and aesthetically pleasing.

2.5 DOOR ASSEMBLY

The door shall be one piece, manufactured from polycarbonate resin, with two (two) integral hinge lugs and two integral latch slots. The door shall pivot from the bottom. The door shall pivot at the bottom front of the housing by means of two hinge pins with retaining clips. The door shall latch at the top using stainless steel hardware. Hardware shall not require tools for latching or unlatching.

2.6 VANDAL RESISTANCE

The IPPSH shall be provided with an optional use vandal resistant mechanism i.e., requires tools to open which is not part of the standard latching mechanism and does not interfere with normal access when not in use.

2.7 SCREEN

Each IPPSH door shall incorporate a visor screen to provide maximum sun and vandal protection. The screen (egg crate) shall be a molded, one piece network of equally spaced horizontal and diagonal louvers approximately one inch deep with a .030 inch nominal thickness. The screen may be molded into the door assembly or shall be attached internally using stainless steel screws.

2.8 TERMINAL STRIP

Each unit shall be provided with a terminal block mounted on an aluminum plate in the inside lower section of the housing to provide a connection point for external wiring. The aluminum plate shall be .062 inch (1.6 mm) minimum thickness.

The terminal block shall be cinch barrier series 142, type 6-142 or equal, to accommodate up to 12 AWG wire on each of the six terminals.

2.9 WIRING

The IPPSH terminal block shall be pre-wired to the terminal compartment with 18 AWG conductors having insulation conforming to a conductor rating of 200 degrees celsius (395 degrees F) minimum. A "NO MOUNT" housing consisting of the signal compartment devoid of mounting hardware shall have the conductors landed and bundled inside the housing.

2.10 ENVIRONMENTAL

The IPPSH, when assembled with the LED signal module, shall be weather-proof and dust tight.

2.11 HOUSING HARDWARE

All hardware, including but not limited to, pins, bolts, screws, lugs, clips, etc., shall be type 302, 304 or 305 stainless steel. Threaded inserts, when cast into the housing or other assemblies, may be manufactured from brass.

3. MOUNTING HARDWARE

- 3.1 All materials used in hardware for traffic control equipment shall be BEST QUALITY first run material.
- 3.2 Recycled materials, in part or in full, shall not be used in the manufacture of hardware for mounting traffic control equipment.

4. MOUNTING ASSEMBLIES

- 4.1 Mounting assemblies shall comprise of brackets made from standard 1-1/2 inch steel pipe and/or LADOT approved one piece casting with LADOT approved coating. See attached drawings in appendix A for acceptable pipe fittings and assemblies.
- 4.2 Rain tight terminal compartments, lock ring adapters, slipfitters, pole plates and 4 inch post top mount shall be cast from malleable iron, bronze or 356-T6 aluminum alloy.
- 4.3 Units that are supplied assembled shall be wired with sufficient color coded wire for connecting between IPPSH terminal block and mounting compartment terminal block.

4.4 COATINGS

- a. All parts shall be coated with an ultra-violet resistant polyester powder and shall be black in color.
- b. Areas to be coated
Prior to final assembly of pedestrian signal pipe assemblies, fittings and terminal compartments shall be powder coated by an LADOT approved process.
 - 1) A 3-5 stage pre-treatment
 - (a) An acid etch DEGREASING bath.
 - (b) A clean water RINSE.
 - (c) An iron PHOSPHATE adhesion bath.
 - (d) A clean water RINSE
 - (e) A non Chromate acidulated SEAL bath.

Note: Items (a) and (c) can be combined and thereby make this a three stage process.
 - 2) A dry off cycle for at least 10 minutes at 300 to 400 degrees F.
 - 3) Electrostatically applied power at 75-90 KV
 - 4) Thermal setting cycle for 20 minutes at 400 degrees F.

4.5 FASTENERS

- a. All fasteners, including but not limited to, pins, bolts, screws, lugs, clips, etc. , shall be type 302, 304 or 305 stainless steel or of the same material and coating as the mating part.

5. WARRANTY

Manufacturer and Supplier shall warrant IPPSH, including associated hardware, to be free from defects in material and manufacture for a minimum of one (one) year from date of test and acceptance by the City of Los Angeles, Department of transportation.

All warranty expenses including parts, labor and shipping are the responsibility of the Manufacturer or Supplier.

6. SAMPLES

Upon request by the City of Los Angeles or any of its authorized agents, the Manufacturer or supplier shall submit for approval, one sample of an IPPSH as specified.

7. CERTIFICATION

Written certification that the IPPSH complies with this specification shall be prepared by an independent certified testing laboratory and maintained on file by the manufacturer.

The Supplier shall provide design details and drawings in sufficient detail for complete evaluation of the proposal, and comparison with these specifications.

8. APPROVAL AND WAIVERS

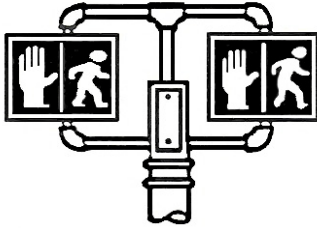
Approval of any materials or practices not covered in this document must be requested in writing and proposed to the Signal Design group. Approval must be granted and on file with the signal design group to be valid. Approval is contract specific.

Waivers are contract specific and must be re-submitted for each and every individual contract. Waivers of any specification must be requested in writing and proposed to the Signal Design group. Waivers must be granted and on file with the Signal Design group to be valid.

9. DELIVERY

Delivery, when not specified in the contract, shall be as described in Delivery Specification.

APPENDIX -A- Drawings



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Post Top Double Bracket



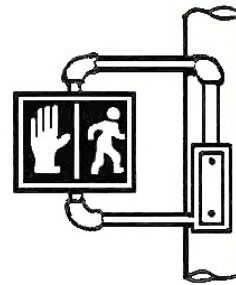
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Double Bracket



461615040381
No Mount



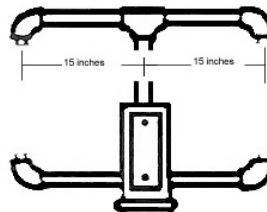
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Post Top



461615040383
Left Bracket

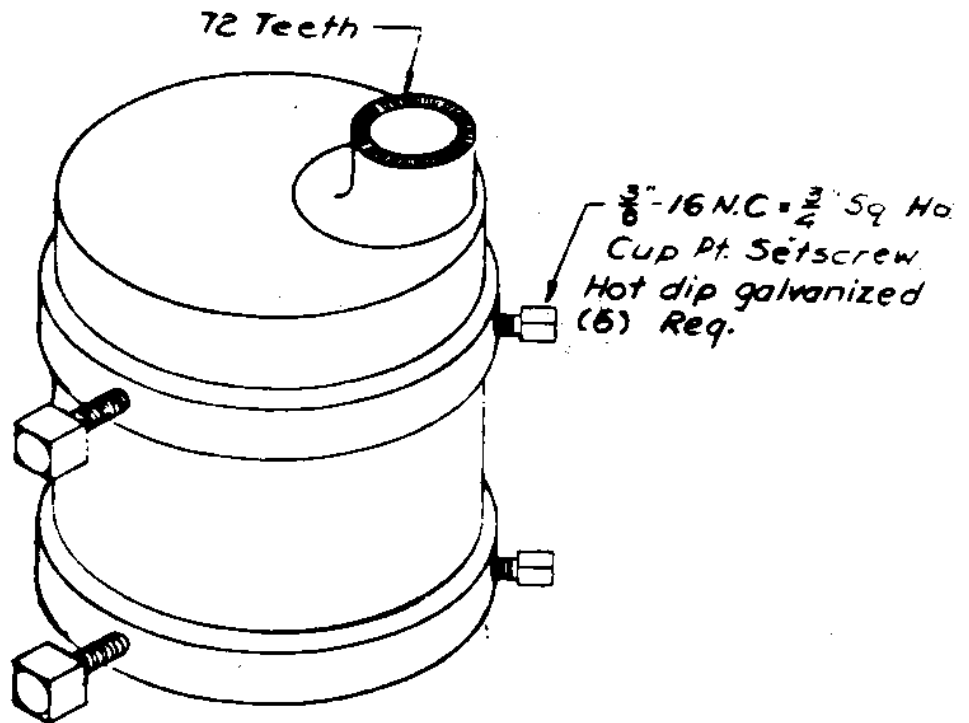


461615040384
Right Bracket

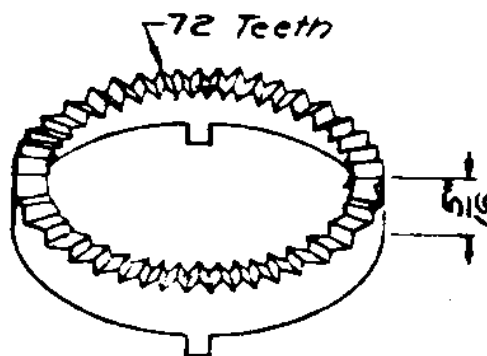


Note:

The horizontal dimension between the pedestrian housing and the terminal compartment for all assemblies shall be 15 inches on center as shown above.



SLIP FITTER

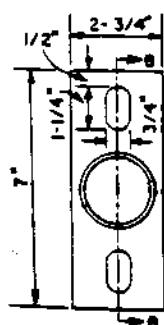
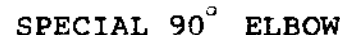
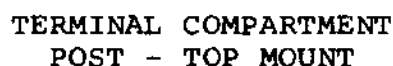
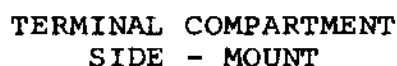


LOCK RING

Note :

1. Construction, material & finish painting shall conform to "Standard Specifications", 1984 (or latest edition), Dept. of Transportation, State of California.

Drawn By	KAL	2-67	FITTINGS, TYPICAL, POST TOP MOUNTING
Checked By			
Supervised By			
Reviewed By			
Revisions			CITY OF LOS ANGELES
DEPARTMENT OF TRANSPORTATION			
DONALD R. HOWERY, General Manager			
UPDATED RD	JF	3-14-83	DRAWING NO.
			S-6LL



POLE PLATE
For Side Mountings

1. CONSTRUCTION, MATERIAL & FINISH PAINTING SHALL CONFORM TO "STANDARD SPECIFICATIONS; 1984 (OR LATEST EDITION), DEPT. OF TRANSPORTATION, STATE OF CALIFORNIA.

Drawn By	J.C	7-10-84	<u>Title</u> FITTINGS, TYPICAL, TERMINAL COMPARTMENT & POLE PLATE MOUNTING CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION DONALD R. HOWERY, General Manager
Checked By	RO	7-10-84	
Supervised By	JK	7-11-84	
Reviewed By	JHC	7-17-84	
Revisions			<u>Approved</u> <u>July 17, 1984</u> <u>Donald R. Howery</u> General Manager
			DRAWING NO S-63.1

**CITY of LOS ANGELES
DEPARTMENT of TRANSPORTATION**

BATTERY BACKUP SYSTEM (BBS)

PURCHASE SPECIFICATION

92-066-03

March 2013

1 GENERAL

This specification establishes the minimum requirements for an emergency power backup system for use with traffic signals equipped with Light Emitting Diode (LED) modules. The Battery Backup System (BBS) will be of the Offline or Online (double conversion) type capable of providing power for a fully operational LED equipped intersection in the event of power failure or power interruption. The Battery Backup System will be powered by 24 or 48 volts DC and include, but not be limited to the following:

1. A power inverter
2. Batteries
3. Battery charging system
4. Power transfer relay
5. A non-electronic Bypass Switch
6. All necessary hardware and interconnect wiring.
7. A housing as outlined in section 4.

2 QUALITY ASSURANCE

- A. Each BBS shall be manufactured in accordance with the highest industry standards for design and components.
- B. To be qualified for use in the city of Los Angeles a BBS must first be submitted for approval by the City of Los Angeles, Department of Transportation. The unit shall operate in compliance with the requirements of this specification as determined by test and evaluation conducted by the LADOT Signal Lab.

3 OPERATION

The BBS shall be one of two different styles as specified by the plan or by the purchase order and as described by the following: A stand alone system with battery and components housed in a 332 style cabinet; A vault installation where the batteries are housed underground and the inverter components are rack mounted in the traffic signal cabinet assembly.

A. Run Time shall comply with one of two options as specified by the plan or by the purchase order and which will determine the type of battery array required to comply with the following:

1. BBS rated at 1000 watts of power capable of providing **800 watts** of continuous power for **eight hours** at 80% minimum inverter efficiency.
2. BBS rated at 1000 watts of power capable of providing **500 watts** of continuous power for **six hours** at 80% minimum inverter efficiency.

B. Buck/Boost Operation

Buck/Boost function shall be provided and the BBS shall have a range of 80 to 160 Vac. The user will have the option to either "Enable" or "Disable" the Buck/Boost feature. The user shall not be able to configure transfer point settings. If Buck/Boost is disabled, the BBS will resort to the user set transfer points. With Buck/Boost enabled, the BBS shall output regulated voltage between 110 -130 Vac.

C. Power Transfer

The BBS shall incorporate two line voltage transfer points. The low cutoff shall be set at 110 ± 2 Vac and the high cutoff transfer point shall be set at 132 ± 2 Vac. The BBS shall automatically apply the five volt hysteresis for the return transfer points.

If the BBS is configured to use the transfer points (Buck/Boost is disabled), the BBS shall bypass the utility line power whenever the utility line voltage is outside of the transfer points ± 2 Vac.

In the case of low or absent utility line power (below the low cutoff point), when the line is restored to 110 ± 2 VAC or above for more than 30 seconds, the BBS shall transfer from battery backed inverter mode back to utility line mode.

In the case of high (above the high cutoff point) utility line power, when the line is restored to 127 ± 2 VAC or below for more than 30 seconds, the BBS shall transfer from battery backed inverter mode back to utility line mode.

The maximum transfer time allowed for the BBS shall not be greater than 65 milliseconds when transferring from a disruption in utility power to stabilized battery backup inverter power, or when returning to utility power after line restoration.

D. Modes of Operation

Stand by. External power is connected to the inverter through the Bypass switch. The BBS automatically senses and qualifies external utility power, switching the inverter “Off” and the battery charger “On.” Loads attached to the BBS output will operate directly from the external power line. The BBS internal transfer relay will automatically switch the system to inverter mode if the external power fails.

Inverter- the BBS inverter is providing power to the load from the battery system.

Bypass- This switch is used to isolate the BBS module manually during maintenance operation. The switch locks the unit into the utility line power source and turns off the battery charging circuitry.

E. BBS Status Outputs

Three sets of normally open (NO) and normally closed (NC) single-pole double-throw (SPDT) dry relay contacts rated at 1 amp/120 volts shall be provided and labeled appropriately to reflect the status of the BBS:

ON BATTERY- The inverter unit is in backup operation.

LOW BATTERY- The system is in the inverter mode and the useful battery capacity is below 40%.

BBS FAIL- The Inverter or Battery system has failed and the unit reverts to Bypass mode.

F. Failsafe

In the event of inverter/charger failure, battery failure or complete battery discharge, the power transfer relay shall revert to the NC (and de-energized) state, where utility line power is connected directly to the load.

G. Battery Recharge

The recharge time for the battery shall not exceed 20 hours to recover to 80% or more of full battery capacity.

The Inverter/Charger unit, Power Transfer Relay, Bypass Switch and any other components whether integrated into one device or separate, shall be of the 19 inch rack mount type and conform to Electronic Industries Standards EIA-310-B, Racks, Panels, and Associated Equipment, provided with 10-32 “Universal Spacing” threaded holes. The BBS shall be available in two possible configurations based on the engineering plan or work order.

A. 332 Cabinet

The rack mounted Inverter, Charger, auxiliary switching components and Battery system reside in a 332 style cabinet enclosure (see figure 2) separate from the traffic signal controller cabinet assembly.

The cabinet shall be a standard 332 enclosure containing the following:

1. A Rack Assembly based on the 19 inch standard EIA to mount the BBS inverter, charger and transfer switch system.
2. The shelving and framework necessary to accommodate the number of batteries as required by the specification.
3. A thermostatically controlled fan with fuse protection.
4. A front mounted light operated by a door switch and fuse protected.
5. Front and rear door locks (BEST LOCK) per L.A.D.O.T. cabinet specification 5405308
6. A front door filter per L.A.D.O.T. cabinet specification 5405308
7. Incoming line power terminal block with neutral and ground buses per L.A.D.O.T. cabinet specification 5405308
8. A 30 amp main circuit breaker shall be provided to accommodate the rated load of the BBS and shall be listed by UL or ETL. The trip and frame size shall be plainly marked (marked on the breaker by the manufacturer), and the ampere rating shall be visible from the front of the breaker.
9. A Panel shall be provided as shown in figure 2 to be populated with the following:
 - 1- Inverter mechanical connection block designed to land the inverter input power cable.
 - 1- Incoming service power block including the circuit breaker as described in item 8 above
 - 1- Inverter output power block
 - 1- Battery power terminal blocks, the positive terminal block shall be an 80 amp DC ANL style fuse and block
 - 1- 8 position #6 screw terminal block for connections to fan, light and relay contacts
 - 1- Auxiliary convenience Receptacle NEMA 5-15R duplex type and shall have ground fault circuit interruption as defined in the National Electrical Code.

B. Vault Installation

The Inverter/UPS, charger, auxiliary switching components and power circuit breaker shall be rack mounted in the back of the 332 traffic signal cabinet assembly (see figure 4.) The Battery shall be housed separately in a sidewalk vault (see figure 5.)

The 30 amp main circuit breaker shall be provided to isolate incoming power and handle the rated load of the BBS and signal cabinet assembly. The trip and frame size shall be plainly marked (marked on the breaker by the manufacturer), and the ampere rating shall be visible from the front of the breaker.

1. The length of the battery and temperature interconnect harness from the first battery in the string in the vault, to the inverter/charger in the signal cabinet, shall be no greater than 20 feet.
3. All battery interconnect harness wiring shall be UL Style 1015 CSA TEW or Welding Style Cable or equivalent no smaller than #6 gauge and with sufficient strand count for flexibility and ease of handling.
4. An in-line, HEJ-BB type weather proof fuse holder and fuse rated at the appropriate ampacity for the selected configuration outlined in section 3-A shall be installed in the vault for short circuit protection, as close as practical to the Positive (+) terminal of the battery array.

5 BATTERY SYSTEM

A. 332 Cabinet BBS

1. The battery array shall be either 24 or 48 Volts DC of a design compatible with the back up unit and provide the run time specified in the plan or purchase order.
2. The battery shall be secured in a metal frame of appropriate design to support the entire weight of the battery. The bottom of the frame shall rest on the cabinet foundation and secured to the foundation anchor studs. Neither the cabinet chassis nor the EIA rack shall support the weight of the battery. The frame shall be constructed to allow 10 inches of clearance from the cabinet foundation to the bottom of the support frame. The frame shall provide support for the battery modules and provide ease of mechanical access to replace any one individual battery.
3. The battery cables shall not be less than #6 AWG in cross sectional area and use only mechanical connections or terminal blocks.
4. The temperature sensing cable from the inverter/UPS shall be installed in the center of the battery array as shown in figure 2.
4. The front face of the battery and all exposed connections shall be protected with a clear plastic cover of substantial strength and construction.

B. Battery Vault Storage

1. A series of batteries shall be configured to create a 24 or 48 volt DC system and provide sufficient amp-hour capacity to comply with the specification.
 2. Batteries shall be sealed deep cycle, AGM/VRLA (Absorbed Glass Mat. Valve Regulated Lead Acid), shall be easily replaced and commercially available.
 3. The battery design for a vault installation shall be such that terminals and physical dimensions are compatible with the limited space for ease of maintenance and access.
- C. The batteries shall be certified by the manufacturer to operate over a temperature range of -25°C to +74 °C.
- D. The batteries shall be provided with appropriate interconnect wiring and corrosion-resistant connections appropriate for the housing into which they will be installed.
- E. The BBS/UPS shall remotely monitor battery temperature as part of a temperature compensated charging management system. The system automatically charges the batteries per the manufacturer's recommended guidelines while maintaining electrical performance integrity and reducing the likelihood of premature failure.

6 BATTERY CABLES

- A. Battery interconnect wiring shall consist of welding style cable, UL listed, super K90 of sufficient rating to handle the power requirements.
1. Connection between batteries and harnesses to the inverter/charger shall be terminal blocks or "Anderson" type or approved equivalent. Compression splices can only be used in the vault style installation where jumper straps are not practical.
 2. Metal straps (jumpers) of the appropriate cross sectional area shall be used to interconnected battery terminals in the 332 style battery housing.
 3. Battery harnesses shall be fully insulated and constructed to allow batteries to be easily connected with ordinary tools in any order to achieve proper polarity and circuit configuration.
 4. All battery interconnect harness wiring shall be UL Style 1015 CSA TEW or Welding Style Cable or equivalent, all of proper gauge with respect to design current and with sufficient strand count for flexibility and ease of handling.
 5. Battery terminals shall be covered and insulated with molded boots or otherwise protected to prevent accidentally shorting.

Output Voltage	120 VAC Regulated
Output Power (continuous @ 74 Deg. C.)	800/500
Output Frequency	60 Hz $\pm$ 0.05%
Harmonic Distortion	< 3%
Input Voltage	24 or 48 VDC
Efficiency	$\geq$ 80% @ 25 Degrees C.
Transient Voltage Protection	Compliant with IEEE 587/ANSI C.62.41
Operating Temperature	-37 Degrees C. to +74 Degrees C.

8 FRONT PANEL

- A. Battery Status- The BBS front panel shall provide a display to indicate current battery charge status and conditions.
- B. Test Jacks- The BBS shall provide voltmeter standard probe input jacks (+) and (-) to read the exact battery voltage drop at the inverter input.
- C. Event Log- The BBS shall provide a means of counting, storing and displaying, with time and date stamp, a minimum of ten events. An event is defined as each occurrence that the BBS transferred to battery backup operation or recovered from battery backup to restored line operation.

9 **DOCUMENTATION**

Two sets of Operational and Maintenance Manuals shall be provided with each unit. The Manual(s) shall include but not be limited to thorough documentation of the following:

1. Theory of operation
2. Operating instructions
3. Maintenance procedures
4. Technical specifications
5. Block Diagrams
6. List of parts and components
7. Full service schematics and wiring diagrams

10 **WARRANTY**

Manufacturers shall provide a two (2) year factory repair warranty for parts and labor on the BBS from the date of acceptance by the L.A.D.O.T. Batteries shall be warranted for full replacement for two (2) years from the date of purchase. The warranty shall be included in the total bid price of the BBS.

11 **DRAWINGS**

Figure 1	Battery Back Up System (BBS) Block Diagram
Figure 2	Stand Alone 332 Cabinet Layout
Figure 3	F-332 Foundation drawing
Figure 4	Vault Installation 332 Cabinet Layout
Figure 5	Battery Vault Drawing

Battery Back Up System Block Diagram

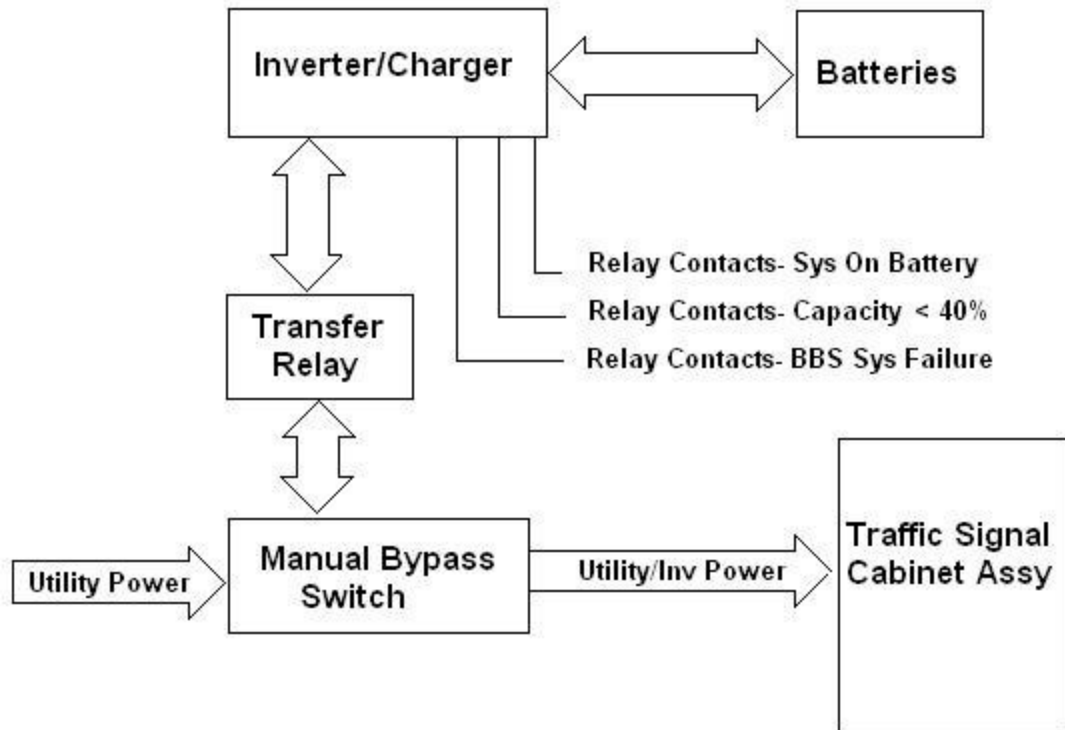
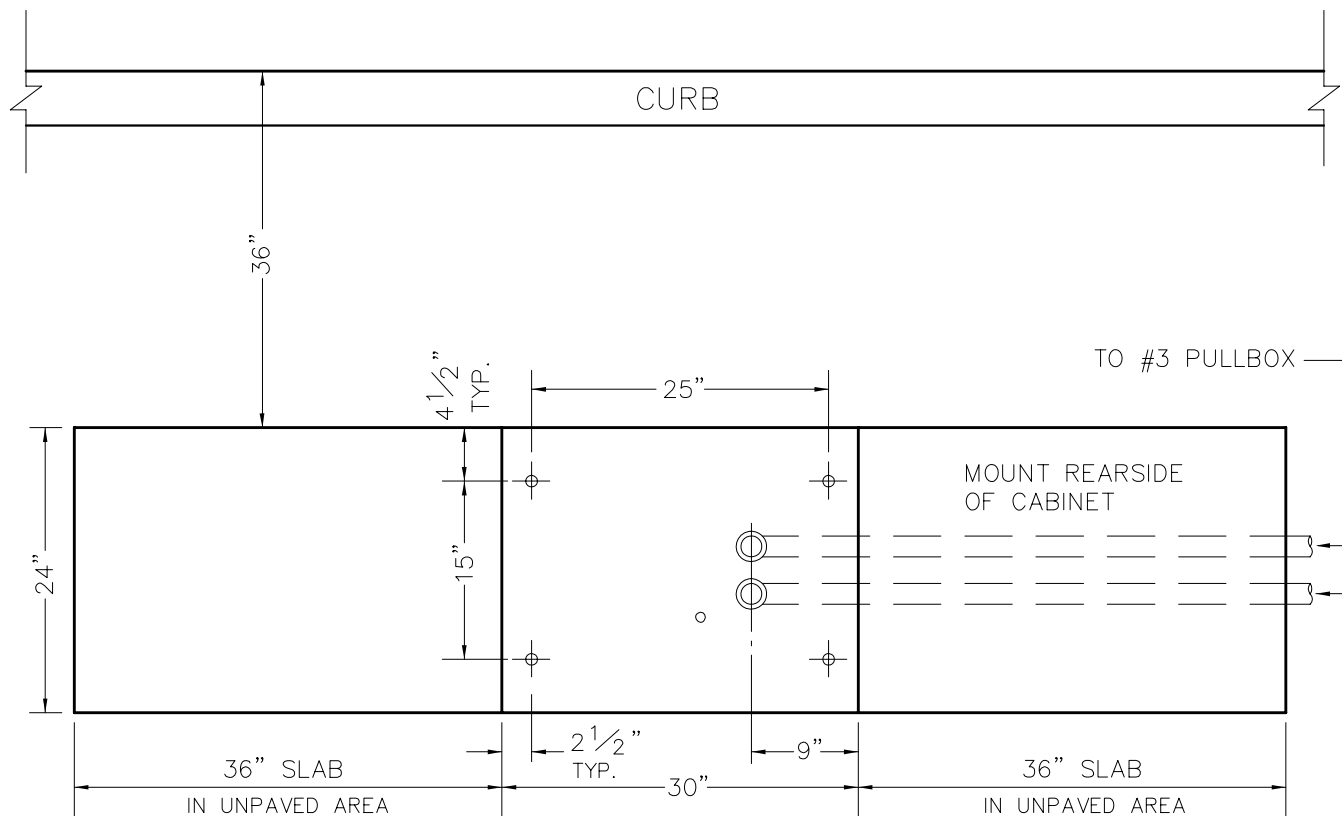
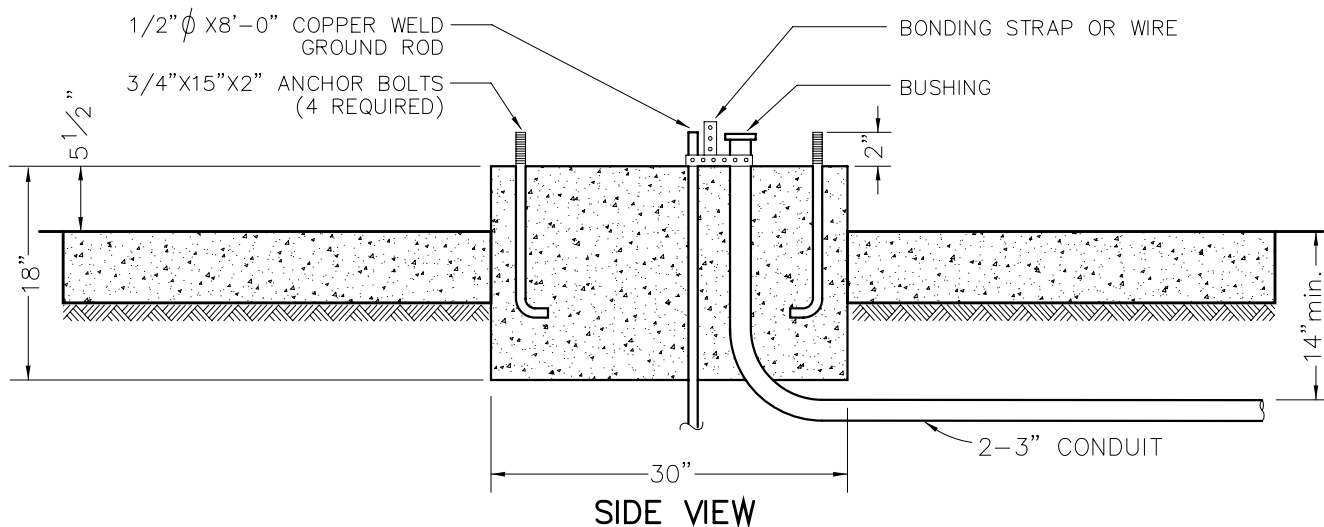


Figure 1



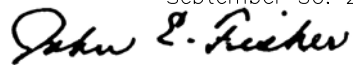
TOP VIEW



SIDE VIEW

NOTE:

1. NO PULLBOX TO BE LOCATED WITHIN THE FRONT OR REAR 24" X 36" CONCRETE SLAB.

DWN	AC	05-19-05	Title	FOUNDATION, TYPE F-332 1/1
CKD				
T. E.				
Sr. T. E.				
Pr. T. E.			CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION	
Approved			September 30, 2005	Drawing No.
 for Wayne K. Tanda, General Manager			S-52.1.3	

Inverter / Bypass Mounting Diagram

For a typical 332 LA Cabinet Vault installation

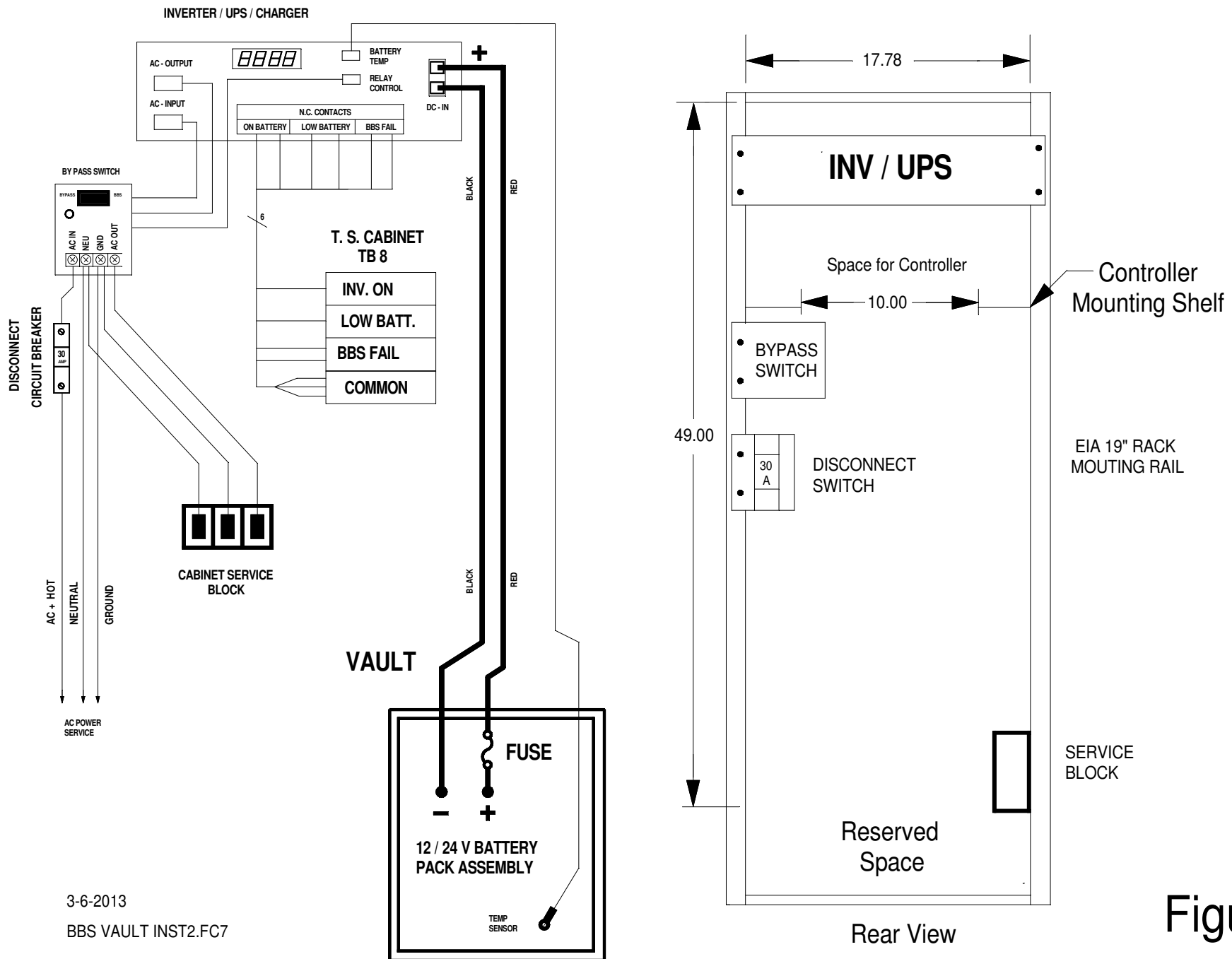
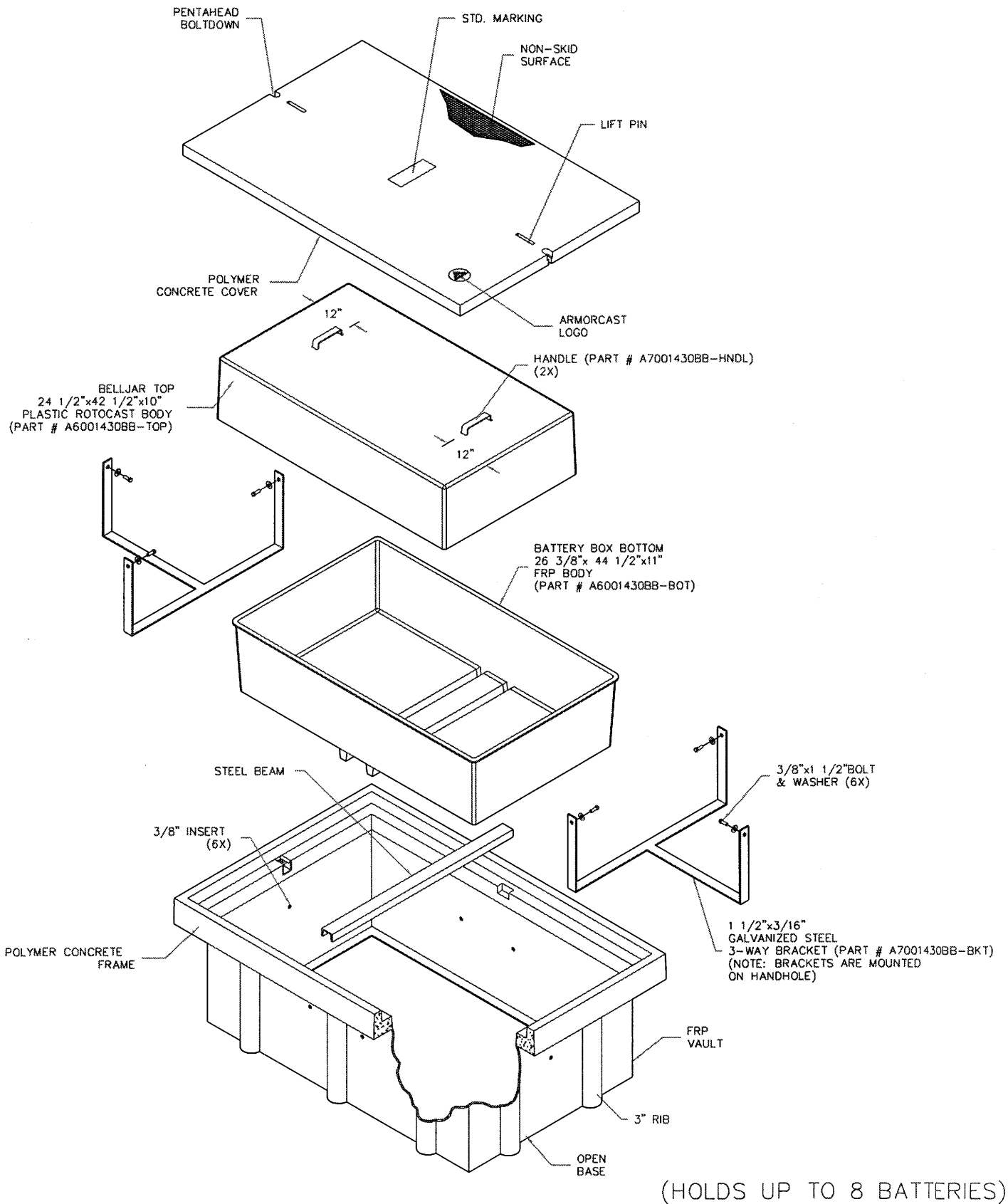


Figure 4



FILE # AG-1430AX18-8BB-M	 13230 Saticoy Street, North Hollywood, CA 91605 (818) 982-3600 ARMORCAST® PRODUCTS COMPANY			PART DESCRIPTION 30"X 48"X 18" BOX W/BATTERY BELL JAR	
	THE INFORMATION IN THIS DRAWING IS CONFIDENTIAL. THE DRAWING IS NOT TO BE REPRODUCED OR ITS CONTENTS DIVULGED IN ANY WAY WHATSOEVER EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF ARMORCAST PRODUCTS COMPANY. IT IS THE PROPERTY OF AND MUST BE RETURNED TO ARMORCAST PRODUCTS COMPANY, 13230 SATICOY STREET, NORTH HOLLYWOOD, CALIFORNIA 91605.			CUSTOMER	
	DRAWN CL	DATE 9/00	SCALE NONE	MAX. LOAD 10K	
	APPROV. WS		MATERIAL FRP,RPM,STL	DRAWING NUMBER A6001430A18-8BB	

CITY OF LOS ANGELES
DEPARTMENT OF TRANSPORTATION
TYPE II CABINET
01-24-91

I. PURPOSE

The purpose of this specification is to describe the general and specific requirements for a traffic signal communications cabinet.

II. CABINET CONSTRUCTION

- II.1 Aluminum Construction: Cabinets shall be constructed from 5052-H32 sheet aluminum alloy which has a thickness of .125 inch. The cabinet shall meet the requirements of NEMA 3R. External welds shall be made by using the Heliarc welding method, whereas internal welds will be made by the wire welding method. All welds shall be neatly formed and free of cracks, blow holes, and other irregularities.
- II.2 Steel Construction: The cabinet and door shall be constructed from No. 12 U.S.S. gauge cold rolled sheet steel. External welds shall be made by using the Heliarc welding method, whereas internal welds will be made by the wire welding method. All welds shall be neatly formed and free of cracks, blow holes, and irregularities.
- II.3 All inside and outside edges of the cabinet shall be free of burrs.
- II.4 The door opening shall be double flanged on all (4) sides which increases strength around openings and keeps dirt and liquids from entering the enclosure when the door is opened.

III. DOOR HARDWARE

- III.1 The cabinet door will be a minimum of 80% of the front surface area and shall be hinged on the left side when facing the cabinet. The name "City of Los Angeles" shall be molded, cast, or inscribed in quarter inch (1/4") letters on the outside, top center area of the cabinet door.

- III.1.A. The door shall be furnished with a gasket that satisfies the physical properties as found in UL508 table 21.1 and shall form a weather tight seal between the cabinet and door.
- III.2. The hinge shall be continuous and bolted to the cabinet door utilizing 1/4-20 stainless steel bolts and ny-lock nuts.
 - III.2.A. The hinges will be made of .075 inch thick stainless steel and shall have a three inch (3") open width with a .250 inch diameter stainless steel hinge pin.
 - III.2.B. The hinge pin shall be capped top and bottom by weld to render it tamper proof.
- III.3. The latching mechanism shall have provisions for padlocking. Padlock hole shall have minimum diameter of 7/16 inch. Latching mechanism shall be mounted with tamper-proof hardware. Hardware shall not protrude beyond outside of cabinet.
 - III.3.A. Latch mechanism shall be made of .075 min. thick stainless steel material, attaching the door to cabinet while maintaining a waterproof and dust tight seal of door opening. Latch mechanism shall be adjustable vertically and horizontally, allowing gasket compression to be adjusted.

IV. CABINET VENTILATION

- IV.1 The cabinet shall be provided with louvered vents on the rear as shown on drawing #D-160011 and shall comply with U.L. 508 rod entry test.
- IV.2 A security screen shall be mounted over the interior of each louver.

V. EQUIPMENT MOUNTING

- V.1. The enclosure shall be equipped with four (4) panel mounting studs.
- V.2. A plywood back panel shall be supplied with depth adjustable hardware.
- V.3. Back panel must be removable through both the base and door of the cabinet.

VI. CABINET FINISH

VI.1 Aluminum cabinets may be either painted or anodized.
If painted they shall conform to same provisions stated for steel. Aluminum cabinets requiring an anodized finish shall conform to the requirements of Military Specification MIL-A-8625C "Anodic Coatings for Aluminum Alloys" as modified by section 86, Caltrans, January 88.

VI.2 Aluminum cabinets may be either painted or anodized.
If painted they shall conform to same provisions stated for steel. Aluminum cabinets requiring an anodized finish shall conform to the requirements of Military Specification MIL-A-8625C "Anodic Coatings for Aluminum Alloys" as modified by section 86, Caltrans, January 88.

Steel cabinets shall be painted with a polymeric or an enamel coating system conforming to color No. 14672 (light green) of Federal Standard 595. The cabinet doors and any other parts to be painted shall be submerged in each tank of a three (3) step Iron Phosphate Conversion technique. After phosphatizing, the parts shall be baked to eliminate any moisture in seams. The finish coat of an Alkyd Bake Enamel will be baked for 10 minutes at 300°-325° F. The finish shall be commercially smooth, substantially free of flow lines, paint washout, streaks, blisters, and other defects.

CITY OF LOS ANGELES
DEPARTMENT OF TRANSPORTATION
August, 1982

Specification No. 92-069-01 For: Cable, Filled Telephone

August, 1982

I. PURPOSE

The purpose of this specification is to describe the requirements of a filled telephone cable, to be utilized for traffic signal interconnect.

II. DESCRIPTION

The cable shall consist of paired #22 AWG solid annealed copper conductors. The cable shall be polyethylene insulated, aluminum shielded, conforming to the construction requirements of the Rural Electrification Administration (R.E.A.) Specification PE-39 for filled telephone cable.

III. SIZE

The cable sizes shall be 12, 25, 50, and 75 pair.

IV. ENVIRONMENT

The cable shall meet the environmental requirements of R.E.A. Specification PE-39 for filled telephone cable.

V. TESTING

The cable shall meet environmental, mechanical, and electrical tests of R.E.A. Specification PE-39.

VI. GUARANTEE

The manufacturer of cable under this specification shall agree to replace any length of cable found to be defective in workmanship or material within one year from date of installation, but not more than two years from the date of delivery to the user.



United States
Department of
Agriculture

Rural
Electrification
Administration

REA Bulletin
1753F-205

June 1993

REA Specification for Filled Telephone Cables (PE-39)

UNITED STATES DEPARTMENT OF AGRICULTURE
Rural Electrification Administration

BULLETIN 1753F-205(PE-39)

SUBJECT: REA Specification for Filled Telephone Cables

TO: All Telephone Borrowers
REA Telephone Staff

EFFECTIVE DATE: June 21, 1993.

EXPIRATION DATE: Date of change in 7 CFR §1755.390 by rulemaking.

OFFICE OF PRIMARY INTEREST: Outside Plant Branch,
Telecommunications Standards Division.

PREVIOUS INSTRUCTIONS: This bulletin replaces REA Bulletin 345-67, REA Specification for Filled Telephone Cables, PE-39, issued January 2, 1987.

FILING INSTRUCTIONS: Discard REA Bulletin 345-67, REA Specification for Filled Telephone Cables, PE-39, dated January 2, 1987, and replace with this bulletin.

PURPOSE: This specification covers REA requirements for filled telephone cables intended for direct burial installation either by trenching or by direct plowing, for underground application by placement in a duct, or for aerial installation by attachment to a support strand. This bulletin is a reformat of the text codified in 7 CFR 1755.390 published at 58 FR 29336, dated May 20, 1993.

Every effort has been made to ensure the accuracy of this document. However, in case of discrepancies, the regulations at 7 CFR 1755.390 are the authorized sources.

Robert P. Peltis

ACTING Administrator

6/4/93

Date

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Cable, Filled, Telephone

CFR TO CONVERSION TABLE

7 CFR 1755.390	Bulletin 1753F-205	7 CFR 1755.390	Bulletin 1753F-205	7 CFR 1755.390	Bulletin 1753F-205
(a)	1.	(g) (1)	7.1	(n)	14.
(a) (1)	1.1	(g) (2)	7.2	(n) (1)	14.1
(a) (2)	1.2	(g) (3)	7.3	(n) (2)	14.2
(a) (3)	1.3	(h)	8.	(n) (3)	14.3
(a) (4)	1.4	(h) (1)	8.1	(o)	15.
(a) (5)	1.5	(h) (2)	8.2	(o) (1)	15.1
(a) (6)	1.6	(h) (3)	8.3	(o) (2)	15.2
(b)	2.	(i)	9.	(p)	16.
(b) (1)	2.1	(i) (1)	9.1	(p) (1)	16.1
(b) (2)	2.2	(i) (2)	9.2	(p) (2)	16.2
(b) (3)	2.3	(i) (3)	9.3	(p) (3)	16.3
(b) (4)	2.4	(i) (4)	9.4	(p) (4)	16.4
(b) (5)	2.5	(i) (5)	9.5	(p) (5)	16.5
(b) (6)	2.6	(i) (6)	9.6	(p) (6)	16.6
(b) (7)	2.7	(i) (7)	9.7	(q)	17.
(b) (8)	2.8	(i) (8)	9.8	(q) (1)	17.1
(b) (9)	2.9	(i) (9)	9.9	(q) (2)	17.2
(b) (10)	2.10	(i) (10)	9.10	(r)	18.
(c)	3.	(i) (11)	9.11	(r) (1)	18.1
(c) (1)	3.1	(i) (12)	9.12	(r) (2)	18.2
(c) (2)	3.2	(i) (13)	9.13	(s)	19.
(c) (3)	3.3	(j)	10.	(s) (1)	19.1
(c) (4)	3.4	(j) (1)	10.1	(s) (2)	19.2
(c) (5)	3.5	(j) (2)	10.2	(s) (3)	19.3
(c) (6)	3.6	(j) (3)	10.3	(s) (4)	19.4
(c) (7)	3.7	(j) (4)	10.4	(s) (5)	19.5
(d)	4.	(k)	11.	(s) (6)	19.6
(d) (1)	4.1	(k) (1)	11.1	(s) (7)	19.7
(d) (2)	4.2	(k) (2)	11.2	(s) (8)	19.8
(d) (3)	4.3	(k) (3)	11.3	(s) (9)	19.9
(d) (4)	4.4	(k) (4)	11.4	(s) (10)	19.10
(d) (5)	4.5	(k) (5)	11.5	APPENDIX A	APPENDIX A
(d) (6)	4.6	(k) (6)	11.6	(I)	1.
(d) (7)	4.7	(k) (7)	11.7	(II)	2.
(d) (8)	4.8	(k) (8)	11.8	(II) (1)	2.1
(d) (9)	4.9	(k) (9)	11.9	(II) (2)	2.2
(d) (10)	4.10	(k) (10)	11.10	(III)	3.
(e)	5.	(k) (11)	11.11	(III) (1)	3.1
(e) (1)	5.1	(l)	12.	(III) (2)	3.2
(e) (2)	5.2	(l) (1)	12.1	(III) (3)	3.3
(e) (3)	5.3	(l) (2)	12.2	(III) (4)	3.4
(e) (4)	5.4	(l) (3)	12.3	(III) (5)	3.5
(f)	6.	(l) (4)	12.4	(III) (6)	3.6
(f) (1)	6.1	(l) (5)	12.5	(III) (7)	3.7
(f) (2)	6.2	(l) (6)	12.6	(IV)	4.
(f) (3)	6.3	(m)	13.	(IV) (1)	4.1
(f) (4)	6.4	(m) (1)	13.1	(IV) (2)	4.2
(g)	7.	(m) (2)	13.2	(IV) (3)	4.3
				(V)	Formats

ABBREVIATIONS

ANSI	American National Standards Institute
ASTM	American Society For Testing and Materials
AWG	American Wire Gauge
°C	Centigrade temperature scale
CACSP	Coated aluminum shield/coated steel armor polyethylene sheath
cm	Centimeter
dc	Direct current
dB/km	Decibels per 1 kilometer
dB/mile	Decibels per 1 mile
ECCS	Electrolytic chrome coated steel
FEXT	Far-end crosstalk loss
ft	Feet
g	Grams
IACS	International Annealed Copper Standard
ICEA	Insulated Cable Engineers Association
in.	Inches
KHz	Kilohertz
kPa	Kilopascals
kV	Kilovolts
lbf	Pound-force
m	Meter
mm	Millimeter
N	Newton
NEXT	Near-end crosstalk loss
nF/km	Nanofarad per 1 kilometer
nF/mile	Nanofarad per 1 mile
ohms/km	Ohms per 1 kilometer
pF/km	Picofarad per 1 kilometer
pF/1000 ft	Picofarad per 1000 feet
psig	Pounds per square inch gauge
REA	Rural Electrification Administration
rms	Root mean square
T1C	North American Digital Hierarchy Line Code
V/s	Volt per 1 second
Yoc	Open circuit admittance
Zsc	Short circuit impedance

1. SCOPE

1.1 This specification covers the requirements for filled telephone cables intended for direct burial installation either by trenching or by direct plowing, for underground application by placement in a duct, or for aerial installation by attachment to a support strand.

1.1.1 The conductors are solid copper, individually insulated with an extruded solid insulating compound.

1.1.2 The insulated conductors are twisted into pairs which are then stranded or oscillated to form a cylindrical core.

1.1.3 For high frequency applications, the cable core may be separated into compartments with screening shields.

1.1.4 A moisture resistant filling compound is applied to the stranded conductors completely covering the insulated conductors and filling the interstices between pairs and units.

1.1.5 The cable structure is completed by the application of suitable core wrapping material, a flooding compound, a shield or a shield/armor, and an overall plastic jacket.

1.2 The number of pairs and gauge size of conductors which are used within the REA program are provided in the following table:

<u>AWG</u>	<u>19</u>	<u>22</u>	<u>24</u>	<u>26</u>
Pairs	6	6	6	
	12	12	12	
	18	18	18	
	25	25	25	25
		50	50	50
		75	75	75
		100	100	100
		150	150	150
		200	200	200
		300	300	300
		400	400	400
			600	600
				900

Note: Cables larger in pair sizes than those shown in the above table must meet all requirements of this specification.

1.3 Screened cable, when specified, must meet all requirements of this specification. The pair sizes of screened cables used within the REA program are referenced in Paragraph 5.2.1 of this specification.

1.4 All cables sold to REA borrowers for projects involving REA loan funds under this specification must be accepted by REA Technical Standards Committee "A" (Telephone). For cables manufactured to this specification, all design changes to an accepted design must be submitted for acceptance. REA will be the sole authority on what constitutes a design change.

1.5 Materials, manufacturing techniques, or cable designs not specifically addressed by this specification may be allowed if accepted by REA. Justification for acceptance of modified materials, manufacturing techniques, or cable designs must be provided to substantiate product utility and long-term stability and endurance.

1.6 Copies of ANSI/ICEA S-84-608-1988, "Standard For Telecommunications Cable Filled, Polyolefin Insulated, Copper Conductor Technical Requirements," as referenced in this specification can be obtained from the Insulated Cable Engineers Association, Inc. (ICEA) for a nominal fee at the address indicated below:

Insulated Cable Engineers Association, Inc.
P. O. Box 440
South Yarmouth, Massachusetts 02664
Telephone: (508) 394-4424

2. CONDUCTORS AND CONDUCTOR INSULATION

2.1 The gauge sizes of the copper conductors covered by this specification must be 19, 22, 24, and 26 AWG.

2.2 Each conductor must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 2.1.

2.3 Factory joints made in conductors during the manufacturing process must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 2.2.

2.4 The raw materials used for conductor insulation must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraphs 3.1 through 3.1.3.

2.5 The finished conductor insulation must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraphs 3.2.1 and 3.3.

2.6 Insulated conductors must not have an overall diameter greater than 2 mm (0.081 in.).

2.7 A permissible overall performance level of faults in conductor insulation must average not greater than one fault per 12,000 conductor meters (40,000 conductor ft) for each gauge of conductor.

2.7.1 All insulated conductors must be continuously tested for insulation faults during the twinning operation with a method of testing acceptable to REA. The length count and number of faults must be recorded. The information must be retained for a period of 6 months and be available for review by REA when requested.

2.7.2 The voltages for determining compliance with the requirements of Paragraph 2.7 of this specification are as follows:

<u>AWG</u>	<u>DC Voltages (kV)</u>
19	8.0
22	6.0
24	5.0
26	4.0

2.8 Repairs to the conductor insulation during manufacture are permissible. The method of repair must be accepted by REA prior to its use. The repaired insulation must be capable of meeting the relevant electrical requirements of this specification.

2.9 All repaired sections of insulation must be retested in the same manner as originally tested for compliance with Paragraph 2.7 of this specification.

2.10 The colored insulating material removed from or tested on the conductor, from a finished cable, must meet the performance requirements specified in ANSI/ICEA S-84-608-1988, Paragraphs 3.4.1, 3.4.2, 3.4.4, 3.4.5, and 3.4.6.

3. IDENTIFICATION OF PAIRS AND TWISTING OF PAIRS

3.1 The insulation must be colored to identify:

- a. The tip and ring conductor of each pair; and
- b. Each pair in the completed cable.

3.2 The colors to be used in the pairs in the 25 pair group, together with the pair numbers must be in accordance with the table specified in ANSI/ICEA S-84-608-1988, Paragraph 3.5.

3.3 Positive identification of the tip and ring conductors of each pair by marking each conductor of a pair with the color of its mate is permissible. The method of marking must be accepted by REA prior to its use.

3.4 Other methods of providing positive identification of the tip and ring conductors of each pair may be employed if accepted by REA prior to its use.

3.5 The insulated conductors must be twisted into pairs.

3.6 In order to provide sufficiently high crosstalk isolation, the pair twists must be designed to enable the cable to meet the capacitance unbalance and crosstalk loss requirements of Paragraphs 11.5, 11.6, and 11.8 of this specification.

3.7 The average length of pair twists in any pair in the finished cable, when measured on any 3 m (10 ft) length, must not exceed the requirement specified in ANSI/ICEA S-84-608-1988, Paragraph 3.5.

4. FORMING OF THE CABLE CORE

4.1 Twisted pairs must be assembled in such a way as to form a substantially cylindrical group.

4.2 When desired for lay-up reasons, the basic group may be divided into two or more subgroups called units.

4.3 Each group, or unit in a particular group, must be enclosed in bindings of the colors indicated for its particular pair count. The pair count, indicated by the colors of insulation, must be consecutive as indicated in Paragraph 4.6 of this specification through units in a group.

4.4 The filling compound must be applied to the cable core in such a way as to provide as near a completely filled core as is commercially practical.

4.5 Threads and tapes used as binders must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraphs 4.2 and 4.2.1.

4.6 The colors of the bindings and their significance with respect to pair count must be as follows:

<u>Group No.</u>	<u>Color of Bindings</u>	<u>Group Pair Count</u>
1	White-Blue	1-25
2	White-Orange	26-50
3	White-Green	51-75
4	White-Brown	76-100
5	White-Slate	101-125
6	Red-Blue	126-150
7	Red-Orange	151-175
8	Red-Green	176-200
9	Red-Brown	201-225
10	Red-Slate	226-250
11	Black-Blue	251-275
12	Black-Orange	276-300
13	Black-Green	301-325
14	Black-Brown	326-350
15	Black-Slate	351-375

16	Yellow-Blue	376-400
17	Yellow-Orange	401-425
18	Yellow-Green	426-450
19	Yellow-Brown	451-475
20	Yellow-Slate	476-500
21	Violet-Blue	501-525
22	Violet-Orange	526-550
23	Violet-Green	551-575
24	Violet-Brown	576-600

4.7 The use of the white unit binder in cables of 100 pairs or less is optional.

4.8 When desired for manufacturing reasons, two or more 25 pair groups may be bound together with nonhygroscopic and nonwicking threads or tapes into a super-unit. Threads or tapes must meet the requirements specified in Paragraph 4.5 of this specification. The group binders and the super-unit binders must be color coded such that the combination of the two binders must positively identify each 25 pair group from every other 25 pair group in the cable. Super-Unit binders must be of the color shown in the following table:

SUPER-UNIT BINDER COLORS

<u>Pair Numbers</u>	<u>Binder Color</u>
1-600	White
601-1200	Red
1201-1800	Black
1801-2400	Yellow
2401-3000	Violet

4.9 Color binders must not be missing for more than 90 m (300 ft) from any 25 pair group or from any subgroup used as part of a super-unit. At any cable cross-section, no adjacent 25 pair groups and no more than one subgroup of any super-unit may have missing binders. In no case must the total number of missing binders exceed three. Missing super-unit binders must not be permitted for any distance.

4.10 Any reel of cable which contains missing binders must be labeled indicating the colors and location of the binders involved. The labeling must be applied to the reel and also to the cable.

5. SCREENED CABLE

5.1 Screened cable must be constructed such that a metallic, internal screen(s) must be provided to separate and provide sufficient isolation between the compartments to meet the requirements of this specification.

5.2 At the option of the user or manufacturer, identified service pairs providing for voice order and fault location may be placed in screened cables.

5.2.1 The number of service pairs provided must be one per twenty-five operating pairs plus two for a cable size up to and including 400 pairs, subject to a minimum of four service pairs. The pair counts for screened cables are given as follows:

SCREENED CABLE PAIR COUNTS

<u>Carrier Pair Count</u>	<u>Service Pairs</u>	<u>Total Pair Count</u>
24	4	28
50	4	54
100	6	106
150	8	158
200	10	210
300	14	314
400	18	418

5.2.2 The service pairs must be equally divided among the compartments. The color sequence must be repeated in each compartment.

5.2.3 The electrical and physical characteristics of each service pair must meet all the requirements set forth in this specification.

5.2.4 The colors used for the service pairs must be in accordance with the requirements of Paragraph 2.5 of this specification. The color code used for the service pairs together with the service pair number are shown in the following table.

COLOR CODE FOR SERVICE PAIRS

<u>Service Pair No.</u>	<u>Tip</u>	<u>Color</u> <u>Ring</u>
1	White	Red
2	"	Black
3	"	Yellow
4	"	Violet
5	Red	Black
6	"	Yellow
7	"	Violet
8	Black	Yellow
9	"	Violet

5.3 The screen tape must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraphs 5.1 through 5.4.

5.4 The screen tape must be tested for dielectric strength by completely removing the protective coating from one end to be used for grounding purposes.

5.4.1 Using an electrode, over a 30 cm (1 ft) length, apply a dc voltage at the rate of rise of 500 V/s until failure.

5.4.2 No breakdown should occur below 8 kV.

6. FILLING COMPOUND

6.1 After or during the stranding operation and prior to application of the core wrap, filling compound must be applied to the cable core. The compound must be as nearly colorless as is commercially feasible and consistent with the end product requirements and pair identification.

6.2 The filling compound must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraphs 4.4 through 4.4.4.

6.3 The individual cable manufacturer must satisfy REA that the filling compound selected for use is suitable for its intended application. The filling compound must be applied to the cable in such a manner that the cable components will not be degraded.

7. CORE WRAP

7.1 The core wrap must comply with the requirements specified in ANSI/ICEA-S-84-608-1988, Paragraph 4.3.

7.2 If required for manufacturing reasons, white or colored binders of nonhygroscopic and nonwicking material may be applied over the core and/or wrap. When used, binders must meet the requirements specified in Paragraph 4.5 of this specification.

7.3 Sufficient filling compound must have been applied to the core wrap so that voids or air spaces existing between the core and the inner side of the core wrap are minimized.

8. FLOODING COMPOUND

8.1 Sufficient flooding compound must be applied on all sheath interfaces so that voids and air spaces in these areas are minimized. When the optional armored design is used, the flooding compound must be applied between the core wrap and shield, between the shield and armor, and between the armor and the jacket so that voids and air spaces in these areas are minimized. The use of floodant over the outer metallic substrate is not required if uniform bonding, per Paragraph 9.7 of this

specification, is achieved between the plastic-clad metal and the jacket.

8.2 The flooding compound must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 4.5 and the jacket slip test requirements of Appendix A, Paragraph 3.5, of this specification.

8.3 The individual cable manufacturer must satisfy REA that the flooding compound selected for use is acceptable for the application.

9. SHIELD AND OPTIONAL ARMOR

9 A single corrugated shield must be applied longitudinally over the core wrap.

9.2 For unarmored cable the shield overlap must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 6.3.2. Core diameter is defined as the diameter under the core wrap and binding.

9.3 For cables containing the coated aluminum shield/coated steel armor (CACSP) sheath design, the coated aluminum shield must be applied in accordance with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 6.3.2, Dual Tape Shielding System.

9.4 General requirements for application of the shielding material are as follows:

9.4.1 Successive lengths of shielding tapes may be joined during the manufacturing process by means of cold weld, electric weld, soldering with a nonacid flux, or other acceptable means.

9.4.2 Shield splices must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 6.3.3.

9.4.3 The corrugations and the application process of the coated aluminum and copper bearing shields must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 6.3.1.

9.4.4 The shielding material must be applied in such a manner as to enable the cable to pass the cold bend test specified in Paragraph 12.3 of this specification.

9.5 The following is a list of acceptable materials for use as cable shielding. Other types of shielding materials may also be used provided they are accepted by REA prior to their use.

Standard Cable

8-Mil Coated Aluminum¹
5-Mil Copper

Gopher Resistant Cable

10-Mil Copper
6-Mil Copper-Clad
Stainless Steel
5 Mil Copper-Clad
Stainless Steel
5 Mil Copper-Clad Alloy
Steel
7-Mil Alloy 194
6-Mil Alloy 194
8-Mil Coated Aluminum¹
and 6-Mil Coated Steel¹

¹Dimensions of uncoated metal

9.5.1 The 8-mil aluminum tape must be plastic coated on both sides and must comply with the requirements of ANSI/ICEA S-84-608-1988, Paragraph 6.2.2.

9.5.2 The 5-mil copper tape must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 6.2.3.

9.5.3 The 10-mil copper tape must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 6.2.4.

9.5.4 The 6-mil copper clad stainless steel tape must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 6.2.5.

9.5.5 The 5-mil copper clad stainless steel tape must be in the fully annealed condition and must conform to the requirements of ASTM B 694-86, with a cladding ratio of 16/68/16.

9.5.5.1 The electrical conductivity of the clad tape must be a minimum of 28 percent of the International Annealed Copper Standard (IACS) when measured per ASTM B 193-87.

9.5.5.2 The tape must be nominally 0.13 mm (0.005 in.) thick with a minimum thickness of 0.11 mm (0.0045 in.).

9.5.6 The 5-mil copper clad alloy steel tape must be in the fully annealed condition and the copper component must conform to the requirements of ASTM B 224-80 and the alloy steel component must conform to the requirements of ASTM A 505-87, with a cladding ratio of 16/68/16.

9.5.6.1 The electrical conductivity of the copper clad alloy steel tape must comply with the requirement specified in Paragraph 9.5.5.1 of this specification.

9.5.6.2 The thickness of the copper clad alloy steel tape must comply with the requirements specified in Paragraph 9.5.5.2 of this specification.

9.5.7 The 6-mil and 7-mil 194 copper alloy tapes must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 6.2.6.

9.6 The corrugation extensibility of the coated aluminum shield must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 6.4.

9.7 When the jacket is bonded to the plastic coated aluminum shield, the bond between the jacket and shield must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 7.2.6.

9.8 A single plastic-coated steel corrugated armor must be applied longitudinally directly over the coated aluminum shield listed in Paragraph 9.5 of this specification with an overlap complying with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 6.3.2, Outer Steel Tape.

9.9 Successive lengths of steel armoring tapes may be joined during the manufacturing process by means of cold weld, electric weld, soldering with a nonacid flux, or other acceptable means. Armor splices must comply with the breaking strength and resistance requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 6.3.3.

9.10 The corrugations and the application process of the coated steel armor must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 6.3.1.

9.10.1 The corrugations of the armor tape must coincide with the corrugations of the coated aluminum shield.

9.10.2 Overlapped portions of the armor tape must be in register (corrugations shall coincide at overlap) and in contact at the outer edge.

9.11 The armoring material must be so applied to enable the cable to pass the cold bend test as specified in Paragraph 12.3 of this specification.

9.12 The 6-mil steel tape must be electrolytic chrome-coated steel (ECCS) plastic coated on both sides and must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 6.2.8.

9.13 When the jacket is bonded to the plastic coated steel armor, the bond between the jacket and armor must comply with the requirement specified in ANSI/ICEA-S-84-608-1988, Paragraph 7.2.6.

10. CABLE JACKET

10.1 The jacket must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 7.2.

10.2 The raw materials used for the cable jacket must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 7.2.1.

10.3 Jacketing material removed from or tested on the cable must meet the performance requirements specified in ANSI/ICEA S-84-608-1988, Paragraphs 7.2.3 and 7.2.4.

10.4 The thickness of the jacket must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 7.2.2.

11. ELECTRICAL REQUIREMENTS

11.1 Conductor Resistance: The dc resistance of any conductor in a completed cable and the average resistance of all conductors in a Quality Control Lot must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 8.1.

11.2 Resistance Unbalance

11.2.1 The dc resistance unbalance between the two conductors of any pair in a completed cable and the average resistance unbalance of all pairs in a completed cable must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 8.2.

11.2.2 The resistance unbalance between tip and ring conductors shall be random with respect to the direction of unbalance. That is, the resistance of the tip conductors shall not be consistently higher with respect to the ring conductors and vice versa.

11.3 Mutual Capacitance: The average mutual capacitance of all pairs in a completed cable and the individual mutual capacitance of any pair in a completed cable must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 8.3.

11.4 Capacitance Difference

11.4.1 The capacitance difference for completed cables having 75 pairs or greater must comply with the requirement specified in ANSI/ICEA S-84-608-1988, Paragraph 8.4.

11.4.2 When measuring screened cable, the inner and outer pairs must be selected from both sides of the screen.

11.5 Pair-to-pair Capacitance Unbalance

11.5.1 Pair-to-Pair: The capacitance unbalance as measured on the completed cable must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 8.5.

11.5.2 Screened Cable: In cables with 25 pairs or less and within each group of multigroup cables, the pair-to-pair capacitance unbalance between any two pairs in an individual compartment must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 8.5. The pair-to-pair capacitance unbalances to be considered must be:

- a. Between pairs adjacent in a layer in an individual compartment;
- b. Between pairs in centers of 4 pairs or less in an individual compartment; and
- c. Between pairs in adjacent layers in an individual compartment when the number of pairs in the inner (smaller) layer is 6 or less. The center is counted as a layer.

11.5.3 In cables with 25 pairs or less, the rms value must include all the pair-to-pair unbalances measured for each compartment separately.

11.5.4 In cables containing more than 25 pairs, the rms value must include the pair-to-pair unbalances in the separate compartments.

11.6 Pair-to-Ground Capacitance Unbalance

11.6.1 Pair-to-Ground: The capacitance unbalance as measured on the completed cable must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 8.6.

11.6.2 When measuring pair-to-ground capacitance unbalance all pairs except the pair under test are grounded to the shield and/or shield/armor except when measuring cables containing super units in which case all other pairs in the same super unit must be grounded to the shield.

11.6.3 The screen tape must be left floating during the test.

11.6.4 Pair-to-ground capacitance unbalance may vary directly with the length of the cable.

11.7 Attenuation

11.7.1 For nonscreened and screened cables, the average attenuation of all pairs on any reel when measured at 150 and 772 kHz must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 8.7, Solid Column.

11.7.2 For T1C type cables over 12 pairs, the maximum average attenuation of all pairs on any reel must not exceed the values listed below when measured at a frequency of 1576 kHz at or corrected to a temperature of $20 \pm 1^\circ\text{C}$. The test must be conducted in accordance with ASTM D 4566-90.

<u>AWG</u>	<u>Maximum Average Attenuation dB/km (dB/mile)</u>
19	13.4 (21.5)
22	18.3 (29.4)
24	23.1 (37.2)

11.8 Crosstalk Loss

11.8.1 The equal level far-end power sum crosstalk loss (FEXT) as measured on the completed cable must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 8.8, FEXT Table.

11.8.2 The near-end power sum crosstalk loss (NEXT) as measured on completed cable must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 8.8, NEXT Table.

11.8.3 Screened Cable

11.8.3.1 For screened cables the NEXT loss as measured on the completed cable must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraphs 8.9 and 8.9.1.

11.8.3.2 For T1C screened cable the NEXT loss as measured on the completed cable must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraphs 8.9 and 8.9.2.

11.9 Insulation Resistance: The insulation resistance of each insulated conductor in a completed cable must comply with the requirement specified in ANSI/ICEA S-84-608-1988, Paragraph 8.11.

11.10. High Voltage Test

11.10.1 In each length of completed cable, the insulation between conductors must comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 8.12, Solid Column.

11.10.2 In each length of completed cable, the dielectric between the shield and/or armor and conductors in the core must

comply with the requirements specified in ANSI/ICEA S-84-608-1988, Paragraph 8.13, Single Jacketed, Solid Column. In screened cable the screen tape must be left floating.

11.10.3 Screened Cable

11.10.3.1 In each length of completed screened cable, the dielectric between the screen tape and the conductors in the core must comply with the requirement specified in ANSI/ICEA S-84-608-1988, Paragraph 8.14.

11.10.3.2 In this test the cable shield and/or armor must be left floating.

11.11 Electrical Variations

11.11.1 Pairs in each length of cable having either a ground, cross, short, or open circuit condition will not be permitted.

11.11.2 The maximum number of pairs in a cable which may vary as specified in Paragraph 11.11.3 of this specification from the electrical parameters given in this specification are listed below. These pairs may be excluded from the arithmetic calculation.

<u>Nominal Pair Count</u>	<u>Maximum Number of Pairs with Allowable Electrical Variation</u>
6-100	1
101-300	2
301-400	3
401-600	4
601 and above	6

11.11.3 Parameter Variations

11.11.3.1 Capacitance Unbalance-to-Ground: If the cable fails either the maximum individual pair or average capacitance unbalance-to-ground requirement and all individual pairs are 3937 pF/km (1200 pF/1000 ft) or less, the number of pairs specified in Paragraph 11.11.2 of this specification may be eliminated from the average and maximum individual calculations.

11.11.3.2 Resistance Unbalance: Individual pair of 7 percent for all gauges.

11.11.3.3 Conductor Resistance, Maximum: The following table shows maximum conductor resistance.

<u>AWG</u>	<u>ohms/km</u>	<u>(ohms/1000 ft)</u>
19	29.9	(9.1)
22	60.0	(18.3)
24	94.5	(28.8)
26	151.6	(46.2)

Note: REA recognizes that in large pair count cable (600 pair and above) a cross, short or open circuit condition occasionally may develop in a pair which does not affect the performance of the other cable pairs. In these circumstances rejection of the entire cable may be economically unsound or repairs may be impractical. In such circumstances the manufacturer may desire to negotiate with the customer for acceptance of the cable. No more than 0.5 percent of the pairs may be involved.

12. MECHANICAL REQUIREMENTS

12.1 Compound Flow Test: All cables manufactured in accordance with the requirements of this specification must be capable of meeting the compound flow test specified in ANSI/ICEA S-84-608-1988, Paragraph 9.1 using a test temperature of $80 \pm 1^\circ\text{C}$.

12.2 Water Penetration Test: All cables manufactured in accordance with the requirements of this specification must be capable of meeting the water penetration test specified in ANSI/ICEA S-84-608-1988, Paragraph 9.2.

12.3 Cable Cold Bend Test: All cables manufactured in accordance with the requirements of this specification must be capable of meeting the cable cold bend test specified in ANSI/ICEA S-84-608-1988, Paragraph 9.3.

12.4 Cable Impact Test: All cables manufactured in accordance with the requirements of this specification must be capable of meeting the cable impact test specified in ANSI/ICEA S-84-608-1988, Paragraph 9.4.

12.5 Jacket Notch Test (CACSP Sheath Only): All cables utilizing the coated aluminum/coated steel sheath (CACSP) design manufactured in accordance with the requirements of this specification must be capable of meeting the jacket notch test specified in ANSI/ICEA S-84-608-1988, Paragraph 9.5.

12.6 Cable Torsion Test (CACSP Sheath Only): All cables utilizing the coated aluminum/coated steel sheath (CACSP) design manufactured in accordance with the requirements of this

specification must be capable of meeting the cable torsion test specified in ANSI/ICEA S-84-608-1988, Paragraph 9.6.

13. SHEATH SLITTING CORD (OPTIONAL)

13.1 Sheath slitting cords may be used in the cable structure at the option of the manufacturer unless specified by the end user.

13.2 When a sheath slitting cord is used it must be nonhygroscopic and nonwicking, continuous throughout a length of cable and of sufficient strength to open the sheath without breaking the cord.

14. IDENTIFICATION MARKER AND LENGTH MARKER

14.1 Each length of cable must be identified in accordance with ANSI/ICEA S-84-608-1988, Paragraphs 10.1 through 10.1.4. The color of the ink used for the initial outer jacket marking must be either white or silver.

14.2 The markings must be printed on the jacket at regular intervals of not more than 0.6 m (2 ft).

14.3 The completed cable must have sequentially numbered length markers in accordance with ANSI/ICEA S-84-608-1988, Paragraph 10.1.5. The color of the ink used for the initial outer jacket marking must be either white or silver.

15. PRECONNECTORIZED CABLE (OPTIONAL)

15.1 At the option of the manufacturer and upon request by the purchaser, the cables 100 pairs and larger may be factory terminated in 25 pair splicing modules.

15.2 The splicing modules must meet the requirements of REA Bulletin 345-54, PE-52, REA Specification for Telephone Cable Splicing Connectors (Incorporated by Reference at 1755.97) and be accepted by REA prior to their use.

16. ACCEPTANCE TESTING AND EXTENT OF TESTING

16.1 The tests described in Appendix A of this specification are intended for acceptance of cable designs and major modifications of accepted designs. What constitutes a major modification is at the discretion of REA. These tests are intended to show the inherent capability of the manufacturer to produce cable products having long life and stability.

16.2 For initial acceptance, the manufacturer must submit:

- a. An original signature certification that the product fully complies with each section of this specification;
- b. Qualification Test Data, per Appendix A;
- c. To periodic plant inspections;
- d. A certification that the product does or does not comply with the domestic origin manufacturing provisions of the "Buy American" Requirements of the Rural Electrification Act of 1938 (7 U.S.C. 901 et seq.);
- e. Written user testimonials concerning field performance of the product; and
- f. Other nonproprietary data deemed necessary by the Chief, Outside Plant Branch (Telephone).

16.3 For regualification acceptance, the manufacturer must submit an original signature certification that the product fully complies with each section of the specification, excluding the Qualification Section, and a certification that the product does or does not comply with the domestic origin manufacturing provisions of the "Buy American" requirements of the Rural Electrification Act of 1938 (7 U.S.C. 901 et seq.), for acceptance by August 30 of each year. The required data must have been gathered within 90 days of the submission. If the initial acceptance of a product to this specification was within 180 days of August 30, then regualification for that product will not be required for that year.

16.4 Initial and regualification acceptance requests should be addressed to:

Chairman, Technical Standards
Committee "A" (Telephone)
Telecommunications Staff Division
Rural Electrification Administration
Washington, D.C. 20250-1500

16.5 Tests on 100 percent of completed cable

16.5.1 The shield and/or armor of each length of cable must be tested for continuity in accordance with ANSI/ICEA S-84-608-1988, Paragraph 8.16.

16.5.2 The screen tape of each length of screened cable must be tested for continuity in accordance with ANSI/ICEA S-84-608-1988, Paragraph 8.16.

16.5.3 Dielectric strength between conductors and shield and/or armor must be tested to determine freedom from grounds in accordance with Paragraph 11.10.2 of this specification.

16.5.4 Dielectric strength between conductors and screen tape must be tested to determine freedom from grounds in accordance with Paragraph 11.10.3 of this specification.

16.5.5 Each conductor in the completed cable must be tested for continuity in accordance with ANSI/ICEA S-84-608-1988, Paragraph 8.16.

16.5.6 Dielectric strength between conductors must be tested to insure freedom from shorts and crosses in each length of completed cable in accordance with Paragraph 11.10.1 of this specification.

16.5.7 Each conductor in the completed preconnectorized cable must be tested for continuity.

16.5.8 Each length of completed preconnectorized cable must be tested for split pairs.

16.5.9 The average mutual capacitance must be measured on all cables. If the average mutual capacitance for the first 100 pairs tested from randomly selected groups is between 50 and 53 nF/km (80 and 85 nF/mile), the remainder of the pairs need not be tested on the 100 percent basis. (See Paragraph 11.3 of this specification).

16.6 Capability Tests: Tests on a quality assurance basis must be made as frequently as is required for each manufacturer to determine and maintain compliance with:

16.6.1 Performance requirements for conductor insulation, jacketing material, and filling and flooding compounds.

16.6.2 Bonding properties of coated or laminated shielding and armoring materials and performance requirements for screen tape.

16.6.3 Sequential marking and lettering.

16.6.4 Capacitance difference, capacitance unbalance, crosstalk, and attenuation.

16.6.5 Insulation resistance, conductor resistance, and resistance unbalance.

16.6.6 Cable cold bend and cable impact tests.

16.6.7 Water penetration and compound flow tests.

16.6.8 Jacket notch and cable torsion tests.

17. SUMMARY OF RECORDS OF ELECTRICAL AND PHYSICAL TESTS

17.1 Each manufacturer must maintain suitable summary records for a period of at least 3 years of all electrical and physical tests required on completed cable by this specification as set forth in Paragraphs 16.5 and 16.6 of this specification. The test data for a particular reel must be in a form that it may be readily available to the purchaser or to REA upon request.

17.2 Measurements and computed values must be rounded off to the number of places or figures specified for the requirement according to ANSI/ICEA S-84-608-1988, Paragraph 1.3.

18. MANUFACTURING IRREGULARITIES

18.1 Repairs to the shield and/or armor are not permitted in cable supplied to end users under this specification.

18.2 Minor defects in jackets (defects having a dimension of 3 mm (0.125 in.) or less in any direction) may be repaired by means of heat fusing in accordance with good commercial practices utilizing sheath grade compounds.

19. PREPARATION FOR SHIPMENT

19.1 The cable must be shipped on reels. The diameter of the drum must be large enough to prevent damage to the cable from reeling or unreeling. The reels must be substantial and so constructed as to prevent damage to the cable during shipment and handling.

19.2 The thermal wrap must comply with the requirements of ANSI/ICEA S-84-608-1988, Paragraph 10.3. When a thermal reel wrap is supplied, the wrap must be applied to the reel and must be suitably secured in place to minimize thermal exposure to the cable during storage and shipment. The use of the thermal reel wrap as a means of reel protection will be at the option of the manufacturer unless specified by the end user.

19.3 The outer end of the cable must be securely fastened to the reel head so as to prevent the cable from becoming loose in transit. The inner end of the cable must be securely fastened in such a way as to make it readily available if required for electrical testing. Spikes, staples, or other fastening devices which penetrate the cable jacket must not be used. The method of fastening the cable ends must be acceptable to REA and accepted prior to its use.

19.4 Each length of cable must be wound on a separate reel unless otherwise specified or agreed to by the purchaser.

19.5 The arbor hole must admit a spindle 63 mm (2.5 in.) in diameter without binding. Steel arbor hole liners may be used but must be accepted by REA prior to their use.

19.6 Each reel must be plainly marked to indicate the direction in which it should be rolled to prevent loosening of the cable on the reel.

19.7 Each reel must be stenciled or labeled on either one or both sides with the information specified in ANSI/ICEA S-84-608-1988, Paragraph 10.4 and the REA cable designation.

CABLE DESIGNATION

BFC
Cable Construction
Pair Count
Conductor Gauge

A = Coated Aluminum Shield
C = Copper Shield
Y = Gopher Resistant Shield
X = Armored, Separate Shield
H = T1 Screened Cable
H1C = T1C Screened Cable
P = Preconnectorized

Example: BFCXH100-22

Buried Filled Cable, Armored (w/separate shield),
T1 Screened Cable, 100 pair, 22 AWG.

19.8 When cable manufactured to the requirements of this specification is shipped, both ends must be equipped with end caps acceptable to REA.

19.9 When preconnectorized cables are shipped, the splicing modules must be protected to prevent damage during shipment and handling. The protection method must be acceptable to REA and accepted prior to its use.

19.10 All cables ordered for use in underground duct applications must be equipped with a factory-installed pulling-eye on the outer end in accordance with ANSI/ICEA S-84-608-1988, Paragraph 10.5.2.

(The information and recordkeeping requirements of this specification have been approved by the Office of Management and Budget (OMB) under Control Number 0572-0077)

UNITED STATES DEPARTMENT OF AGRICULTURE
Rural Electrification Administration

APPENDIX A

FILLED TELEPHONE CABLE

Qualifications Test Methods Bulletin 1753F-205 (PE-39)

1. The test procedures described in this appendix are for qualification of initial designs and major modifications of accepted designs. Included in Paragraph 5 of this appendix are suggested formats that may be used in submitting test results to REA.

2. SAMPLE SELECTION AND PREPARATION

2.1 All testing must be performed on lengths removed sequentially from the same 25 pair, 22 gauge jacketed cable. This cable must not have been exposed to temperatures in excess of 38°C since its initial cool down after sheathing. The lengths specified are minimum lengths and if desirable from a laboratory testing standpoint longer lengths may be used.

2.1.1 Length A shall be 10 ± 0.2 m (33 ± 0.5 ft) long and must be maintained at $23 \pm 3^\circ\text{C}$. One length is required.

2.1.2 Length B shall be 12 ± 0.2 m (40 ± 0.5 ft) long. Prepare the test sample by removing the jacket, shield or shield/armor, and core wrap for a sufficient distance on both ends to allow the insulated conductors to be flared out. Remove sufficient conductor insulation so that appropriate electrical test connections can be made at both ends. Coil the sample with a diameter of 15 to 20 times its sheath diameter. Three lengths are required.

2.1.3 Length C shall be one meter (3 ft) long. Four lengths are required.

2.1.4 Length D shall be 300 mm (1 ft) long. Four lengths are required.

2.1.5 Length E shall be 600 mm (2 ft) long. Four lengths are required.

2.1.6 Length F shall be 3 m (10 ft) long and shall be maintained at $23 \pm 3^\circ\text{C}$ for the duration of the test. Two lengths are required.

2.2 Data Reference Temperature: Unless otherwise specified, all measurements must be made at $23 \pm 3^{\circ}\text{C}$.

3. ENVIRONMENTAL TESTS

3.1 Heat Aging Test

3.1.1 Test Samples: Place one sample each of lengths B, C, D and E in an oven or environmental chamber. The ends of Sample B must exit from the chamber or oven for electrical tests. Securely seal the oven exit holes.

3.1.2 Sequence of Tests: The samples are to be subjected to the following tests after conditioning:

- a. Water Immersion Test outlined in Paragraph 3.2 of this appendix;
- b. Water Penetration Test outlined in Paragraph 3.3 of this appendix;
- c. Insulation Compression Test outlined in Paragraph 3.4 of this appendix; and
- d. Jacket Slip Strength Test outlined in Paragraph 3.5 of this appendix.

3.1.3 Initial Measurements

3.1.3.1 For Sample B measure the open circuit capacitance for each odd numbered pair at 1, 150, and 772 kHz, and the attenuation at 150 and 772 kHz after conditioning the sample at the data reference temperature for 24 hours. Calculate the average and standard deviation for the data of the 13 pairs on a per kilometer or (on a per mile) basis.

3.1.3.2 The attenuation at 150 and 772 kHz may be calculated from open circuit admittance (Y_{oc}) and short circuit impedance (Z_{sc}) or may be obtained by direct measurement of attenuation.

3.1.3.3 Record on suggested formats in Paragraph 5 of this appendix or on other easily readable formats.

3.1.4 Heat Conditioning

3.1.4.1 Immediately after completing the initial measurements, condition the sample for 14 days at a temperature of $65 \pm 2^{\circ}\text{C}$.

3.1.4.2 At the end of this period note any exudation of cable filler. Measure and calculate the parameters given in Paragraph 3.1.3 of this appendix. Record on suggested formats in Paragraph 5 of this appendix or on other easily readable formats.

3.1.4.3 Cut away and discard a one meter (3 ft) section from each end of length B.

3.1.5 Overall Electrical Deviation

3.1.5.1 Calculate the percent change in all average parameters between the final parameters after conditioning and the initial parameters in Paragraph 3.1.3 of this appendix.

3.1.5.2 The stability of the electrical parameters after completion of this test must be within the following prescribed limits:

- a. Capacitance: The average mutual capacitance must be within 5 percent of its original value.
- b. The change in average mutual capacitance must be less than 5 percent over frequency 1 to 150 kHz.
- c. Attenuation: The 150 and 772 kHz attenuation must not have increased by more than 5 percent over their original values.

3.2 Water Immersion Electrical Test

3.2.1 Test Sample Selection: The 10 m (33 ft) section of length B must be tested.

3.2.2 Test Sample Preparation: Prepare the sample by removing the jacket, shield or shield/armor, and core wrap for sufficient distance to allow one end to be accessed for test connections. Cut out a series of 6 mm (0.25 in.) diameter holes along the test sample, at 30 cm (1 ft) intervals progressing successively 90 degrees around the circumference of the cable. Assure that the cable core is exposed at each hole by slitting the core wrapper. Place the prepared sample in a dry vessel which when filled will maintain a one meter (3 ft) head of water over 6 m (20 ft) of uncoiled cable. Extend and fasten the ends of the cable so they will be above the water line and the pairs are rigidly held for the duration of the test.

3.2.3 Capacitance Testing: Measure the initial values of mutual capacitance of all odd pairs in each cable at a frequency of 1 kHz before filling the vessel with water. Be sure the cable shield or shield/armor is grounded to the test equipment. Fill the vessels until there is a one meter (3 ft) head of water on the cables.

3.2.3.1 Remeasure the mutual capacitance after the cables have been submerged for 24 hours and again after 30 days.

3.2.3.2 Record each sample separately on suggested formats in Paragraph 5 of this appendix or on other easily readable formats.

3.2.4 Overall Electrical Deviation

3.2.4.1 Calculate the percent change in all average parameters between the final parameters after conditioning with the initial parameters in Paragraph 3.2.3 of this appendix.

3.2.4.2 The average mutual capacitance must be within 5 percent of its original value.

3.3 Water Penetration Testing

3.3.1 A watertight closure must be placed over the jacket of length C. The closure must not be placed over the jacket so tightly that the flow of water through pre-existing voids of air spaces is restricted. The other end of the sample must remain open.

3.3.2 Test per Option A or Option B.

3.3.2.1 Option A: Weigh the sample and closure prior to testing. Fill the closure with water and place under a continuous pressure of 10 ± 0.7 kPa (1.5 ± 0.1 psig) for one hour. Collect the water leakage from the end of the test sample during the test and weigh to the nearest 0.1 g. Immediately after the one hour test, seal the ends of the cable with a thin layer of grease and remove all visible water from the closure, being careful not to remove water that penetrated into the core during the test. Reweigh the sample and determine the weight of water that penetrated into the core. The weight of water that penetrated into the core must not exceed 8 grams.

3.3.2.2 Option B: Fill the closure with a 0.2 g sodium fluorscein per liter water solution and apply a continuous pressure 10 ± 0.7 kPa (1.5 ± 0.1 psig) for one hour. Catch and weigh any water that leaks from the end of the cable during the one hour period. If no water leaks from the sample, carefully remove the water from the closure. Then carefully remove the jacket, shield or shield/armor, and core wrap one at time, examining with an ultraviolet light source for water penetration. After removal of the core wrap, carefully dissect the core and examine for water penetration within the core. Where water penetration is observed, measure the penetration distance. The distance of water penetration into the core must not exceed 127 mm (5.0 in.).

3.4 Insulation Compression Test

3.4.1 Test Sample D. Remove jacket, shield or shield/armor, and core wrap being careful not to damage the conductor insulation. Remove one pair from the core and carefully separate, wipe off core filler, and straighten the insulated conductors. Retwist

the two insulated conductors together under sufficient tension to form 10 evenly spaced 360 degree twists in a length of 10 cm (4 in.).

3.4.2 Sample Testing: Center the mid 50 mm (2 in.) of the twisted pair between 2 smooth rigid parallel metal plates that are 50 mm x 50 mm (2 in. x 2 in.). Apply a 1.5 volt dc potential between the conductors, using a light or buzzer to indicate electrical contact between the conductors. Apply a constant load of 67 N (15 lbf) on the sample for one minute and monitor for evidence of contact between the conductors. Record results on suggested formats in Paragraph 5 of this appendix or on other easily readable formats.

3.5 Jacket Slip Strength Test

3.5.1 Sample Selection: Test Sample E from Paragraph 3.1.1 of this appendix.

3.5.2 Sample Preparation: Prepare test sample in accordance with the procedures specified in ASTM D 4565-90a.

3.5.3 Sample Conditioning and Testing: Remove the sample from the tensile tester prior to testing and condition for one hour at $50 \pm 2^{\circ}\text{C}$. Test immediately in accordance with the procedures specified in ASTM D 4565-90a. A minimum jacket slip strength of 67 N (15 lbf) is required. Record the highest load attained.

3.6 Humidity Exposure

3.6.1 Repeat steps 3.1.1 through 3.1.3.3 of this appendix for separate set of samples B, C, D, and E which have not been subjected to prior environmental conditioning.

3.6.2 Immediately after completing the measurements, expose the test sample to 100 temperature cyclings. Relative humidity within the chamber must be maintained at 90 ± 2 percent. One cycle consists of beginning at a stabilized chamber and test sample temperature of $52 \pm 1^{\circ}\text{C}$, increasing the temperature to $57 \pm 1^{\circ}\text{C}$, allowing the chamber and test samples to stabilize at this level, then dropping the temperature back to $52 \pm 1^{\circ}\text{C}$.

3.6.3 Repeat steps 3.1.4.2 through 3.5.3 of this appendix.

3.7 Temperature Cycling

3.7.1 Repeat steps 3.1.1 through 3.1.3.3 of this appendix for separate set of samples B, C, D, and E which have not been subjected to prior environmental conditioning.

3.7.2 Immediately after completing the measurements, subject the test sample to the 10 cycles of temperature between a minimum of -40°C and $+60^{\circ}\text{C}$. The test sample must be held at each temperature

extreme for a minimum of 1 1/2 hours during each cycle of temperature. The air within the temperature cycling chamber must be circulated throughout the duration of the cycling.

3.7.3 Repeat steps 3.1.4.2 through 3.5.3 of this appendix.

4. CONTROL SAMPLE

4.1 Test Samples: A separate set of lengths A, C, D, E, and F must have been maintained at $23 \pm 3^{\circ}\text{C}$ for at least 48 hours before the testing.

4.2 Repeat steps 3.2 through 3.5.3 of this appendix except use length A instead of length B.

4.3 Surge Test

4.3.1 One length of sample F must be used to measure the breakdown between conductors while the other length of F must be used to measure the core to shield breakdown.

4.3.2 The samples must be capable of withstanding without damage, a single surge voltage of 20 kV peak between conductors, and a 35 kV peak surge voltage between conductors and the shield or shield/armor as hereinafter described. The surge voltage must be developed from a capacitor discharged through a forming resistor connected in parallel with the dielectric of the test sample. The surge generator constants must be such as to produce a surge of 1.5×40 microsecond wave shape.

4.3.3 The shape of the generated wave must be determined at a reduced voltage by connecting an oscilloscope across the forming resistor with the cable sample connected in parallel with the forming resistor. The capacitor bank is charged to the test voltage and then discharged through the forming resistor and test sample. The test sample will be considered to have passed the test if there is no distinct change in the wave shape obtained with the initial reduced voltage compared to that obtained after the application of the test voltage.

5. TEST DATA FORMATS

5.1 The following suggested formats may be used for submitting the test data to REA.

ENVIRONMENTAL CONDITIONING _____

FREQUENCY 1 kHz

PAIR
NUMBER

CAPACITANCE
nF/km (nF/mile)

Initial

Final

1

3

5

7

9

11

13

15

17

19

21

23

25

Average $\bar{x}$

Overall Percent
Difference in
Average $\bar{x}$

ENVIRONMENTAL CONDITIONING

FREQUENCY 150 kHz

PAIR NUMBER	CAPACITANCE nF/km (nF/mile)		ATTENUATION (dB/km (dB/mile)	
	Initial	Final	Initial	Final
1				
3				
5				
7				
9				
11				
13				
15				
17				
19				
21				
23				
25				
Average $\bar{x}$				
Overall Percent Difference in Average $\bar{x}$				

ENVIRONMENTAL CONDITIONING

FREQUENCY 772 kHz

<u>PAIR NUMBER</u>	<u>CAPACITANCE</u> <u>nF/km (nF/mile)</u>		<u>ATTENUATION</u> <u>(dB/km (dB/mile))</u>	
	<u>Initial</u>	<u>Final</u>	<u>Initial</u>	<u>Final</u>
1				
3				
5				
7				
9				
11				
13				
15				
17				
19				
21				
23				
25				
Average $\bar{x}$				
Overall Percent Difference in Average $\bar{x}$				

ENVIRONMENTAL CONDITIONING

WATER IMMERSION TEST (1 kHz)

<u>PAIR NUMBER</u>	<u>CAPACITANCE</u> <u>nF/km (nF/mile)</u>		
	<u>Initial</u>	<u>24 Hours</u>	<u>Final</u>
1			
3			
5			
7			
9			
11			
13			
15			
17			
19			
21			
23			
25			
Average $\bar{x}$			
Overall Percent Difference in Average $\bar{x}$			

WATER PENETRATION TEST

	<u>Option A</u>		<u>Option B</u>	
	End Leakage g	Weight Gain g	End Leakage g	Penetration mm (in.)
Control	_____	_____	_____	_____
Heat Age	_____	_____	_____	_____
Humidity Exposure	_____	_____	_____	_____
Temperature Cycling	_____	_____	_____	_____

INSULATION COMPRESSION

	<u>Failures</u>
Control	_____
Heat Age	_____
Humidity Exposure	_____
Temperature Cycling	_____

JACKET SLIP STRENGTH @ 50°C

	<u>Load in N (lbf)</u>
Control	_____
Heat Age	_____
Humidity Exposure	_____
Temperature Cycling	_____

FILLER EXUDATION (g)

Heat Age	_____
Humidity Exposure	_____
Temperature Cycling	_____

SURGE TEST (kV)

Conductor to Conductor	_____
Shield to Conductors	_____

**CITY of LOS ANGELES
DEPARTMENT of TRANSPORTATION**

**PASSIVE INFRARED
PEDESTRIAN DETECTOR**

PURCHASE SPECIFICATION

92-074-03

August 2004

This specification outlines the requirements of the City of Los Angeles Department of Transportation (LADOT) for the purchase of **Passive Infrared Pedestrian Detectors**. This specification describes the minimum acceptable design and operating requirements for a passive infrared device which detects the presence of pedestrians entering the field of view.

General

The detector shall be of the passive infrared type that senses the temperature (heat radiation) difference between the background scene and that of the pedestrian for a range of up to 6 meters (20 feet) from the detector. The detector shall be equipped with automatic temperature compensation to provide optimal sensitivity under all ambient conditions. The sensing areas of the detector will not be detectable by any means of electronic measurement.

The detector shall have available as optional equipment, a portable hand-held device used for testing the analog signal strength as well as a digital output and can be used to determine the area of detection. The strength of signals and disturbances shall be displayed on the installation tester through a LCD display or by some means (Palm or lap top computer) available through an RS 232 serial port. The serial port can be connected to a PC or Laptop for display of events on a computer screen. The necessary software to view both signal strength and output shall be included with the portable testing device.

Environmental & Electrical

The detector shall operate over a voltage range of 10.5 to 26 Vdc with a maximum supply current of 20 ma and a temperature range of -40 degrees C to +70 degrees C (-40 F to +158F) up to 95% relative humidity.

The detector shall provide dry contact relay outputs (SPDT) capable of switching 250 Vac up to 2 amps. The relay shall be energized during normal operation and de-energize when a pedestrian target is in the field of view. The normally closed contacts shall be used to indicate pedestrian activation and shall failsafe in the closed position if the detector should lose power or otherwise fail.

Operating Parameters

The detector shall have some means of adjusting the detection zone both in its geometry and sensitivity. The detector shall be designed to operate at a height up to 4 meters (13 feet) and project a pattern out to 6 meters (20 feet) horizontally from the vertical mounting point.

The detector shall operate in a pulse or presence mode. In a presence mode the detector output will provide a continuous call as long as the zone is active. In the pulse mode the detector will provide one or more pulses of short duration greater than 50 ms to reflect activity in the zone.

In either mode, the detector shall not respond to slow changes in temperature in the detection zone and shall readjust itself to changes in the detection zone that remain longer than five minutes.

Housing

The detector housing shall weigh less than 16 ounces, be constructed of anodized aluminum or an ultra violet stabilized polycarbonate type material. The housing and cable entry points shall be weather proof and conform to IP53 spray proof standard.

The detector shall be provided with hardware that will facilitate mounting on a traffic signal standard with metal strapping. The mounting system shall allow for complete mechanical adjustment of the detector on both a horizontal and vertical plane.

Documentation

A manual shall be provided with each unit purchased under this specification up to a maximum of ten for each purchase order. The manual shall include:

- general description and theory of operation
- detailed specifications
- installation instructions
- electrical schematics
- alignment procedures and troubleshooting guide

Warranty

The detector shall be guaranteed against failure of parts or workmanship for a period of two years from the invoice receipt date. All shipping and handling costs of warranty returns for repair or replacement shall be born by the manufacturer.

**City of Los Angeles
Department of Transportation**

Installation of Six Foot Round
Traffic Loop Detector

SPECIFICATION

92-081-05
June 2008

INSTALLATION METHOD:

The contractor shall install six foot diameter round loops. The method to be used may be by the use of a "Core Bit" or "Circle Loop Cutter" or both. Either method shall not cause any additional holes to be placed in the pavement for the purpose(s) of anchoring the installing machine(s). All saw cuts should be washed clean and vacuumed out and blown dry, leaving a clean dry area before the loop wires can be installed.

Vacuum all water and slurry during the installation of detector loops, making every possible effort to prevent water run off from entering the storm drain system and dispose of all vacuumed material in a proper manner.

LOOP SIZE:

The saw cut shall be of a clean, vertical type cut. The depth and width of the cut shall be maintained, even on crowned roadways, and shall be .500 inches in width and a minimum of 3.0 inches in depth. Saw cut to the appropriate pull box within 100 feet. Saw cut to be .375 inches in width by 5.0 inches in depth. **In no case shall the saw cut be deeper than the depth of the pavement.**

LOOP WIRE INSTALLATION:

The inductive loop installation shall be in accordance with City of Los Angeles, Department of Transportation, SPECIAL PROVISIONS AND STANDARD DRAWINGS for the installation and modification of traffic signals, the latest edition. Drawing S-70.1A the latest revision.

The loop detector wire shall be of the double insulated type and meet the Specifications for CalTrans Type 2 Traffic Loop Wire and IMSA 51-5. It shall be of a continuous and un-spliced conductor and shall be wound three turns into the saw cut by hand, or pre-formed and stacked for insertion into the saw cut.

The pre-wound loop shall consist of three (3) turns of loop wire stacked in a circle six (6) feet diameter. Each turn shall be laid on top of one another and be secured in such a manner that when it is placed in the saw cut, it will remain in place and not float in the cut.

The inductive loop wires shall begin and terminate in the pull box behind the curb or as approved by the Contract Loop Inspector, with a minimum of three (3) feet extending from the top of the conduit. The wires shall be numbered as per LADOT drawing S-70.1A latest revision.

SEALANT:

All cuts shall be sealed with a sealant that meets the State of California Specifications for Hot Melt Rubberized Asphalt Sealant. Hot Melt Rubberized Asphalt Sealant performance characteristics shall conform to ASTM D 3407 Section 5, 6 & 8, ASTM D 113, ASTM D 92 & ASTM D 4402.

INSPECTION:

The loop installation contractor shall notify the LADOT Contract Loop Inspector each day, Monday through Thursday, of the locations that their crews will be working. The notification shall be by **FAX MACHINE** at telephone number 818-756-8732 at the Department of Transportation, Valley Yard, no later than 7:00 AM. Loops may only be cut on Monday through Thursday, with the exception of a City Holiday. No Holiday, Friday, Saturday or Sunday installation is allowed except by prior authorization of the Loop Contract Inspector.

PAYMENT:

Payment will be made upon completion and inspection by the Department of Transportation, Contract Loop Inspector for each suborder. All invoices for completed work shall be mailed or delivered in person to the attention of: Contract Loop Inspector at Department of Transportation, (Valley Yard) 14832 Raymer St, Van Nuys, CA. 91405. He will attest to the work completion.

The Contract Loop Inspector's Supervisor shall certify the invoices for payment.

PENALTY:

Each day the contractor uses in excess of thirty (30) from the date the sub purchase order is issued, The Department of Transportation will deduct one hundred dollars (\$100) per day from the payment due the contractor.

Each sub purchase order shall contain a maximum of 150 (one hundred fifty) loops, unless agreed to in writing by the contractor during any 30 (thirty) day period.

ENTRANCE CONDUIT:

All entrance conduits installed shall be as per Drawing No. S-70.1A. Any deviation from Drawing No. S-70.1A must be approved by the Loop Inspector in writing before the conduit is installed.

LICENSE:

The successful bidder shall have a valid State of California Electrical Contractors License. The contractor shall conform to the Cal/OSHA Guide for the construction industry and the Work Area Traffic Control Handbook. In both cases the latest edition shall be used.

**City of Los Angeles
Department of Transportation
Cable - Loop Home Run**

Specification

92-082-03

05-22-2003

Scope:

This specification defines the general requirements applicable to two pair, three pair and four pair loop home-run cables. The intent of this specification is to establish the minimum acceptable electrical, mechanical, design, and performance requirements within which all loop home-run cable must operate satisfactorily and reliably. All cable supplied will be new and unused.

Construction:

- Conductor: No. 18 AWG, 7/26 stranded, tinned copper per ASTM B-286 or equivalent.
- Insulation: High density polyethylene compound which meets the requirements of ASTM D-1248, Type III, Class A, Category 5, Grade E-8, with a .013" nominal wall thickness or equivalent.
- Color code:
 - Two Pair: blue/white and orange/white
 - Three Pair: blue/white, orange/white, and green/white
 - Four Pair: blue/white, orange/white, green/white, and brown/white
- Number of pairs:

The number of pairs will be specified in the purchase order.
- Twist, shield and drain:

The insulated conductors will be twisted into pairs with a lay not to exceed six inches. Each pair helically applied alum/mylar with #20-7/28 TC drain wire under the shield.
- Cable assembly:

The shielded pairs will be assembled to form a cylindrical core.
- Fill: Water blocking materials not needed.
- Shield: A longitudinally applied aluminum mylar shield will be applied over the filled core with an overlap.
- Jacket: Black high density polyethylene jacketing grade compound with .030 minimum or equivalent.
- Electrical Characteristics:
 - Voltage rating- 300 volts minimum
 - Mutual Capacitance- 27 picofarads per foot, $\pm 20\%$
- Packaging: The finished cable will be shipped on nonreturnable wooden reels. Reels will be shipped in a single lengths of 2500 feet with no splices or as specified in the purchase order.
- Sample: The City has the right to request a sample of cable from the successful bidder before lot shipments. The LADOT remains the sole judge on the ability of cable to meet the specification.

**CITY of LOS ANGELES
DEPARTMENT of TRANSPORTATION**

**PURCHASE SPECIFICATION
SIGNAL / PEDESTRIAN HEAD COVER**

92-086-03

December 2003

1. Purpose

This specification outlines the minimum requirements of the City of Los Angeles Department of Transportation, (LADOT), for the purchase of **Signal / Pedestrian Head Covers**. These head covers are for traffic signal (all sizes) and pedestrian head indications, not in use, in construction, maintenance, or work zones. Head covers shall cover the said devices in a manner such that they compel attention, convey a clear and simple meaning, and permit adequate time for driver or pedestrian response. These head covers are to replace any and all “make-shift” covers that are made from cardboard, rags, bags, etc. They are to be used to keep the work-zone clean and clear, and to prevent the motoring public from observing “out of service” signal indications.

1. Design

- a. Head covers must be designed with light weight material, easy to work with, require minimal time, and be simple to install.
- b. The head covers shall include a perforated portion only visible to signal staff when performing a “flash out” (ring out) test.
- c. Head covers shall stay secured and stable on the signal and pedestrian heads during each project.

1. Materials

- a. Siding
Covers must be made with outdoor fabric, solution dyed, with urethane finish. The fabric must be weather resistant and treated to withstand mildew. The fabric shall stay soft pliable and easy to work with. The color shall be fade resistant. The siding shall be approximately eight (8) inches wide to assist in the attachment to the device being covered.
- a. Facing
 - i. The front (facing) of the cover, attached to the siding must consist of a strip in the middle made out of a “see-through” mesh material that only allows the indication to be visible when the indication is illuminated for testing purposes.
 - ii. The remaining front section should be doubled with an extra inner layer to:
 - (1) prevent light from showing through the cover (except through the “see-through” section),
 - (2) to make the front section thicker and firmer.
 - iii. This part shall also be made of weather and mildew resistant material.
- a. Cord-elastic
Cord-elastic shall be used around the siding of the cover to help the cover stay in place and make it more secure and stable. The cord must be made sturdy and strong for industrial purposes. The cord elastic shall NOT be exposed but sewn inside the cover.
- a. Straps

92-086-03_headcover December 15, 2003

- i. Use
Straps shall be used for more stabilization of the covers against unexpected weather. One (1) inch straps shall be placed on both sides of the covers such that they can be fastened with provided one (1) inch buckles around the back of the signal or pedestrian head being covered. The strap material must be weather, mildew, and fade resistant.
- i. Number of Straps
 - (1) 3-section vehicle signal head - Two (2) sets (each set consists of two pieces)
 - (2) 2-section vehicle signal head - Two (2) sets
 - (3) 1-section vehicle signal head - One (1) set
 - (4) Pedestrian head - One (1) set

Note: the number of straps for 12" or 8" signal heads are the same.

1. **Color**

The color of the covers shall be beige (tan), including both the siding section and the front section with the "see-through" area, to easily identify a covered signal or pedestrian head as being "out-of-service" from a unit that is in service. The color of the straps shall be a matching color either beige or brown in color.

1. **Identification Marking**

A "silk screened" or similar identification marking shall be applied to each head cover on or near the bottom so it can be observed from persons standing on the ground when the head cover is installed on signal devices. The markings shall be: "**LADOT**" in an "arial bold font, with a silk-screened frame, approximately four (4) inches wide by two (2) inches tall. Print color can be black or burgundy.

1. **Warranty**

The manufacturer shall warranty the covers as a whole piece for a period of three years.

1. **Product Samples**

Product samples must be submitted with all bid proposals for evaluation and verification of compliance.

**CITY of LOS ANGELES
DEPARTMENT of TRANSPORTATION**

VIDEO PEDESTRIAN DETECTOR

PURCHASE SPECIFICATION

No. 92-087-01

Revision 02, August 2001

1 DESCRIPTION:

1.01 This document defines the minimum standards for the design, performance and quality for a video pedestrian detector system, hereafter referred to as **VPDS**. The purpose of the system is to detect the presence and movement of pedestrians, in preset optical detection zones which are superimposed on a standard EIA video image . The system shall interface with existing traffic signal equipment which shall act on the signal actuations.

2 GENERAL:

- 2.01 The **VPDS** shall consist of a video image processor that shall reside in the signal controller cabinet input file, two (2) remote cameras (one at each end of the crosswalk) with mounting hardware, all the necessary connectors and five hundred feet of video/power cable. A remote keypad or device that shall interface with the video image processor to program detector parameters shall be provided with each system with a maximum number of six, dependent on the purchase order.
- 2.02 All video detection programming and processing shall reside in the Video Image Processor. The Video Image Processor input shall be compatible with any NTSC composite video camera signal (refer to section 3).

3 CAMERAS

- 3.01 The cameras shall be NTSC, black and white composite video compliant. The video output level shall be 1 V p-p into 75 ohms, unbalanced output. The image pick-up element shall be a ½ inch format interline transfer CCD image sensor.
- 3.02 The lens shall have a focal length of 3.6 mm at F1.6 and be of the auto iris type. The camera sensitivity shall be 0.1 Lux to 60,000 Lux.
- 3.03 The cameras shall be of one piece construction with an integral sun shield. The sun shield shall prevent the direct rays of the sun from heating the camera body and reduce the incidents of lens flare caused by bright sources of light.

- 3.04 The camera body shall be weatherproof and dust tight. The body shall incorporate an optical glass view port and UV filter. The view port shall be resistant to crazing and be scratch proof.
- 3.05 All electrical cables shall be made of weather proof and UV stabilized material. Their connections to all components of the **VPDS** shall be weather and dust tight.

4 **VIDEO IMAGE PROCESSOR:**

- 4.01 The purpose of the Video Image Processor is to detect the presence and the crossing of pedestrians over programmed optical detection zones, which are superimposed upon a standard EIA video image. The Video Image Processor shall install in a standard 332/337 traffic signal controller input file and shall not occupy more than two adjacent input slots.
- 4.02 The Video Image Processor backplane shall interface to the input file and derive its input power (24 Vdc), receive the two video camera input signals and provide two optically isolated call output signals to the traffic signal controller.
- 4.03 The Video Image Processor front panel shall provide input and output status indicators, switches and I/O connections to monitor the video signals and to provide keypad and/or laptop communication interface.
- 4.04 The user shall be able to define a minimum of seven detection zones per each camera video image, on screen by use of an external monitor in conjunction with a programming keypad or laptop. The zones, their logic features and characteristics shall be configured internally in the Video Image Processor through software and not using external relays or matrix circuitry. Each zone can be programmed with the following characteristics:
 - size and shape
 - direction sensitivity
 - presence or pulse
 - time delay
- 4.05 Each zone in an image can be combined with the other zone outputs to form a AND, OR or NOT OR logic output.
- 4.06 The Video Image Processor shall be able to compensate for reduced image quality during night time, fog or rain conditions.

5 **PROGRAMMING & SOFTWARE:**

- 5.01 A front panel service port (DB9-RS232) shall be provided to link the Video Image Processor to accomplish all programming and setup with a keypad and optionally but not exclusively with a laptop computer.

5.02 The program shall be menu driven and the detection configuration parameters stored in nonvolatile memory. It shall be possible to upload and download these parameters via laptop for archiving and for printing hard copies. Batteries shall not be used for maintaining program information in memory.

5.03 Software updates shall be made available subsequent to purchase at no extra cost.

6 **ELECTRICAL:**

6.01 The Video Image Processor shall derive its power from the cabinet input file 24 Vdc supply. The Video Image Processor shall operate at 24 Vdc nominal ± 4 Vdc and tolerate 500 Mv ripple.

6.02 The video camera shall operate at 12 Vdc $\pm 10\%$. Power and video signals must be isolated in the connection system. It shall be possible to connect a standard NTSC monitor of 500 lines or greater to the system without risk of damage from the power supply voltage.

6.03 The **VPDS** shall include voltage surge protection to withstand high-repetition, high-energy transients and low-repetition, high-energy transients as stated in NEMA Section 2.1.6, Standard TS-2, 1992

7 **ENVIRONMENTAL:**

7.01 The **VPDS** must operate reliably between a temperature range of -40 and +74 degrees Celsius.

7.02 The **VPDS** must operate reliably in a harsh outdoor environment and be protected from moisture and dust incursion.

8 **HARDWARE:**

8.01 All mounting hardware and enclosures shall be rust and corrosion resistant. Bolts, screws, pins, lugs, clips, etc., shall be made of type 302, 304 or 305 stainless steel.

9 **IDENTIFICATION:**

9.01 The **VPDS** shall be marked with the manufacturers model, revision and serial numbers.

9.02 The **VPDS** shall be marked with the nominal operating voltage and power rating.

10 **FCC COMPLIANCE:**

10.01 The **VPDS** shall meet Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise interference.

11 DOCUMENTATION:

11.01 Three sets of **VPDS** operation manuals including specifications, theory of operation, programming instructions, schematics and block diagrams shall be provided with each contract.

12 WARRANTY:

12.01 The manufacturer shall warrant the **VPDS** including associated hardware, to be free from defects and failure for a minimum of (2) two years from the date of installation.

12.02 Shipping expenses as part of the warranty shall be the responsibility of the manufacturer or supplier.

13 SAMPLES:

13.01 All bidders shall submit for approval by the Department of Transportation, one **VPDS** as specified at the time of the bid opening and before a bid can be awarded.

**CITY of LOS ANGELES
DEPARTMENT of TRANSPORTATION**

LIGHT EMITTING DIODE (LED) SIGNAL MODULES

PURCHASE SPECIFICATION

92-088-07

January 2011

This specification outlines the requirements of the City of Los Angeles Department of Transportation (LADOT) for the purchase of light-emitting diode (LED) Traffic Signal Modules, hereafter referred to as “signal modules,”

Requirements

All LED signal devices must meet the general specifications of the following ITE publications:

- ? Vehicular Traffic Control Signal Heads- Light Emitting Diode (LED) Circular Signal Supplement adopted June 2005
- ? Vehicle Traffic Control Signal Heads- Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement adopted July 2007
- ? Pedestrian Traffic Control Signal Indicators- Light Emitting Diode (LED) Signal Modules adopted October 2010

All applicable references to NEMA, MUTCD, ASTM, ANSI, FCC Title 47 and the National Electric Code. **The above-mentioned specifications are applicable except where modified or expanded upon by this document. In case of conflict, this document shall govern.**

Approval through the Caltrans Laboratory is not a requirement. However, a report from an independent industry-recognized laboratory will be required to verify that optical and electrical performance adhere to these specifications

General

The signal modules shall have the appearance of a standard, non-program visibility, incandescent traffic signal. This means the surface of signal modules shall appear to the motorist as nearly totally uniform in illumination and still maintain ITE intensity, chromaticity, uniformity and distribution standards. This also means that it shall not be apparent that LEDs are used as the light source for circular type signal or pedestrian modules.

Arrow signal modules, when utilizing LEDs to form the arrow segments, shall be arranged three rows wide. The surface of the arrow modules shall appear as nearly totally uniform in illumination and still maintain ITE intensity, chromaticity, uniformity and distribution standards. Arrows shall be omni-directional for mounting in any orientation while maintaining ITE requirements. The lenses can be clear or tinted.

Programmed Visibility (PV) modules shall be designed for installation in an existing programmed visibility signal housing.

Optical

The measurement criteria for light intensity, uniformity of intensity and chromaticity for red/green/yellow circular type signal modules, red/green/yellow arrow type signal modules and LED pedestrian signals modules shall comply with the ITE Vehicular Traffic Control Signal Heads “Requirements” listed on the previous page.

Programmed Visibility (PV) modules

Shall be evaluated by the LADOT using subjective criteria based on available industry data for temperature, construction and power consumption. Chromaticity shall comply with the ITE requirements for Red, Yellow and Green circular modules.

Light Rail Transit signal modules

Shall be evaluated by the LADOT using subjective criteria based on available industry data for temperature, construction and power performance and have a typical luminance intensity of 6,120 candela per square meter. Chromaticity shall comply with the ITE requirements for the Lunar White spectrum.

Exceptions to the following ITE Specification sections for Vehicle Modules

- 3.2.1 A LED signal module shall not be defined as a “complete signal head” but shall refer only to an individual signal section.
- 3.2.4 The module lens shall be an integral part of the signal module not a separate replaceable part.
- 3.4.1 The power supply shall be integral to the signal module not a separate component outside of the module.
- 5.1 The attached module lead wires shall additionally terminate with 0.25 inches plated female, disconnect terminals with removable spade inserts.
- 5.3 The LADOT transient voltage requirements shall supercede:

Transient voltage suppression rated at 1500 watts for 1 millisecond and fusing with a maximum rating of two amps shall be provided to minimize the effect and repair cost of an extreme over voltage situation or other failure mode. The modules shall withstand short duration line transients up to 2000 volts magnitude, of positive or negative polarity, and up to 10 microseconds in duration.

The module shall be capable of withstanding a high energy transient having the following characteristics repeatedly applied to the alternating current input terminals (de-energized) without failure of the module:

- 1. Amplitude: 2000 volts +/- 5 percent, both positive and negative polarity.
- 2. Energy Source: Capacitor, oil filled, 15 microfarads +/- 10 percent, internal surge impedance less than one ohm.
- 3. Repetition: Applied to the module once every two seconds for a maximum of three applications for each polarity.

After the foregoing, the module shall perform all defined functions upon application of nominal alternating current power.

- 5.8.1 If dimming is required it must be accomplished within the module not by external control or circuitry.

Countdown Pedestrian Signal Module

The pedestrian signal module must meet the October 2010 ITE specification for 16 in x 18 in pedestrian countdown signal modules with the LADOT additions and exceptions listed below.

Count Mode

The stored countdown timing value that represents the length of the Flashing Don't Walk interval shall display as described in ITE section 3.2.5.5 dated August 04, 2010. This shall apply whether the Flashing Don't Walk output from the controller to the pedestrian module begins in a high state (120 VAC) or low state (0 VAC) at the end of the WALK interval.

Walk Recycle

A Flashing Don't Walk interval that is terminated with the display of a new Walk interval SHALL NOT initiate a reset. The time of this shorter Flashing Don't Walk interval shall be discarded. At the end of the Walk interval the display will count as normal using the stored count value. This operation can continue as long as the Walk interval is recycled until and when a continuous solid Don't Walk signal occurs.

Conflict Monitor

The countdown module shall have some internal provision to monitor and prevent simultaneous illumination of the Walk and Don't Walk indications and the time display. It shall not be possible for the display to countdown during a solid Hand indication. For abnormal conditions when nominal voltage is applied to the unit across the two phase wires or simultaneously to both "upraised hand" and "walking person" icons, the pedestrian signal unit shall default to the "upraised hand" icon.

Exceptions to the ITE Specification for Pedestrian Modules

- 3.2.4 The module lens shall be an integral part of the signal module not a separate replaceable part.
- 3.2.5 Countdown Signal Module: The LADOT requires only the countdown type.
- 3.4.1 The power supply for the module shall be integral to the unit and not a separate component.
- 5.1.1 Wiring and Terminal Blocks: Add "The attached module lead wires shall terminate with 0.25 inches plated female, disconnect terminals with removable spade inserts."
- 5.3.1 Transient Voltage: LADOT 2 KV transient voltage requirements outlined on page two shall apply.
- 5.8.1 If dimming is required it must be accomplished within the module not by external control or circuitry.

Power

The power consumption for traffic signal and pedestrian modules shall comply with the values shown in Table 1 below:

Table 1 Maximum power consumption (in watts) at 25 degrees C

	Red	Yellow	Green	Hand	Walking Person	Digits	Lunar White
12 Inch 300 mm	10	18	12	-	-	-	-
8 Inch 200 mm	6	8	8	-	-	-	-
Arrow 12 Inch/300mm	6	6	6	-	-	-	-
P. V. Indication	10	15	12	-	-	-	-
Pedestrian Module	-	-	-	10	10	6	-
Transit Signal	-	-	-	-	-	-	8

Technical Data and Quality Products List

As part of the module pre qualification process, the signal module and LED pedestrian signal module manufacturer is required to provide reports from a nationally recognized testing Laboratory supporting the product's adherence to the ITE specifications for optical and electrical performance. This data shall be provided upon the submittal deadline or the bid opening date. Failure to provide this data on time may be cause to reject the product.

Vendors must submit samples of their signal modules for evaluation by the LADOT Signal Lab or its agents, as part of the Bid participation process. Products along with the model numbers of the modules that meet the design and test criteria, will be placed on a list of accepted vendors. The **Quality Products List** or **QPL** will be used to expedite the purchasing process for LADOT requirements or for contractors purchasing signal modules for installation in the city of Los Angeles. Products previously approved but that have been redesigned or modified, must be resubmitted for test and approval by the LADOT.

Module Identification

Each module shall have the manufacturer's name, trademark, model number, serial number, date of manufacture (month-year), and lot number as identification permanently marked on the back of the module. Additionally, a bar code label in 128 format shall be adhered to the module to give the model number, serial number and lot number or date of manufacture.

The operating characteristics shall be permanently marked on the back of the module: rated Voltage, rated Power in Watts and Volt-Amps.

If a specific mounting orientation is required, each module shall have prominent and permanent markings for correct indexing and orientation within a signal housing. The markings shall consist of an up arrow or the word "UP" or "TOP."

Warranty

All signal modules shall be warrantied for a minimum of six years from the date of installation against manufacturing defects. The manufacturer or his distributor shall be responsible for the shipping cost as well as the arrangements for return and replacement of items failed while under the warranty period.

Red, green, and yellow circular type signal modules including PV signal modules, red, green, and yellow arrow signal modules, and LED pedestrian modules shall be performance warrantied for minimum intensity and chromaticity for a period of five (5) years.

City of Los Angeles
Department of Transportation
Cable - Multiconductor Traffic Signal - 28cc

Purchase Specification

92-089-01

10-03-2001

- Description:
 - This document defines minimum standards for product performance and composition relating to:
28 CONDUCTOR TRAFFIC SIGNAL CABLE.
- General:
 - 28 Conductor Traffic Signal Cable shall meet California Standard Specifications, dated July 1999, except for the following:
 - **#14 AWG**
 - #14 AWG, solid bare copper conductor
 - .016" minimum polyvinyl chloride insulation
 - .005" minimum clear nylon jacket over each insulated conductor
 - **#10 AWG**
 - #10 AWG, solid bare copper conductor
 - .022" minimum polyvinyl chloride insulation
 - .008" minimum clear nylon jacket over each insulated conductor
 - **Assembly**
 - 27 Conductors #14 AWG and 1 conductor #10 AWG, color coded and cabled with polyethylene fillers if necessary to make round.
 - Clear binder tape wrap over cable core.
 - .080" nominal black polyvinyl chloride jacket, per IMSA 19-1
 - Jacket printed with: [Manufacture's name], THWN 27/C #14 AWG 1/C #10 AWG 600 Volts.
 - Sequential footage marking on outer surface of jacket, printed at two (2) foot intervals.
 - Nominal cable O.D. .860".
 - Temperature rating: 75° C
 - Voltage Rating: 600 Volts
 - **Color Code:** Stripes are spiral, permanent, under nylon.

■ #10 AWG	1.	White		
■ #14 AWG	1.	Red/Black	15.	Red/Black/Black
	2.	Yellow/Black	16.	Brown/Black/Black
	3.	Brown/Black	17.	Red/Orange/Orange
	4.	Red/Orange	18.	Brown/Orange/Orange
	5.	Yellow/Orange	19.	Red/Silver/Silver
	6.	Brown/Orange	20.	Brown/Sliver/Silver
	7.	Red/Silver	21.	Red/Purple/Purple
	8.	Yellow/Silver	22.	Brown/Purple/Purple
	9.	Brown/Silver	23.	Blue/Black
	10.	Red/Purple	24.	Blue/Orange
	11.	Yellow/Purple	25.	Blue/Silver
	12.	Brown/Purple	26.	Blue/Purple
	13.	White/Black	27.	Black
	14.	Black/Red		
 - **Reel Size**
 - Put up to 2000' on 36" maximum reel, 2.75" arbor hole

SPEC NUMBER: 92-089-01 LADOT #18 28Cond "Type"

DESCRIPTION 18/27 16/1 SIGNAL CABLE CITY OF LA

CONSTRUCTION

AWG	18 AWG & 16 AWG Sol BC
Conductors	28
Primary Insulation	PVC/NYLON
Nominal Wall	.015/.005 .015/.005
Tape	Clear Mylar
% Overlap	20
Jacket	PVC
Nominal Wall	.060
Tempature Rating	75C
Operating Voltage	600V
Characteristics	CITY OF LOS ANGELES (DOT) Foot Markers

Print: Fine Wire TFN 27/C 18AWG 1/C 16AWG 600V

Color Code: Wht, Red/Blk, Yel/Blk, Brn/Blk, Red/Org, Yel/Org, Brn/Org, Red/Silver,
Yel/Silver, Brn/Silver, Red/Pur, Yel/Pur, Brn/Pur, Wht/Blk, Blk/Red, Red/Blk/Blk,
Brn/Blk/Blk, Red/Org/Org, Brn/Org/Org, Red/Silver/Silver, Brn/Silver/Silver,
Red/Pur/Pur, Brn/Pur/Pur, Blu/Blk, Blu/Org, Blu/Silver, Blu/Pur, Blk

City of Los Angeles
Department of Transportation

Cable - Multiconductor Traffic Signal - 9cc

Purchase Specification

92-090-01

03-18-2003

- Description:
 - This document defines minimum standards for product performance and composition relating to:
9 CONDUCTOR TRAFFIC SIGNAL CABLE.
- General:
 - 9 Conductor Traffic Signal Cable shall meet California Standard Specifications, dated July 1999, except for the following:
 - **#14 AWG**
 - #14 AWG, solid bare copper conductor
 - .016" minimum polyvinyl chloride insulation
 - .005" minimum clear nylon jacket over each insulated conductor
 - **#10 AWG**
 - #10 AWG, solid bare copper conductor
 - .022" minimum polyvinyl chloride insulation
 - .008" minimum clear nylon jacket over each insulated conductor
 - **Assembly**
 - 8 Conductors #14 AWG and 1 conductor #10 AWG, color coded and cabled with polyethylene fillers if necessary to make round.
 - Clear binder tape wrap over cable core.
 - .060" nominal black polyvinyl chloride jacket, per IMSA 19-1
 - Jacket printed with: [Manufacture's name], THWN 8/C #14 AWG 1/C #10 AWG 600 Volts.
 - Sequential footage marking on outer surface of jacket, printed at two (2) foot intervals.
 - **Nominal cable O.D. .532".**
 - Temperature rating: 75° C
 - Voltage Rating: 600 Volts
 - **Color Code:** Stripes are spiral, permanent, under nylon.
 - **#10 AWG**
 - 1. White
 - **#14 AWG**
 - 1. Red/Black
 - 2. Yellow/Black
 - 3. Brown/Black
 - 4. Red/Orange
 - 5. Yellow/Orange
 - 6. Brown/Orange
 - 7. White/Black
 - 8. Blue/Black
 - **Reel Size**
 - Put up to 2000' on 36" maximum reel, 2.75" arbor hole

City of Los Angeles
Department of Transportation
Cable - Multiconductor Traffic Signal - 13cc

Purchase Specification

92-091-01

03-18-2003

- Description:
 - This document defines minimum standards for product performance and composition relating to:
13 conductor traffic signal cable.
- General:
 - 13 Conductor Traffic Signal Cable shall meet California Standard Specifications, dated July 1999, except for the following:
 - **#10 AWG**
 - #10 AWG, solid bare copper conductor
 - .022" minimum polyvinyl chloride insulation
 - .008" minimum clear nylon jacket over each insulated conductor
 - **#14 AWG**
 - #14 AWG, solid bare copper conductor
 - .016" minimum polyvinyl chloride insulation
 - .005" minimum clear nylon jacket over each insulated conductor
 - **Assembly**
 - 12 Conductors #14 AWG and 1 conductor #10 AWG, color coded and cabled with polyethylene fillers if necessary to make round.
 - Clear binder tape wrap over cable core.
 - .060" nominal black polyvinyl chloride jacket, per IMSA 19-1
 - Jacket printed with: [Manufacture's name], THWN 12/C #14 AWG 1/C #10 AWG 600 Volts.
 - Sequential footage marking on outer surface of jacket, printed at two (2) foot intervals.
 - Nominal cable O.D. .612".
 - Temperature rating: 75° C
 - Voltage Rating: 600 Volts
 - **Color Code:** Stripes are spiral, permanent, under nylon.
 - **#10 AWG**
 - 1. White
 - **#14 AWG**
 - 1. Red/Black
 - 2. Yellow/Black
 - 3. Brown/Black
 - 4. Red/Orange
 - 5. Yellow/Orange
 - 6. Brown/Orange
 - 7. Red (no stripe)
 - 8. Yellow (no stripe)
 - 9. Brown (no stripe)
 - 10. White/Black
 - 11. Blue/Black
 - 12. Blue/Orange
 - **Reel Size**
 - Put up to 2000' on 36" maximum reel, 2.75" arbor hole

City of Los Angeles
Department of Transportation

Cable - Multiconductor Traffic Signal - 19cc

Purchase Specification

92-092-01

03-18-2003

- Description:
 - This document defines minimum standards for product performance and composition relating to:
19 CONDUCTOR TRAFFIC SIGNAL CABLE.
- General:
 - 19 Conductor Traffic Signal Cable shall meet California Standard Specifications, dated July 1999, except for the following:
 - **#14 AWG**
 - #14 AWG, solid bare copper conductor
 - .016" minimum polyvinyl chloride insulation
 - .005" minimum clear nylon jacket over each insulated conductor
 - **#10 AWG**
 - #10 AWG, solid bare copper conductor
 - .022" minimum polyvinyl chloride insulation
 - .008" minimum clear nylon jacket over each insulated conductor
 - **Assembly**
 - 18 Conductors #14 AWG and 1 conductor #10 AWG, color coded and cabled with polyethylene fillers if necessary to make round.
 - Clear binder tape wrap over cable core.
 - .060" nominal black polyvinyl chloride jacket, per IMSA 19-1
 - Jacket printed with: [Manufacture's name], THWN 18/C #14 AWG 1/C #10 AWG 600 Volts.
 - Sequential footage marking on outer surface of jacket, printed at two (2) foot intervals.
 - Nominal cable O.D. .670".
 - Temperature rating: 75° C
 - Voltage Rating: 600 Volts
 - **Color Code:** Stripes are spiral, permanent, under nylon.
 - **#10 AWG**

1.	White
 - **#14 AWG**

1.	Red/Black	10.	White/Black
2.	Yellow/Black	11.	Black/Red
3.	Brown/Black	12.	Red/Black/Black
4.	Red/Orange	13.	Brown/Black/Black
5.	Yellow/Orange	14.	Red/Silver/Silver
6.	Brown/Orange	15.	Brown/Silver/Silver
7.	Red/Silver	16.	Blue/Black
8.	Yellow/Silver	17.	Blue/Silver
9.	Brown/Silver	18.	Black
 - **Reel Size**
 - Put up to 2000' on 36" maximum reel, 2.75" arbor hole

**City of Los Angeles
Department of Transportation
Wire - Traffic Loop Detector**

Specification

92-093-01

05-22-2003

Description:

This document defines minimum standards for product performance and composition relating to:

Traffic Loop Detector Wire (also called Tube Loop Detector Cable)

General:

Traffic Loop Detector Wire shall be of the double insulated type meeting all specifications for Cal Trans Type 2 traffic Loop cable and IMSA 51-5 cable and shall include the following:

- **Conductors:** Stranded bare annealed copper per ASTM requirements, #14 - 19/.147"
- **Insulation:** Black polyvinyl chloride per U.L. 62 class 12. Wall thickness: .020".
- **Nylon Jacket:** Clear nylon per ASTM D04066. Wall thickness: .010" nominal.
- **Tube:** Orange polyvinyl chloride per ASTM D2220. Wall thickness: .040" nominal loose fit.
- **Marking:** Ink print at 24" minimum with "IMSA 51-5 14 AWG 600V"
- **Testing:** 100% spark testing at 4 KV during extrusion process for insulation, 100% continuity test before shipping. Compliance of materials to U.L. and ASTM requirements per supplier's certifications, with periodic verification testing in house
- **Spool Size:** Wire shall be provided on spools of at least 36" and no larger than 42", with a length of 2500' +/- 10%.

City of Los Angeles
Department of Transportation

Cable - Multiconductor Traffic Signal - 5cc

Purchase Specification

92-094-01
(Formerly Spec # 92-087-01)

10-03-2001

- Description:
 - This document defines minimum standards for product performance and composition relating to:
5 CONDUCTOR TRAFFIC SIGNAL CABLE.
- General:
 - 5 Conductor Traffic Signal Cable shall meet California Standard Specifications, dated July 1999, except for the following:
 - **#14 AWG**
 - #14 AWG, solid bare copper conductor
 - .016" minimum polyvinyl chloride insulation
 - .005" minimum clear nylon jacket over each insulated conductor
 - **Assembly**
 - 5 Conductors #14 AWG, color coded and cabled with polyethylene fillers if necessary to make round.
 - Clear binder tape wrap over cable core.
 - .045" nominal black polyvinyl chloride jacket, per IMSA 19-1
 - Jacket printed with: [Manufacture's name], THWN 5/C #14 AWG 600 Volts.
 - Sequential footage marking on outer surface of jacket, printed at two (2) foot intervals.
 - Nominal cable O.D. .385".
 - Temperature rating: 75° C
 - Voltage Rating: 600 Volts
 - **Color Code:** Stripes are spiral, permanent, under nylon.
 - 1. Red
 - 2. Yellow
 - 3. Brown
 - 4. Black
 - 5. White
 - **Reel Size**
 - Put up to 2000' on 36" maximum reel, 2.75" arbor hole

**CITY of LOS ANGELES
DEPARTMENT of TRANSPORTATION**

ACCESSIBLE PEDESTRIAN SIGNAL (APS)

PURCHASE SPECIFICATION

92-095-03

February 2012

This document outlines the minimum requirements for an Accessible Pedestrian Signal (APS) for the visually impaired. The APS communicates information about pedestrian timing in a nonvisual format such as audible tones, verbal messages, and vibrating surfaces (*MUTCD*, Section 4A.02). APS systems purchased for installation by or for the City of Los Angeles Department of Transportation, shall meet these requirements or addenda as stated on the signal plans.

General

The APS system consists of an audible, vibro-tactile “Push Button Station” (Pbs) that works in conjunction with a control unit. The control unit interfaces with the corresponding 120VAC Walk/Don’t pedestrian signals. All sounds and tactile information are integrated on the Pbs unit.

Locator Tone the locator tone informs pedestrians of the need to push a button and provides an audible cue to the location of the pushbutton. The pushbutton locator tone is a click sound of repetition rate and length of tone standardized by language in the *MUTCD*: "...pushbutton locator tones shall be easily locate able, shall have a duration of 0.15 seconds or less, and shall repeat at 1-second intervals." (4E.09)

Push Button Both a momentary or extended button push will be registered by the Pbs by latching on a LED in front of the Pbs and by an audible click. The tactile push button arrow will vibrate during the WALK interval and shall be adjustable for correct orientation with the crosswalk.

Walk Mode in response to a button push, the Pbs will generate a “Fast Tick” audible sound, as specified in the *MUTCD*, concurrent with the WALK interval and terminate at the start of the CLEARANCE interval.

Clearance Mode following the termination of the “Fast Tick” during the WALK interval the Pbs will revert to the Locator Tone with duration of 0.15 seconds at one second intervals.

Volume Settings the maximum volume for any tone or message shall not exceed 60 db. All tone volume settings shall be adjustable by percentage of maximum and shall include an automatic volume over ambient noise adjustment.

Programmingthe Pbs shall be configured by wireless means, i.e., radio frequency, infrared or blue tooth. Set-up and programming through electrical connectors or jacks are not acceptable.

Physical & Mechanical

The housing shall be designed to mount on a traffic signal standard or on top of a 2.5 inch diameter, Type 7 standard. The housing shall be provided with a top plate for mounting on the Type 7 standard and a method of attaching the same.

The housing shall be die-cast or permanent mold cast aluminum with a powder coat finish, black or green in color conforming to color number 14062 of federal standard 595B.

The housing shall incorporate #8-32 threaded stainless steel inserts for mounting standard pushbutton signs. For the hole pattern, see LADOT specification drawing S-73.1

Mounting hardware to be provided:

Housing: (2) hex machine cap screws 1/4-20 #302/303 stainless steel, one (1) inch in length.

Sign: (4) #8-32 x 1/2 inch stainless steel, TORX T15, pan head tamper proof machine screws for attaching a sign to the housing.

Environmental

The Pbs shall be rated for intermittent use in the ambient temperature range of - 40°C (- 40°F) to +85°C (+185°F).

The Pbs shall be protected against dust and moisture intrusion and shall withstand direct sunlight exposure without exhibiting evidence of either physical or mechanical deterioration.

Circuit boards and electronic components shall be conformal coated and wire connections sufficiently protected so as to operate reliably in a moisture environment.

Electrical

The Pbs push button output shall interface with a standard model 242 DC isolator and operate over the normal voltage range of 8 to 30 VDC. Actuation of 50 milliseconds or greater with less than three pounds of actuation force shall constitute an output contact closure. The Pbs shall be capable of sinking a maximum of 50 milliamps at 30 VDC. The push button shall be rated for greater than twenty million operations .

Each Pbs unit shall come with an extension cable ten feet in length for connection to the control unit within the Ped Head. The cable shall be a four-conductor Belden 8489 or equivalent,.

A control unit typically mounted inside the Ped Head shall connect to and transform the 120VAC WALK and DON'T WALK signals to low-level signals that interface with the Pbs.

Warranty

APS shall be warranted against functional failure, physical or mechanical deterioration for two years from the date of purchase.

Sample

Prior to a purchase agreement or competitive bid approval, a sample unit or system shall be submitted for test and evaluation by the LADOT Signal Lab at the address shown below. Shipping costs to and return from the LADOT test facility shall be covered by the vendor.

LADOT Signal Lab
555 Ramirez Street, Space 100
Los Angeles, CA 90012

**CITY of LOS ANGELES
DEPARTMENT of TRANSPORTATION**

IN-ROADWAY LIGHT SYSTEM

PURCHASE SPECIFICATION

92-096-01

March 2011

GENERAL

This specification defines the requirements for a hardwired, In-Roadway Light System (IRWL) used for pedestrian crosswalks and vehicle stop bar operation to alert motorists that they are approaching an active pedestrian or rail/bus crossing and for vehicle traffic lane delineation. The system consists of the materials for the installation of a hardwired In-Roadway Light System and auxiliary components to support the System, as outlined in this specification.

IN-ROADWAY MODULES

In-roadway LED modules are designed to be embedded into the roadway surface and interconnected by direct burial cable hardwired and controlled from a traffic signal cabinet or other suitable housing approved by the LADOT.

Module Housing

Mechanical-

The design of the housing shall be such to withstand the weight and constant surface abuse caused by vehicular traffic operating in all weather environments.

The dimensions of each housing shall not exceed more than 10 square inches in cross-sectional area nor more than 3 inches in overall height. The upper portion of the housing shall not extend more than ¼ inch above the road surface when installed.

The housing shall allow for adjustment of the visible display up to 90 degrees in relation to the plane of the interconnection cable.

The upper removable assembly-

Material – Heat treated, M8x20 DIN912 cast A4 stainless steel. The upper LED removable assembly shall attach to the base with stainless steel security screws easily removable for maintenance or replacement and is completely water tight and tested for water ingress to IP68. All electrical terminations shall occur within the IRWL housing. Under no circumstances shall any electrical connection be made in the pavement outside the IRWL housing.

The lower housing-

The lower housing shall be made of an aluminum alloy or other corrosion resistant material tested for a minimum of 5,000 kg compressive strength.

It shall be designed to be permanently embedded in the roadway with epoxy or other adhesive material to secure it below the asphalt or concrete surface. There shall be adequate space to accommodate wire terminations or connectors with the interconnect cable.

Lens

Prismatic- Borofloat hardened glass, and shall be uni-directional or bi-directional determined by application. **NO PLASTIC LENS OR BODY COMPONENTS SHALL BE EXPOSED TO TRAFFIC.**

Optical Characteristics

LEDs –ultra bright design, redundant circuitry.

Colormetrics: (Red Amber White Green): to comply with MUTCD specifications.

Color	Dominant Wavelength			Spectral Half Width (nm)
	Min	Typical	Max	
White	4500	6500K	10000K	-
Red	620.5	627	645	20
Green	520	530	550	35
Amber	584.5	590	597	14

Daytime visibility range: to exceed 1000 feet regardless of ambient light conditions.

Illumination- The LED indications shall illuminate in any of the three modes of operation described under the Electrical section on page three.

Electrical Characteristics

Supply Voltage: 15 to 48VDC without change of light intensity.

Power consumption /IRWL: not to exceed 3 watts per display.

PWM Amplitude: 24VDC at 500Hz.

Environmental

Must operate in an ambient temperature range from -25C to 65C in all weather environments and be completely water tight, tested for water ingress to IP68.

CONTROLLER

General

The IRWL controller housing shall be designed to mount in a standard EIA 19 inch rack assembly. The housing shall enclose all power supplies and circuitry designed to control and operate the IRWL. Power, control, status and any other circuitry into or out of the unit shall be accessed through terminal blocks, cables or connectors of appropriate type.

The controller shall be designed to illuminate the IRWL in three possible modes of operation in response to an external command from a 2070 traffic signal controller unit through a standard 120 VAC switch pack:

- 1) Continuous Illumination
- 2) Standard Flash (1 Hz)
- 3) Fast Flash (LADOT)

The three modes of operation can be pre-programmed and generated internally by the IRWL controller in response to a continuous AC input from the switch pack or can respond in real time to AC levels from the switch pack to achieve the pulsed display.

Electrical

Power-

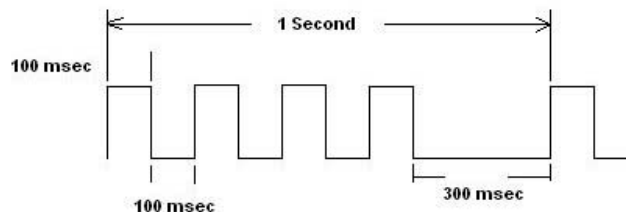
The controller shall operate from its own power source with an input supply voltage between 95 to 130 VAC and provide for adequate fault protection according to its design rating.

Control-

The controller will drive the IRWL in response from a 120 VAC 60 Hz input:

Input voltage- 95 VAC to 130 VAC continuous or:

- Standard Flash- pulsed at a 1 Hz rate with 50% duty cycle
- Fast Flash- burst of (4) 100 msecond wide pulses at 100 msecond intervals, followed by a 300 msecond pause and repeated every second.



The IRWL Supply Voltage- 24 to 48VDC (typically 24V DC or 48V DC)

The turn-on and turn-off response time shall not exceed 75 mseconds.

Transient/Inrush current limiting – internal on all outputs.

Overload –internal, auto-reset circuit breakers on outputs.

Short Circuit – Continuous protection.

Day/ night mode control – automatic photocell activated selectable on/off.

Night Brightness adjustable 5%-100%.

Environmental

The IRWL controller and components must operate in an ambient temperature range from -25C to 65C.

IN-ROAD INSTALLATION

One 3/8" slot to be cut, 2 1/2" depth; holes, 2 3/4" depth cores cut for each housing, centered over the slot where IRWLs are to be placed. Alternately, manufacturer supplied conduit system may be used for installation in concrete.

IRWL control cable – 14/2-22/2, conductor insulator color code Red, Black, Green, white; .36" o.d. (nominal), with dry water block system; tinned copper conductors; outer jacket labeled specific to the IRWL manufacture. Supplied by the manufacturer.

Sub-Base Encapsulation material –supplied by the manufacturer

Waterproof connectors: silicon filled w/cap; supplied by the manufacturer.

Mounting and Bedding; manufacturer approved resilient-setting Epoxy Resin (to be provided by the manufacturer).

WARRANTY

System components shall have a limited warranty of 5 (FIVE) years. The manufacturer or his distributor shall be responsible for the shipping cost as well as the arrangements for return and replacement of items failed while under the warranty period.

City of Los Angeles
Department of Transportation
Cable – Accessible Pedestrian Systems - 4cc

Purchase Specification

92-097-01

March 2013

Description:

This document defines minimum standards for product performance and composition relating to:

Accessible Pedestrian System: **FOUR (4) CONDUCTOR CABLE.**

General:

4 Conductor APS Cable shall be allowed for use in LADOT APS installations providing that the cable is also approved for "Direct Burial" installation:

- Total number of conductors: Four (4)
- AWG: #18 AWG, stranded bare copper conductors
- Insulation Material: Polypropylene OR Polyvinyl Chloride (PVC)/Nylon
- Insulation/Dielectric thickness: .012" (minimum)
- Nominal Insulation Diameter: .070" - .090"
- Color code: Black, Red, (White or Orange) and (Green or Blue)
- Cabling Overall Lay: 2" left hand lay (6 turns per foot)
- Tape Material: Aluminum/Polyester Water Blocking Tape (preferred)
- Drain Wire Material: Tinned Copper
- Nominal Cabling Diameter: .170" - .320"
- Final Jacket Material: High Density Polyethylene OR PVC
- Nominal Thickness: .030" - .050"
- Jacket Color: Black
- Nominal Jacket Diameter: .241" (approx.)
- Ripcord: Yes
- Sequential Foot Marks: Preferred
- Cable ID printed on Cable: Yes

Operating Parameters

- Operating Voltage: 600V
- Inductance: approx 23 pico henries/100 ft (diagonal pairs)
- Capacitance: 27pF/ft (diagonal pairs)
30 pF/ft (adjacent pairs)
- Loop Resistance: 1.7 Ohms/100 ft (maximum)
- Operating Temperature: -30 deg F to 90 deg F

Applicable Standards

- U/L Type: N/A
- IMSA: N/A
- Conductor: ASTM B-8
- ROHS Compliant: Yes

**CITY of LOS ANGELES
DEPARTMENT of TRANSPORTATION**

FLASHING BEACON TRAFFIC SIGNAL

PURCHASE SPECIFICATION

93-004-01

November 2013

This specification outlines the requirements of the City of Los Angeles Department of Transportation (LADOT) for the purchase of Flashing Beacon Traffic Signal equipment.

DESCRIPTION

A flashing beacon is a vehicular traffic signal indication red or amber in color that flashes at a prescribed rate as a caution warning device or for stop command. The indication will be a standard vehicular LED module that meets the requirements of the MUTCD, and all requirements of ITE VTCSH for 12 and 8 inch circular signals. The beacon will operate from 120 volts AC nominal line voltage or from an independent low voltage solar DC system as specified by the LADOT.

GENERAL

The signal modules when illuminated, will have the appearance of a standard, non-program visibility, incandescent traffic signal. This means the surface of signal modules will appear to the motorist as nearly totally uniform in illumination and still maintain ITE intensity, chromaticity, uniformity and distribution standards. This also means that it will not be apparent that LEDs are used as the light source for circular type signal.

The signal module with a visor will be housed in a standard 12 or 8-inch traffic signal compartment that utilizes fittings for 2-inch or 4-inch standard traffic signal mounting hardware as required.

Flash circuitry, power management and solar panel if specified will be located external of the signal module in a separate housing but attached to and integral to the signal compartment.

120 VOLT FLASH CIRCUIT

A beacon operated from external 120 vac power will provide a terminal block for landing conductors and a flash circuit or module located within the signal module housing. The flash circuit will power a standard 120 vac LED traffic signal module that meets the LADOT specification. The flash pattern will be 1 Hertz at 50% duty cycle or quick-flash per MUTCD 2009, Chapter 4L, Flashing Beacons.

DC SOLAR POWER SYSTEM

A solar powered beacon will be designed around a 12-volt DC system which includes a photo voltaic array, a 12-volt DC battery, a solar controller and flash circuit. The beacon will be designed to operate 24 hours a day on a combination of solar or battery power. In absence of solar power the battery will provide flash operation for a minimum of 72 hours.

Solar Panel

The solar panel photovoltaic array will provide sufficient power to operate the beacon and maintain battery charge during sunlight hours. The panel must be tilted to minimize collection of dirt and debris and be able to rotate independent of the signal module housing in order to maximize sun exposure.

Battery

A 12-volt replaceable, recyclable, sealed, maintenance free battery system will provide DC power. The battery capacity will be such that it can provide power to the beacon for a minimum of 72 hours in the absence of solar energy. The battery system will be designed and warranted for a 5-year life.

Solar Controller

The solar controller will provide energy management between the photovoltaic array, the battery system and the beacon load. The controller will regulate the required charging requirements for the battery system and manage optimum power efficiency to the beacon from the photovoltaic array and the battery system.

HOUSING (per LADOT specification 92-061-06 Traffic Signal Vehicle Head and Housing)

The LED module housing section will be one-piece molded, manufactured from Ultra-Violet stabilized, 10% glass reinforced, new polycarbonate resin. Regrind material is NOT acceptable. The housing will be a minimum of .090 inches thick. All housings and compartments will be waterproof and dust tight.

All signal housing components will be colored BLACK with a lusterless finish. Black will match Color No. 17038, 27038 or 30738 of Federal Standard 595A. Color will be completely impregnated in the resin material so that scratches will not expose uncolored material.

The door will have two (2) integral hinge lugs and required latch slots. The door will pivot from the left side on stainless steel hinge pins. The door will latch at the right side using stainless steel hardware. The door will have brass or stainless steel threaded inserts for retaining the LED module and visor. The door will form a dust and moisture resistant seal between the door and module housing. The door will accommodate standard LED traffic signal modules.

Visors

Visors will be manufactured from Ultra-Violet stabilized, polycarbonate resin (glass fill not required). Visors will be full circle and will have four (4) integral screw tab slots to provide secure attachment to the door assembly. Visors will provide a downward tilt between three (3) and seven (7) degrees. 8-inch section visors will be a minimum of seven (7) inches in length. 12-inch section visors will be a minimum of nine and one half (9½) inches in length.

HARDWARE

All hardware materials used for traffic control equipment will be BEST QUALITY first run material. Recycled materials, in part or in full, will not be used in the manufacture of hardware for mounting traffic control equipment. All hardware, including but not limited to pins, bolts, screws, lugs, clips, etc., will be type 302, 304, or 305 stainless steel. Threaded inserts, when cast into the housing or other assemblies, may be manufactured from brass.

ENVIRONMENTAL

The beacon will be capable of continuous operation over a range in temperatures from -40 degrees to +122 degrees Fahrenheit (-40 to +50 degrees Celsius.) The beacon will be unaffected by harsh outdoor weather and dust conditions.

SAMPLES AND TESTING

Upon request by the City of Los Angeles or any of its authorized agents, the Manufacturer or supplier will submit for approval, one (1) sample for test and evaluation for compliance with the specification.

WARRANTY

Manufacturer or Supplier will warrant the beacon including associated hardware, to be free from defects in material and manufacture for a minimum of three (3) years from the date of test and acceptance by the City of Los Angeles, Department of Transportation. The battery system will be designed and warranted for a 5-year life. All warranty expenses including parts, labor and shipping are the responsibility of the Manufacturer or Supplier.

**City of Los Angeles
Department of Transportation**

Rectangular Rapid Flash Beacon (RRFB) System

Purchase Specification

93-005-03

June 2016

General

The City of Los Angeles provides various methods for the safety enhancement of Pedestrian Crossings throughout the City. One of these devices is the "Rectangular Rapid Flash Beacon (RRFB)". This document outlines the type of device and system that will provide increased driver awareness by alerting motorists that they are approaching an active pedestrian crossing.

RRFB

This specification defines the minimum standards for product performance and components relating to a stand-alone, wireless linked and solar assisted **Rectangular Rapid Flash Beacon (RRFB) System**. The system consists of the materials, auxiliary components and hardware for the installation of the RRFB System: RRFB LED module assembly(s); a solar array with battery and battery management system in a weather proof housing; pedestrian pushbutton assembly; a wireless communication system; and associated mounting hardware.

RRFB Module

The RRFB assembly will consist of two rectangular-shaped yellow indications, each with LED modules approximately 7.25 inches x 3 inches in dimension, mounted **ABOVE** a Pedestrian Crossing (W11-2), School Advance Warning (S-1) or Equestrian Crossing (W11-7) warning sign with diagonal downward pointing arrow (W16-7P) diagonal arrow sign. The assembly will be housed in a suitable water-proof enclosure with UV resistant lenses. The two vehicle RRFB indications will be aligned horizontally, with the longer dimension of the indication horizontal, and a minimum space between the two indications of approximately 7 inches measured from the inside edge of one indication to the inside edge of the second indication. The end of the assembly will illuminate the LED indication for pedestrians which will flash concurrently with the vehicle RRFB module LEDs. The light intensity of all of the RRFB indications will comply with the Society of Automotive Engineers (SAE) standard J595 certified, class 1. The system will incorporate automatic light control for ambient settings and night intensity.

The RRFB will be normally dark and only upon a pedestrian actuation will initiate a 2/4-1 flash pattern as described in MUTCD Interim Approval #11 (IA-11) and will discontinue operation after a predetermined time limit adjustable from 20 to 100 seconds. Active vehicle indications will be visible when unobstructed at distances over 1,000 feet during the day and over one mile at night.

Mast Arm Installation

A crossing location may require the RRFB to be installed on a mast arm if there is an issue of restricted visibility, roadway width, and/or number of vehicle lanes. The RRFB is to be mounted directly below the bottom of the overhead W11-2 or S1-1 or W11-7 sign. A second option is a RRFB mounted on a 5 ft. extension arm attached to a standard at a height of 17 feet above the street. The mast arm **or 5 ft. extension arm** RRFB will be enabled and powered from the controller on the mast arm standard adjacent to the roadway.

Solar Panel

A solar array in conjunction with a rechargeable battery will provide DC power to the RRFB. The panel will be adjustable for maximize exposure to the sun and will conform to IP-67. The solar panel will have a minimum operating temperature range of -40 to +185 degrees F (-40 to +85 degrees C.)

Battery

A sealed, maintenance free 12 volt battery system with a rated life of five years, will provide power to the RRFB. The solar and battery system will have the capacity to operate four RRFB modules with a minimum operational autonomy of three to five days under anticipated actuations designed for the RRFB location.

Solar Controller

A solar controller will be incorporated into the RRFB system to manage the power between the solar panel, the battery and the LED modules. The solar panels are connected to the batteries through the controller which regulates the charging and discharging rate of the batteries. The controller provides temperature compensated charging so that the rate of charge is controlled for both temperature and state of charge. The controller will shut off charging when the battery reaches a sufficient charge level per the manufacturer's specification. The controller will disconnect the load when the battery discharges below the manufacturer's recommended voltage level. These set points have been established to prevent damage to the battery from an overcharge condition or a low voltage condition. The controller will have a manual switch to provide electrical disconnection of the batteries from the system.

Housing

The controller, battery and electronic modules will be housed in a fiberglass or an aluminum powder coated enclosure with a lockable hinged door. The RRFB light bar housing will be constructed of durable, corrosion-resistant powder coated aluminum with stainless steel fasteners. Units that are mounted back-to-back will be designed so that the angle of adjustment for the light bars is independent.

Pushbutton Assembly

The pushbutton assembly will meet the operational requirements of MUTCD 2009-4E; NEMA TS 2 Section 2.1 for temperature and humidity requirements; NEMA 250-Type 4X Enclosure requirements, and will consist of the following:

- An ADA compliant, Piezo-driven push button with a directional tactile arrow for activating crosswalk operation.
- An instructional sign in English and in braille
- A "Locate Tone" audible at all times that the crosswalk is not in operation
- A voice message that says: **"Yellow Lights Are Flashing"** while the crosswalk is activated.
- A group of LEDs above the push button which flash in sync with the flashing beacon
- User programmable volume control with automatic ambient noise adjust

Wireless System

The RRFB light bars will be wirelessly activated, synchronized and with a range of up to 600 +/- 25 feet.

Environmental

The RRFB will be capable of continuous operation over a range in temperatures from -30 degrees to +165 degrees F (-34 to +74 degrees C.) The RRFB will be unaffected by harsh outdoor weather and dust conditions.

Mounting Hardware

All hardware will be provided for installation on a 4 to 4 ½ inch outer diameter pole either top mount with appropriate slip fitter or side mount using stainless steel U-bolts and hardware. In addition, some locations may need hardware to mount to a 6 ½ - 9 inch diameter pole using straps.

Samples and Testing

Upon request by the City of Los Angeles or any of its authorized agents, the Manufacturer or Supplier will submit for approval, one (1) sample for test and evaluation for compliance with the specification.

Warranty and Support

The Manufacturer or Supplier will warrant the RRFB including associated hardware, to be free from defects in material and manufacture for a minimum of three (3) years from the date of test and acceptance by the City of Los Angeles, Department of Transportation. The battery system will be designed and warranted for a 5-year life. All warranty expenses including parts, labor and shipping are the responsibility of the Manufacturer or Supplier. Repair support must be local to Southern California.

CONTRACT FOR CABINET ASSEMBLIES & EQUIPMENT FOR THE LADOT

September, 2017

The Contract

All documents and specifications described here shall be used to establish a single traffic signal cabinet assembly and parts contract for the City of Los Angeles Department of Transportation. The selected bidder shall be able to provide and deliver as needed, all of the cabinet assemblies and parts outlined herein. A spreadsheet is attached listing the cabinets, equipment and parts list with estimated annual usage.

Advanced Transportation Controller

This section describes and identifies traffic signal cabinet assembly requirements that are consistent with the latest ATC family of serially interconnected cabinets and peripheral control equipment. The ATC assemblies shall combine the best existing standards with the latest technology while providing a migration path to low voltage intersections.

Serial Interconnection

The cabinet assemblies shall be serially interconnected to input/output assemblies and field input/output termination assemblies using SIU modules per the latest ATC standards and technology.

ATC Cabinet Assemblies

The cabinet assemblies will reside in the previous standard housing configurations for 336, 337 and 332 cabinets respectively with standard 19 inch rack dimension requirements. The ATC cabinet assemblies will be referred to as 356, 357 and 352 respectively. The cabinet housing dimensions and normally energized flash transfer relay configuration will adhere to the July 2008 specifications.

356 Assembly will provide 16 field output channels and 48 input channels per attached LADOT specification 356 ATC **95-002-00** dated August, 2016.

357 Assembly will provide 8 field output channels and 16 input channels per attached LADOT specification 357 ATC **95-003-00** dated August, 2016.

352 Assembly will provide up to 32 field output channels and up to 96 input channels per attached LADOT specification **95-001-00** including ***Fort Worth, Texas specification 352 ATC dated July, 2016.***

ATC Cabinet Verification Test Program

The Vendor shall furnish Cabinet Verification Test Program software and associated hardware with each contract. The program shall execute from the front panel in a 2070E controller unit designed per LADOT Specification 54-055-02. The program provided with any necessary test jigs shall verify the integrity of cabinet wiring related to the output file, input file, the police panel, and flash switches. It shall be possible by front panel selection to test each cabinet input in a given sequence. The controller will acknowledge each correct input test with an audible tone and display the appropriate assignment before advancing to the next test interval in the sequence.

It shall be possible by front panel selection to generate and observe controller unit outputs in by phase-color or conflict monitor channel for either a 352, 356 or 357 style cabinet assembly. The output feature shall be selectable for manual control of an individual output or for automatic advance, activating one output at a time in sequence.

10 copies of Cabinet Verification Program operational manuals shall be supplied per contract. The manual shall give a full and complete description of the specific tests and procedures.

Parts List

The bid for cabinet assemblies will include a complete list of replaceable parts and modules for each of the cabinet assemblies listed above along with pricing for each line item. This parts list shall also include updated pricing for parts and modules (see the following page) included in the ***July, 2008 specification #54-053-08.***

**LIST OF APPROVED TRAFFIC SIGNAL CABINET ASSEMBLIES
&
PERIPHERAL EQUIPMENT**

The following, with the exception of the ATC equipment is a list of traffic signal cabinets and peripheral devices that have been tested and approved by the Department of Transportation Signal Lab for use in cabinet assemblies described in LADOT specification **54-053-08 dated July, 2008**. Devices purchased individually or as part of a contractor furnished cabinet assembly must meet all applicable LADOT specifications. The specific item quantities, where shown, reflect the number of devices to be supplied in each designated cabinet assembly.

All devices shown in this list will also be part of the cabinet contract parts list. Items furnished to the Department that are not shown on this list will be evaluated on a nonpriority basis. This could cause delays in approving cabinet assemblies designated for scheduled projects.

Traffic Signal Cabinets - Model 332, 336, 337

McCain Traffic Systems- 332, 336, 337

Safetran 332LA only

<u>Model 222 Vehicle Detector</u>	Cabinet- Qty	<u>332</u>	<u>336</u>	<u>337</u>
RENO A&E 222		1	1	1

<u>Model 224 Vehicle Detector</u>	Cabinet- Qty	<u>332</u>	<u>336</u>	<u>337</u>
RENO A&E Y200		4	1	1

Bus Detector * (available on parts list)

RENO A&E model AVI-E

Light Rail Detector * (available on parts list)

RENO A&E model GT-200-LRT

<u>Model 200 Switchpack</u>	Cabinet- Qty	<u>332</u> 9	<u>336</u> 6	<u>337</u> 4
EDI 200 with water clear LEDs				
PDC- model SSS-87				
PDC- model SSS-88LA				
RENO A&E LS200				

<u>Model 204 Flasher</u>	Cabinet- Qty	<u>332</u> 2	<u>336</u> 2	<u>337</u> 1
EDI 204 with water clear LEDs				
PDC- model SSF-88LA (w/ component mechanical support)				
PDC- model SSF-87WP				

<u>Model 242 DC Isolator</u>	Cabinet- Qty	<u>332</u> 3	<u>336</u> 2	<u>337</u> 1
EDI 242L				

<u>Model 252 AC Isolator</u>	Cabinet- Qty	<u>332</u> 2	<u>336</u> 1	<u>337</u> 0
PDC- ACI-88 (without DIP switches)				

<u>Model 255 AC-Railroad Isolator</u>	Cabinet- Qty	<u>332</u> 0	<u>336</u> 0	<u>337</u> 0
PDC- ACI-88 (without DIP switches and w/255 faceplate)				

<u>Model 2018 Conflict Monitor</u>	Cabinet- Qty	<u>332</u> 1	<u>336</u> 1	<u>337</u> 0
EDI 2018ECL-LAX				

<u>Model 2010 Conflict Monitor</u>	Cabinet- Qty	<u>332</u> 0	<u>336</u> 0	<u>337</u> 1
EDI 2010ECL-LAX				

<u>332 Power Supply</u>	*on parts list for replacement of ferro-resonant power supplies			
EDI 216EP-24	19 inch rack mounted			

ATC Cabinet Assembly - Model 356, 357, 352

356

3.4.1 Service Assembly Components Requirements

- Service Assembly (1-HDFU)
 - (1 each) Model 2202-HV HDFU or approved equal
 - (1 each) Cabinet Suppressor–Filter

3.4.2 Output Assembly Components Requirements

- Output Assembly (16-Channel)
 - (8 each) Model 2202-HV HDSP or approved equal
 - (1 each) Model 2218 SIU or approved equal
 - (1 each) Model 2212-HV CMUip or approved equal

3.4.3 Field Output Termination Assembly Components Requirements

- Field Output Termination Assembly (16-Channel)
 - (8 each) Model 21H HDFTR or approved equal
 - (8 each) HDSP Suppressor
 - (16 each) Red Flash Program Block
 - (4 each) Yellow Flash Program Block
 - (4 each) White Flash Program Block

3.4.4 Input Assembly Components Requirements

- Input Assembly (48-Channel)
 - (2 each) Model 2218 SIU or approved equal
 - (10 each) Model LMD624H 4-Channel Half Width Detector or approved equal
 - (2 each) Model 244L DC Isolator or approved equal

3.4.5 Field Input Termination Assembly Components Requirements

- Field Input Termination Assembly (48-Channel)
 - (N/A) Detection Module Suppressor

3.4.6 Cabinet Components

- (1 each) Model 2220 ADU or approved equal
- (1 each) Model 2216-24 CPS or approved equal
- (1 each) Mounting Hardware

3.4.1 Combo Input and Output Assembly Components Requirements

- (4 each) Model 2202-HV HDSP or approved equal
- (2 each) Model 2218 SIU or approved equal
- (1 each) Model 2212-HV CMUip or approved equal
- (3 each) Model LMD624H 4-Channel Half Width Detector or approved equal
- (1 each) Model 244L DC Isolator or approved equal

3.4.2 Combo Field Input and Output Termination Assembly Components Requirements

- (4 each) Model 21H HDFTR or approved equal
- (4 each) HDSP Suppressor
- (N/A) Detection Module Suppressor
- (8 each) Red Flash Program Block
- (2 each) Yellow Flash Program Block
- (2 each) White Flash Program Block

3.4.3 Service Assembly Components Requirements

- (1 each) Model 2202-HV HDFU or approved equal
- (1 each) Cabinet Suppressor-Filter
- (1 each) Model 2217 Cabinet Power Supply (CPS) or approved equal

3.4.4 Cabinet Components Requirements

- (1 each) Model 2220 ADU or approved equal
- (1 each) Mounting Hardware

3.4.1 Service Assembly Components Requirements

- Service Assembly (1-HDFU)
 - (2 each) Model 2202-HV HDFU or approved equal
 - (1 each) Cabinet Suppressor–Filter
- Service Assembly (2-HDFU)
 - (2 each) Model 2202-HV HDFU or approved equal
 - (1 each) Cabinet Suppressor–Filter

3.4.2 Output Assembly Components Requirements

- Output Assembly (16-Channel)
 - (10 each) Model 2202-HV HDSP or approved equal
 - (1 each) Model 2218 SIU or approved equal
 - (1 each) Model 2212-HV CMUip or approved equal

- Output Assembly (32-Channel)
 - (18 each) Model 2202-HV HDSP or approved equal
 - (3 each) Model 2218 SIU or approved equal
 - (2 each) Model 2212-HV CMUip or approved equal

3.4.3 Field Output Termination Assembly Components Requirements

- Field Output Termination Assembly (16-Channel)
 - (8 each) Model 21H HDFTR or approved equal
 - (8 each) HDSP Suppressor
 - (16 each) Red Flash Program Block
 - (4 each) Yellow Flash Program Block
 - (4 each) White Flash Program Block

3.4.4 Input Assembly Components Requirements

- Input Assembly (48-Channel)
 - (2 each) Model 2218 SIU or approved equal
 - (12 each) Model LMD624H 4-Channel Half Width Detector or approved equal
 - (3 each) Model 244L DC Isolator or approved equal

3.4.5 Field Input Termination Assembly Components Requirements

- Field Input Termination Assembly Components Requirements
 - (N/A) Detection Module Suppressor

3.4.6 Cabinet Components Requirements

- (1 each) Model 2220 ADU or approved equal
- (1 each) Model 2216-24 CPS or approved equal

City of Los Angeles



Model 352i Advanced Transportation Controller (ATC) Cabinet Specification

Specification No. 95-001-00

August 31, 2016

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Model 352i ATC Cabinet Specification

General

This specification describes the 120 Vac High Voltage (HV) Model 352i Advanced Transportation Controller (ATC) Cabinet ("the cabinet") for the City of Los Angeles. The ATC Cabinet family is a modular, serially-interconnected cabinet architecture that is designed to fulfill a variety of transportation applications.

The cabinet shall include: Service Assembly (SA), Input Assembly (IA), Output Assembly (OA), Serial Bus1/Serial Bus2 and DC/Clean Power Bus, Field Input Termination Assembly (FITA), and Field Output Termination Assembly (FOTA).

The LADOT 352i ATC Cabinet Specification shall comply with the City of Fort Worth 352i ATC Cabinet Specification except for following items:

1. City of Los Angeles identification

Each cabinet shall include City of Los Angeles identification. The name "City of Los Angeles" shall be molded, cast, or scribed in 0.250 inch letters on the outside, top center area of the front cabinet door.

2. Door Latches and Lock Mechanism

Each door shall be equipped with a removable hex handle and "U" handle.

The latching mechanism shall be a three-point draw type. When the door is closed and latched, the door shall be locked. The lock and lock support shall be rigidly mounted on the door. In the locked position, the bolt throw shall extend a minimum of 0.25 inch (+/- 0.03125 inches) into the latch cam area. A seal shall be provided to prevent dust or water entry through the lock opening.

3. Locks & Keys

The locks shall be BEST type. One key shall be supplied with each lock. The keys shall be removable in the locked position only. The locks shall have rectangular, spacing loaded bolts.

The bolt shall have a 0.281 inch throw and shall be 0.75 inch wide by 0.375 inch thick. Tolerance is 0.035 inch. A swing away cover shall be placed over the key entrance to protect the lock mechanism. The lock shall be mounted in the center.

Best Lock numbers are:

- Right Hand - 5L6RL3XA7559-606
- Left Hand - 5L6RL4X47559-606

Each cabinet will be supplied with two (2) locks, each with a "LA-1" core, keyed alike. LA-1 Keys and Core Keys shall be supplied separately, the quantity will be specified at

the time of each purchase order. Contractor cores must be available upon request through the parts contract.

4. Aluminum Surface Protection

The aluminum surface protection shall be LADOT Anti-Graffiti Paint.

5. Communication Panel

Each cabinet shall be equipped with a Communication Panel.

Communications Cable Terminal Block (CTB-1):

Communications Cable Terminal Blocks shall be quick-connected blocks consisting of 25 horizontal rows of six (6) clips per row, mounted in a molded self-extinguishing plastic case. The horizontal rows of six (6) clips shall be divided into two (2) sets of three (3) electrically common clips. The two (2) sets of three (3) clips shall be connected by a bridge clip. These blocks, commonly referred to "66B Type" blocks, shall terminate 25 pairs of 20 through 24 AWG solid unstripped conductors. The blocks shall be equipped with integral fanning strips and an enclosed back to prevent grounding of clips to the panel.

Termination Block (CTB-2):

A four (4) position, double row, closed back design terminal block, Kulka part No. 671-GP-04 or equivalent, labeled CTB-2 shall be mounted on the Communications Termination Panel. The strip shall be rated at 15 Amps and shall be provided with 6-32 by 0.250 inch nickel plated brass binder head screws.

C-20 Termination Block (CTB-3):

A four (4) position, double row, closed back design terminal block, Kulka part No. 671-GP-04 or equivalent, labeled CTB-3 shall be mounted on the Communications Termination Panel. The strip shall be rated at 15 Amps and shall be provided with 6-32 by 0.250 inch nickel plated brass binder head screws.

Over-Voltage Protection:

An over voltage surge protector shall be provided for each active communications cable pair (Audio-In pair, and Audio-Out pair) terminating at CTB-2 and CTB-3. Protectors shall be of the Three-Electrode Gas Tube type, and shall have the following ratings:

- Impulse Life (1,000 Amp, 10/1000 waveshape at one minute intervals each direction, with 500 Amps on each side to ground simultaneously): 1,000 surges minimum, 2,500 surges typical.
- AC Discharge Current, 11 cycles, 60 Hz: 400 Amps RMS, 200 Amps on each side to ground simultaneously
- Maximum Single Impulse Discharge Current, 8/20 waveshape: 40 kA maximum, 20 kA/side simultaneously
- Capacitance: Line-ground = 4 pf, Line-line = 2 pf
- DC Holdover: 180 VDC typical at 200 mA, 150 VDC minimum
- DC Arc Voltage: 30 volts typical

- Glow to Arc Transition Current: 1.0 Amp typical
- Transition Time: 0.5 microseconds maximum
- Line-Ground Impulse Breakdown Voltage at 10 kV/sec: 1000 volts maximum average

Insulation Resistance:

1,000 megohms minimum at 100 VDC (line-ground). The protectors shall be encapsulated, and shall be equipped with minimum 2 inches long, spade lug tipped leads. Maximum size of each protector shall be 0.5 x 0.5 x 2.0 -inches. The grounding lead shall be attached to the panel's grounding stud.

Grounding Stud:

A grounding stud shall be provided. The stud shall extend through the panel. The over voltage protection devices' ground leads shall be attached to the stud on the front side of the panel. A No. 8 AWG copper conductor shall connect to the stud on the back side of the panel, and shall connect to the cabinet's Equipment Grounding Bus.

C2P Harness and Connector:

4-conductor jacketed cables shall each be attached to terminal blocks CTB-2 and CTB-3 with soldered ring lugs. The cables shall terminate with a standard C2P and C20P connectors, and shall be routed through the cabinet, 2 feet in length to reach the back of the 2070 Controller Unit, when the unit is installed in the equipment rack.

Feed-Through Opening:

A feed-through openings, complete with protective grommets, shall be provided on the panel to protect the C2P and C20P harnesses. A strain relief device shall also be provided for each.

Cable-Tie Openings:

Six (6) 0.250 inch diameter holes shall be provided for installation of cable ties.

Allen Tel Distribution Ring:

Allen Tel Distribution Ring model #GB 13 or equivalent shall be installed at the bottom of the panel CTB-1

Attachment to Equipment Rack:

The panel shall be securely attached to the equipment rack using mounting keyholes sized to facilitate removal of the panel without removing the mounting screws.

6. Police Panel

A police panel assembly shall be provided to allow limited control access. The panel door shall be equipped with a lock and master police key. The front and back of the panel shall be enclosed with a rigid metal covering so that no parts having live voltage are exposed. The panel assembly shall have a drain to prevent water from collecting within the assembly. The drain shall be channeled to the outside. The cabinet shall have one switch provided and labeled "SIGNALS ON / OFF" and one switch provided and labeled "FLASH / AUTO".

**7. Model 352i ATC Cabinet (16-Channel Output & 48-Channel Input))
Configuration**

Item #	Modules / Assemblies	Quantity
1	352i Housing / 352i Cage	1
2	352i Side Panel	2
3a	Service Assembly (1 - HDFU)	1
4a	Output Assembly (16 - Channel)	1
	Field Output Termination Assembly (16 - Channel)	1
5a	Input Assembly (48 - Channel)	1
	Field Input Termination Assembly (48 - Channel)	1
6	SB1/SB2 and DC/Clean Power Bus	1
7	Model 2216-24 Cabinet Power Supply	1
8	CMU Auxiliary Display Unit	1
9	LED - Cabinet Light Assembly	2
10	Drawer Shelf Unit	1

**8. Model 352i ATC Cabinet (32-Channel Output and 96-Channel Input)
Configuration**

Item #	Modules / Assemblies	Quantity
1	352i Housing / 352i Cage	1
2	352i Side Panel	2
3b	Service Assembly (2 - HDFU)	1
4b	Output Assembly (32 - Channel)	1
	Field Output Termination Assembly (16 - Channel)	2
5b	Input Assembly (48 - Channel)	2
	Field Input Termination Assembly (48 - Channel)	2
6	SB1/SB2 and DC/Clean Power Bus	1
7	Model 2216-24 Cabinet Power Supply	1
8	CMU Auxiliary Display Unit	1
9	LED - Cabinet Light Assembly	2
10	Drawer Shelf Unit	1

9. Field Input Termination Assembly (48-Channel)

The 48-Channel Field Input Termination Assembly shall be coupled with the 48-Channel Input Assembly and shall have positions for landing 48, two-wire inputs and their associated earth ground wires. The 48-Channel Field Input Termination Assembly shall be mounted across the EIA rails and it shall swing down to provide access to the back of the assemblies mounted in the opposite side.

10. Warranty Statement

It is the responsibility of the Vendor to ensure that all equipment provided has been thoroughly tested prior to shipment, and that each shipment conforms to these specifications.

The minimum warranty for any equipment and materials shall be for a period of 2 years from the date of test acceptance by the Department of Transportation, City of Los Angeles. The warranty shall cover all manufacturer's defects, parts, labor, and shipping costs. The warranty for each unit of equipment that requires repair by the Vendor shall be extended by the length of time that the unit is out of service for repair.

The supplier shall furnish the City with a contact name and telephone number for the person to notify of any alleged defects for which the supplier has repair or replacement responsibilities..

11. Sample Delivery

The first shipment of cabinet assemblies shall be delivered not more than 60 calendar days from the award of the bid. The rate of delivery shall not exceed or be less than 25 per month; unless the contract calls for less than 25 units or a variance is authorized by the City. A Unit shall consist of the controller unit (if called for in the contract), cabinet, and the number of peripherals that the bid designates for each complete controller assembly. Additional shipments will be predicated on the acceptance of the previous delivery.

In addition to the standard shipping invoices, shipment documentation shall be e-mailed to the LADOT Signal Lab in a database format compatible with Microsoft ACCESS 2000 or EXCEL 97-2003. The e-mail address(s) shall be provided at the award of the contract.

The list shall be organized by Cabinet assembly by manufacturer name and serial number and shall include the manufacturer name and serial number for each controller unit (when specified) and conflict monitor unit supplied in each assembly.

Each shipment shall be delivered to:

**Piper Technical Center
Att: Signal Lab
555 Ramirez Street
Quad 1, Space 100
Los Angeles, California 90012**

A minimum of 48 hours advance notice to the Prep Lab Supervisor shall be given by the Vendor prior to each delivery. All deliveries shall be made during the hours of 8:00 AM and 2:00 PM on any working day, Monday - Thurs.



352i ATC Cabinet Specification

July 18, 2016



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Section 1

ATC Cabinet Components

1.1 Model 2202-HV High-Density Switch Pack / Flasher Unit (HDSP-FU)

The HDSP-FU shall be compact, pluggable, modular PCB-based, and equipped with DIN connector. The HDSP-FU shall be compatible with ultra-low power LED signal heads and it shall have a current monitoring feature for each output of each channel. The HDSP-FU shall use real-time standardized high speed SB3 communications with the Cabinet Monitor Unit to send a complete set of RMS voltage and load current measurements. The HDSP-FU shall be 4.5" H x 6.5" D and shall be equipped with a handle, reset push button switch, six RYG LED indicators, four flasher LED indicators, one power LED indicator and two Rx/Tx LED indicators.

The HDSP-FU can function as either a switch pack (HDSP) or as a flasher unit (HDFU). When installed in the Output Assembly, the High-Density Switch Pack (HDSP) shall provide two RYG channels of operation (6 outputs).

When installed in the Service Assembly, the High-Density Flasher Unit (HDFU) shall function as a four output flasher.

1.2 Model 2212-HV Cabinet Monitor Unit (CMUip)

The Cabinet Monitor Unit (CMUip) shall be compact, pluggable and modular. The CMUip shall use real-time standardized 614.4 Kbs SDLC communications with the ATC to transfer command and response data on Serial Bus #1 (SB1). The CMUip shall be capable of monitoring up to 32 physical switch pack channels (RYG) and shall have optional four virtual channels. The CMUip shall provide a Flasher Alarm feature. The CMUip shall analyze the ATC output commands and field input status to isolate the failure source by channel and color. The CMUip configuration programming shall be provided by an interchangeable Datakey nonvolatile memory device. This rugged key shall store all CMUip configuration parameters and shall eliminate programming using jumpers, diodes, or DIP switches. The CMUip shall maintain a nonvolatile event log recording the complete intersection status as well as time stamped previous fault events, AC Line events, configuration changes, monitor resets, cabinet temperature and true RMS voltages and currents for all field inputs. The signal sequence history log stored in nonvolatile memory graphically shall display up to 30 seconds of signal status prior to the fault trigger event with 50 ms resolution to ease diagnosing of intermittent and transient faults.

1.3 Model 2218 Serial Interface Unit (SIU)

The Model 2218 Serial Interface Unit (SIU) shall be a compact, pluggable and modular. The SIU shall use real-time standardized 614.4 Kbs SDLC communications with the ATC to transfer command and response data on Serial Bus #1 (SB1). The SIU shall be

equipped with 54 programmable input/out pins, four optically isolated input pins, one line sync reference input pin and 4 address select input pins. The optically isolated inputs shall work with either 12 Vac or 24 Vdc.

The SIU outputs shall be rated at 150 mA continuous sink current. Each output shall provide a 500 mA typical current limit and shall be rated to 50 V and utilize a voltage clamp for inductive transient protection. The SIU shall be equipped with a front panel LED indicator that can report the current SIU assembly address assignment of the SIU for cabinet configuration verification.

1.4 Model 2220 Auxiliary Display Unit (ADU)

The ADU shall install in a 1U height 19" rack space and shall provide a menu driven user interface to the enhanced features of the CMUip monitor including the built-in Diagnostic Wizard. The ADU shall provide 32 channels of Red, Yellow and Green LED indicators that display full intersection status and 32 Blue fault status LED indicators shall identify faulty channels. The ADU shall provide proper electrical termination to SB3. The ADU shall have a 4 line by 20 character menu driven liquid crystal display with backlight and heater. The ADU built-in Diagnostic Wizard shall automatically pinpoint faulty signals and offers trouble-shooting guidance and automatically isolate and identify problems. The ADU shall be equipped with Event Logging displaying the CMUip time-stamped nonvolatile event log records with the complete intersection status as well as AC Line events, monitor resets, temperature and true RMS voltages and currents.

1.5 Model 2216-24 Cabinet Power Supply (CPS)

The CPS shall install in a 1U height 19" rack space. The CPS shall be rated at 168 Watts, 48 Vdc @ 1 Amp and 24 Vdc @ 5 Amp. The CPS shall have power factor corrected features and shall ensure a full load power factor of 0.98 or better, reducing peak AC Line input current and associated stress on wiring. The CPS shall use modern switching technology and shall provide full output regulation across changes in AC Line voltage and output load over the full operating temperature range of -34C to +74C without the need for a fan. The CPS shall have separate green LED indicators that display AC input status, DC output status and associated fuse integrity. The CPS outputs shall be fused for over-current protection and shall be protected against voltage transients by a 1500 Watt suppressor.

1.6 MonitorKey Programming Tool

The Programming Tool provides the capability to Read and Write data from the CMUip Datakey device. The MonitorKey software shall be compatible with the CMUip-2212.

1.7 Model 21H High-Density Flash Transfer Relay (HDFTR)

The HDFTR shall have a hermetically sealed cover and shall be moisture proof. The HDFTR shall be filled with dry nitrogen to protect contacts from corrosion and to prevent condensation. The HDFTR shall have a shock/impact resistant metal can cover with solid and bend proof pins. The HDFTR contacts shall be rated at 120 Vac @ 5 Amp. The coil of the HDFTR shall be rated at 48 Vdc. The HDFTR shall have an LED indicator to display contact transfer position.

1.8 Main Contactor (MC)

The MC shall be mercury free and shall be rated at 120 Vac @ 60 Amp. The coil of the MC shall be rated at 48 Vdc. The MC shall be equipped with input indicator and shall have SPST- N.O. contacts.

1.9 Cabinet Suppressor-Filter

The cabinet shall be equipped with a Cabinet Suppressor–Filter. The unit shall incorporate the use of warning and failure indicators and shall have a dry relay contact remote sensing circuit. The unit shall be modular and pluggable with a 12-position Beau 5412 connector. The unit shall be rated at continuous service current of 15 Amp and maximum clamp voltage of 390 Vac. The unit shall filter noise and spike from 10 KHz to 25 MHz and shall have a peak surge current of 48 KA.

1.10 HDSP Suppressor

The HDSP Suppressor shall be modular and pluggable. The unit shall be epoxy encapsulated and equipped with 9-position 5.08 mm Phoenix Contact connector or approved equal. The unit shall be able to protect 6 circuits. The device operating voltage shall be 120 Vac and clamping voltage shall be 340 Vac. The unit dimensions shall be 2" H x 0.7" W x 2" D.

1.11 Detection Module Suppressor

The Detection Module Suppressor shall be modular and pluggable. The unit shall be epoxy encapsulated and equipped with 6-position 5.08 mm Phoenix Contact or approved equal connector. The unit shall be able to protect 6 circuits. The device operating voltage shall be 75 Vac and clamping voltage shall be 130 Vdc. The device dimensions shall be 2" H x 0.7" W x 1.2" D.

Section 2

Model 352i ATC Cabinet General Requirements

2.1 General Requirements

The cabinet shall adhere to the following requirements:

- The assemblies shall be completely removable from or installable in the cabinet without removing any other equipment and using only a standard slotted or Phillips screwdriver.
- The cabinet shall be capable of Cabinet Flash signal operation in the absence of any of the following assemblies: Input Assembly, Output Assembly, Cabinet Power Supply, and Controller.
- A momentary push button shall be provided that, when pressed, energizes the 24 Vdc to the HDSPs during Flash Mode. The button shall be labeled “24 VDC BYPASS” and shall be located on the front of the Output Assembly.
- High-voltage components (over 50 V) shall be protected from incidental contact per NEC.
- All fuses, circuit breakers, switches (except police panel switches) and indicators shall be readily visible and accessible from the area accessed by opening the front door.
- All circuit breakers located on the rack shall have covers to prevent accidental tripping.
- All Assemblies shall be modular with pluggable cabling.
- The ventilation fans shall be fastened to the cabinet via two thumb screws and shall not be fastened in a manner that requires any tools for removal or installation.
- Door switches shall be powered by 48 Vdc.
- Wire raceway shall be integrated as part of the cabinet allowing for neat internal and field wiring.
- All equipment in the cabinet shall be clearly and permanently labeled.
- The marker strips shall be made of material that can be easily and legibly written on using a pencil or ballpoint pen. Marker strips shall be located immediately below the item they are to identify and must be clearly visible with the items installed.
- Guides (top and bottom) shall be provided for assembly plug-in units. The guides shall begin 0.50 inch from the assembly front panel face.

Section 3

Model 352i ATC Cabinet Specification

3.1 General

This specification describes the 120 Vac High Voltage (HV) Model 352i Advanced Transportation Controller (ATC) Cabinet (“the cabinet”) for City of Fort Worth. The ATC Cabinet family is a modular, serially-interconnected cabinet architecture that is designed to fulfill a variety of transportation applications.

The cabinet shall include: Service Assembly (SA), Input Assembly (IA), Output Assembly (OA), SB1/SB2 and DC/Clean Power Bus, Field Input Termination Assembly (FITA), and Field Output Termination Assembly (FOTA).

3.2 Cabinet Housing

The housings shall include, but not be limited to, the following:

- Enclosure
- Doors
- Gasketing
- Lifting Eyes & External Bolt Heads
- Latches & Locks
- Ventilation
- Hinges and Door Catches
- Police Panel
- Cage Supports and Mounting

3.2.1 Housing Construction

The housing shall be rainproof. It shall have front and rear doors, each equipped with a lock and handle. The enclosure top shall be crowned to prevent standing water. The cabinet shall be: 67” H x 24” W x 30” D (rounded to the nearest inch).

3.2.2 Material Thickness

The enclosure, doors, lifting eyes, gasket channels, police panel door, spacer supports and all supports welded to the enclosure and doors shall be fabricated of 0.125 inch minimum thickness aluminum sheet. The filter shell, filter trough, fan support and police panel enclosure shall be fabricated of 0.080 inch minimum thickness aluminum sheet. The spacer supports shall have the option to use 0.059 inch minimum stainless steel sheet.

3.2.3 Welds

All exterior seams for enclosure and doors shall be continuously welded and shall be smooth. All edges shall be filled to a radius of 0.03125 inch minimum. Exterior cabinet

welds shall be done by gas Tungsten arc TIG process only. ER5356 aluminum alloy bare welding electrodes conforming to AWS A5.10 requirements shall be used for welding on aluminum. Procedures, welders and welding operators shall conform to the requirements and practices in AWS B3.0 and C5.6 for aluminum. Internal cabinet welds shall be done by gas metal arc MIG or gas Tungsten arc TIG process.

3.2.4 Aluminum Surface Protection

The aluminum surface protection shall be Natural Finish.

3.2.4.1 Anti-Graffiti Paint

If Anti-Graffiti Paint is requested, each stage in the process shall be as follows:

- Perform treatment with a moderately acidic, liquid cleaner concentrate for thorough cleaning.
- Clean water rinse from reverse osmosis system (< 2500 PPM).
- Clean water rinse from reverse osmosis system (< 500 PPM).
- Apply a conversion coating to form an excellent base for bonding powder to parts and producing good resistance to corrosion.
- Clean water rinse from reverse osmosis system (< 800 PPM).
- Clean water rinse from reverse osmosis system to decrease any solids on surfaces (< 100 PPM).
- Final seal rinse to enhance corrosion resistance.
- Convey through a dry-off oven at a cycle of 10 to 20 minutes at 380° F. This eliminates any trapped water and gases in the parts.
- Apply polyester dry powder at 90,000 volts for maximum mil transfer. Thickness of the powder coating shall nominally be 2 to 5 mils.
- Convey into the cure oven for a thermal setting [cure] cycle of 10 to 20 minutes at 380 - 425° F.

The City, at its option, may require the winning the Vendor to submit written certification of compliance to the requirements listed in this section of the specification.

3.2.5. Enclosure Door Frames and Door Seals

The enclosure door frames shall be double-flanged out on all four sides and shall have strikers to hold tension on, and to form a firm seal between, the door gasketing and the frame. The dimension between the door edge and the enclosure external surface when the door is closed and locked shall be 0.156 inch (+/-0.08 inches).

3.2.6 Gasketing

Gasketing shall be provided on all door openings and shall be dust-tight. Gaskets shall be 0.25 inches minimum thickness closed cell neoprene or silicone (BOYD R- 108480 or approved equal) and shall be permanently bonded to the metal. A gasket top and

side channels shall be provided to support the top gasket on the door to prevent gasket gravitational fatigue.

3.2.7 Lifting Eyes and Exterior Bolt Heads

The housing shall be provided with 2 lifting eyes for placing the cabinet on its foundation. Each eye opening shall have a minimum diameter of 0.75 inch. Each eye shall be able to support the weight load of 1000 lbs. All bolt heads shall be tamperproof type.

3.2.8 Door Latches & Locks

3.2.8.1 Latching Handles

The latching handles shall have provision for padlocking in the closed position. Each handle shall be 0.75 in minimum diameter stainless steel with a minimum 0.5 in shank. The padlocking attachment shall be placed at 4.0 in from the handle shank center to clear the lock and key. An additional 4.0 in minimum gripping length shall be provided.

3.2.8.2 Latching Mechanism

The latching mechanism shall be a three-point draw roller type. The pushrods shall be turned edgewise at the outward supports and have a cross section of 0.25 in thick by 0.75 in wide, minimum.

3.2.8.3 Locks and Handles

When the door is closed and latched, the door shall be locked. The locks and handles shall be on the right side of the front door and left side of the rear door. The lock and lock support shall be rigidly mounted on the door. In the locked position, the bolt throw shall extend a minimum of 0.25 ± 0.03125 in into the latch Cam area. A seal shall be provided to prevent dust or water entry through the lock opening.

3.2.8.4 Locks

The locks shall be Corbin 2 type, or approved equal. One key shall be supplied with each lock. The keys shall be removable in the locked position only.

3.2.8.5 Bolts

The locks shall have rectangular, spring-loaded bolts. The bolts shall have a 0.281 in throw and shall be 0.75 in wide by 0.75 in thick (tolerance is ± 0.035 in).

3.2.8.6 Center Latch Cam

The center latch cam shall be fabricated of a minimum thickness 0.1875 in steel or aluminum. The bolt surface shall horizontally cover the cam thickness. The cam shall be

structured to only allow the door to open when the handle is moved toward the center of the door.

3.2.8.7 Rollers

Rollers shall have a minimum diameter of 0.875 in with nylon wheels and steel ball bearings.

3.2.9 Hinges

Stainless steel hinges (two bolts per leaf) shall be provided to bolt the enclosure to the doors.

Each door shall have four hinges per door. Each hinge shall be 3.5 inch minimum length and have a fixed pin. The pin ends shall be welded to hinge and ground smooth. The pins and bolts shall be covered by the door edge and not accessible when the door is closed. A ground strap between the door and the main cabinet housing shall be required when 120 Vac devices are mounted on the door.

3.2.10 Door Catches

Front and rear doors shall be provided with catches to hold the door open at both 90 and 165 (+/-10) Degrees. The catch minimum diameter shall be 0.375 inch aluminum rods. The catches must be capable of holding the door open at 90 degrees in a 60 mph wind acting at an angle perpendicular to the plane of the door.

3.2.11 Police Panel

A police panel assembly shall be provided to allow limited control access. The panel door shall be equipped with a lock and master police key. The front and back of the panel shall be enclosed with a rigid metal covering so that no parts having live voltage are exposed. The panel assembly shall have a drain to prevent water from collecting within the assembly. The drain shall be channeled to the outside. The cabinet shall have one switch provided and labeled "SIGNALS ON / OFF" and one switch provided and labeled "FLASH / AUTO". The MANUAL CONTROL ENABLE ON / OFF switch and a receptacle for the INTERVAL ADVANCE cord shall be provided. An INTERVAL ADVANCE cord, six feet in length, shall be provided.

3.2.12 Rack Cage

A standard rack cage shall be installed inside the housing for mounting of the ATC and cabinet assemblies. The EIA rack portion of the cage shall consist of four continuous, adjustable equipment mounting angles. The mounting angle nominal thickness shall be 11- gauge plated steel. The mounting angles shall be tapped with 10-32 threads with EIA universal spacing. The mounting angle shall comply with standard EIA-310-B and shall be supported at the top and bottom by either welded or bolted support angles to form a cage. The mounting angles shall provide holes to mount the side panels.

3.2.12.1 Cage Connection

The cage shall be bolted to the cabinet at four points via the housing cage supports and four points via associated spacer brackets (top and bottom).

3.2.12.2 Cage Location

The cage shall be centered within the cabinet door opening(s).

3.2.12.3 Cage Mounting Supports

Cage mounting supports shall be provided on either side, level with the bottom edge of the door opening, for horizontal support and bolt attachment; side cage supports provided for the bracket cage supports; and bracket cage support attachments.

3.2.12.4 Clearance between Rails

Clearance between rails for mounting assemblies shall be 17.75 inch.

3.2.13 Housing Ventilation

Housing ventilation shall include intake, exhaust, filtration, fans and thermostat.

3.2.13.1 Intake & Filter

The louvered vent depth shall be a maximum of 0.25 inch. A removable and reusable air filter shall be housed behind the door vents. The filter filtration shall cover the vent opening area. A filter shell shall be provided that fits over the filter providing mechanical support for the filter. The shell shall be louvered to direct the incoming air downward. The shell sides and top shall be bent over a minimum of 0.25 inch to house the filter. The filter resident in its shell shall be held firmly in place with a bottom trough and spring loaded upper clamp. No incoming air shall bypass the filter. The bottom filter shall be formed into a waterproof sump with drain holes to the outside housing. The filter shall be 16 inch wide by 12 inch high by 0.875 inch thick. The filter shall be an ECO-AIR Product E35S or approved equal.

3.2.13.2 Fans

Each electric fan shall be equipped with ball or roller bearings and shall have a minimum capacity of 100 cubic feet of free air delivery per minute. Two fans shall be mounted within the housing and protected with a finger guard. A Fan Test switch shall be provided.

3.2.13.3 Temperature Controlling

The fans shall be thermostatically controlled and shall be manually adjustable to turn on between 32 Fahrenheit and 140 Fahrenheit with a differential of not more than 20 Fahrenheit between automatic turn on and off. The fan circuit shall be protected at 125% of the fan motor ampacity. The manual adjustment shall be graded in 20

Fahrenheit increment scale. The Thermostat shall be an Omega KT01101141900 or approved equal.

3.2.14 Cabinet Lights

The cabinet shall be equipped with two LED lights activated by door switches and equipped with fuses.

3.3 Model 352i ATC Cabinet Assemblies

3.3.1 Output Assembly (16-Channel)

The Output Assembly shall be a 3U high rack mounted assembly. The Output Assembly shall accommodate eight Model 2202-HV High-Density Switch Pack / Flasher Units (HDSP/FU), providing 48 output circuits.

The Output Assembly shall accommodate one Model 2218 Serial Interface Unit (SIU) to provide interface and control via system SB1/SB2.

The Output Assembly shall accommodate one Model 2212-HV Cabinet Monitor Unit (CMUip), Main Contactor, Stop Time Switch, Flash / Auto Switch, four Circuit Breakers and Momentary 24 Vdc Bypass Switch.

3.3.2 Output Assembly (32-Channel)

The Output Assembly shall be a 6U high rack mounted assembly. The Output Assembly shall house sixteen Model 2202-HV High-Density Switch Pack / Flasher Units (HDSP/FU) and shall provide ninety six output circuits.

The Output Assembly shall accommodate two Model 2218 Serial Interface Units (SIU) to provide interface and control via system SB1/SB2.

The Output Assembly shall house one model 2212-HV Cabinet Monitor Unit (CMUip), the Main Contactor, Stop Time Switch, Flash / Auto Switch, eight Circuit Breakers and Momentary 24 Vdc Bypass Switch.

3.3.3 Field Output Termination Assembly (16-Channel)

The 16-Channel Field Output Termination Assembly shall be coupled with the 16-Channel Output Assembly and shall house eight Model 21H High-Density Flash Transfer Relays (HDFTR). The HDFTRs and Flash Program Blocks (FPB) shall be provided to control and select the color (red, yellow, or dark) during ATC Cabinet flash mode. HDSP Suppressors shall be provided at the field terminals for the protection of the HDSP. Each HDFTR position shall be labeled with the number of its associated HDSP (1-16). Each FPB position shall be labeled with the number of its associated channel (1-16).

The Field Output Termination Assembly shall be provided with 16, 6-position Phoenix Contact terminal block model number 18-04-94-6 plugs and 18-61-19-6 sockets or approved equal. Each Load Terminal Block receptacle shall be labeled with the number

of its associated channel (1-16). Additional labels shall be provided to clearly indicate which terminals correspond to the red, yellow, and green switch pack outputs. The color of these labels shall match the color of their associated output (red, yellow, or green). One Field Output Termination Assembly shall be provided with each 16 channel cabinet, while two Field Output Termination Assemblies shall be provided with each 32 Channel Output Assembly.

The 16-Channel Field Output Termination Assembly shall be mounted across the EIA rails and it shall swing down to provide access to the HDSP Suppressors.

3.3.4 Input Assembly (24-Channel)

The Input Assembly shall be a 3U high rack mounted assembly providing twelve slots of 22/44 pin PCB sockets. One Model 2218 Serial Interface Unit (SIU) shall be provided and mated to a DIN 96-pin connector. The SIU shall provide interface and control between the Controller and the input devices via system SB1/SB2. The Input Assembly shall house either 2-channel or 4-channel detection modules. The Input Assembly shall house twelve 2-channel detection modules, or six 4-channel detection modules, or a combination of 2 & 4 channel detection modules up to 24 channels. The Input Assembly shall be equipped with an Opto Input Card. The Opto Input Card shall be equipped with four LED indicators and four toggle switches. Activation of the switch 1-4 shall place a call into SIU Opto 1-4 input respectively.

3.3.5 Input Assembly (48-Channel)

The Input Assembly shall be a 3U high rack mounted assembly providing twelve slots of 22/44 pin PCB sockets. Two Model 2218 Serial Interface Units (SIU) shall be provided and mated to two DIN 96-pin connectors. The SIU shall provide interface and control between the Controller and the detection modules via system SB1/SB2. The Input Assembly shall house either a 2-channel or a 4-channel half width device, up to twelve detection modules providing a maximum of 48 channels.

3.3.6 Field Input Termination Assembly (24-Channel)

The 24-Channel Field Input Termination Assembly shall be coupled with the 24-Channel Input Assembly and shall have positions for landing 24, two-wire inputs and their associated earth ground wires. The Field Input Termination Assembly shall have positions for 12 Detection Module Suppressors. The Detection Module Suppressors shall be supplied with the cabinet if procurement requires. The 24-Channel Field Input Termination Assembly shall be mounted across the EIA rails and it shall swing down to provide access to the back of the assemblies mounted in the opposite side. Two 24-Channel Field Input Termination Assembly shall be coupled with the 48-Channel Input Assembly.

3.3.7 Service Assembly (1-HDFU)

The Service Assembly shall be modular and shall be mounted on the left of the EIA rail when viewed from the front. It shall house: one Model 2202-HV High-Density Switch Pack / Flasher Units (HDSP/FU), Cabinet Suppressor–Filter, BBS landing wire terminals, GFCI, one convenience outlet NEMA 15-5 format, four HDFU output fuses, five Circuit Breakers and a Raw AC+ terminal block having 5 screw terminals.

3.3.8 Service Assembly (2-HDFU)

The Service Assembly shall be modular and shall be mounted on the left of the EIA rail when viewed from the front. It shall house: two Model 2202-HV High-Density Switch Pack / Flasher Units (HDSP/FU), Cabinet Suppressor–Filter, BBS landing wire terminals, GFCI, one convenience outlet NEMA 15-5 format, eight HDFU output fuses, six Circuit Breakers and a Raw AC+ terminal block having 5 screw terminals.

3.3.9 SB1/SB2 and DC/Clean Power Bus

SB1/SB2 and DC/Clean Power Bus shall include eight DB25 d-submodular socket connectors to interconnect the SB1/SB2 communication ports of the assemblies and Controller. It shall include a termination circuit at the end of the connections (S8) to prevent radio frequency signal reflection. It shall include one Phoenix Contact plug block or approved equal to bring the DC power to the Bus; such power shall be distributed to the ATC Cabinet Assemblies through seven Phoenix Contact receptacle blocks or approved equal. The copper traces for the DC voltages shall support at least 10 Amp. The AC Clean Power Bus shall also include eight NEMA 5-15 receptacles, to provide AC Clean Power to the ATC Cabinet Assemblies, the Controller and Cabinet Power Supply.

SB1/SB2 and DC/Clean Power Bus shall be mounted across the EIA rails and it shall swing down to provide access to the back of the assemblies mounted in the opposite side.

3.3.10 Drawer Shelf Unit

A telescopic slide out drawer to storage document shall be provided. The Drawer Shelf Unit shall be mounted across the EIA rails and shall have a non-conductive top, locking provision when fully extended and lip or handle for pulling.

3.4. Components Requirements

3.4.1 Service Assembly Components Requirements

- Service Assembly (1-HDFU)
 - (1 each) Model 2202-HV HDFU
 - (1 each) Cabinet Suppressor–Filter
- Service Assembly (2-HDFU)
 - (2 each) Model 2202-HV HDFU
 - (1 each) Cabinet Suppressor–Filter

3.4.2 Output Assembly Components Requirements

- Output Assembly (16-Channel)
 - (TBD*) Model 2202-HV HDSP
 - (1 each) Model 2218 SIU
 - (1 each) Model 2212-HV CMUip
- Output Assembly (32-Channel)
 - (TBD*) Model 2202-HV HDSP
 - (2 each) Model 2218 SIU
 - (1 each) Model 2212-HV CMUip

3.4.3 Field Output Termination Assembly Components Requirements

- Field Output Termination Assembly (16-Channel)
 - (8 each) Model 21H HDFTR
 - (8 each) HDSP Suppressor
 - (16 each) Red Flash Program Block
 - (4 each) Yellow Flash Program Block
 - (4 each) White Flash Program Block

3.4.4 Input Assembly Components Requirements

- Input Assembly (24-Channel)
 - (1 each) Model 2218 SIU
 - (TBD*) Detection Module
 - (TBD*) Isolation Module (242L)
- Input Assembly (48-Channel)
 - (2 each) Model 2218 SIU
 - (TBD*) Detection Module
 - (TBD*) Isolation Module (244L)

3.4.5 Field Input Termination Assembly Components Requirements

- Field Input Termination Assembly Components Requirements
 - (12 each) Detection Module Suppressor

3.4.6 Cabinet Components Requirements

- (1 each) Model 2220 ADU
- (1 each) Model 2216-24 CPS

* Quantity per each procurement requirement

3.5 Model 352i ATC Cabinet Configuration Example

The ATC Cabinet shall consist of Assemblies and Components needed to carry out a specific application. ATC Cabinet version provided here is an EXAMPLE of many possible configurations.

Item #	Modules / Assemblies	Quantity
1	352i Housing / 352i Cage / (2) 352i Side Panels	1
2a	Service Assembly (1 - HDFU)	1
2b	Service Assembly (2 - HDFU)	1
3a	Output Assembly (16 - Channel)	1
	Field Output Termination Assembly (16 - Channel)	1
3b	Output Assembly (32 - Channel)	1
	Field Output Termination Assembly (16 - Channel)	2
4a	Input Assembly (24 - Channel)	1-3
	Field Input Termination Assembly (24 - Channel)	1-3
4b	Input Assembly (48 - Channel)	1
	Field Input Termination Assembly (24 - Channel)	2
5	SB1/SB2 and DC/Clean Power Bus	1
6	Model 2216-24 Cabinet Power Supply	1
7	CMU Auxiliary Display Unit	1
8	LED - Cabinet Light Assembly	2
9	Drawer Shelf Unit	1

Model 352i ATC Cabinet Configuration Example

3.6 Model 352i ATC Cabinet Configuration for City of Fort Worth

The ATC Cabinet shall consist of following Assemblies and Components.

(9 each) Model 2202-HV (HDSP-FU) or approved equal

(2 each) Model 2218 SIU or approved equal

(1 each) Model 2212-HV CMUip or approved equal

(8 each) Model 21H HDFTR or approved equal

(1 each) Model 2220 ADU or approved equal

(1 each) Model 2216-24 CPS or approved equal

(16 each) Red Flash Program Block

(4 each) Yellow Flash Program Block

(4 each) White Flash Program Block

(1 each) Cabinet Suppressor–Filter

(12 each) Detection Module Suppressor

(8 each) HDSP Suppressor

Item #	Modules / Assemblies	Quantity
1	352i Housing / 352i Cage / (2) 352i Side Panels	1
2a	Service Assembly (1 - HDFU)	1
3a	Output Assembly (16 - Channel)	1
	Field Output Termination Assembly (16 - Channel)	1
4a	Input Assembly (24 - Channel)	1
	Field Input Termination Assembly (24 - Channel)	1
5	SB1/SB2 and DC/Clean Power Bus	1
6	Model 2216-24 Cabinet Power Supply	1
7	CMU Auxiliary Display Unit	1
8	LED - Cabinet Light Assembly	2
9	Drawer Shelf Unit	1

Model 352i ATC Cabinet Configuration for City of Fort Worth

3.7 Model 352i ATC Cabinet I/O Assignments

ATC Cabinet 16-Channel (Ch) Output Assembly								
Controller Phase/Overlap/Pedestrian Assignments								
Ch1/2	Ch3/4	Ch5/6	Ch7/8	Ch9/10	Ch11/12	Ch13/14	Ch15/16	SIU 1
HDSP1	HDSP2	HDSP3	HDSP4	HDSP5	HDSP6	HDSP7	HDSP8	
R	R	R	R	R	R	R	R	
Y	Y	Y	Y	Y	Y	Y	Y	
G	G	G	G	G	G	G	G	
R	R	R	R	R	R	R	R	
Y	Y	Y	Y	Y	Y	Y	Y	
G	G	G	G	G	G	G	G	

CMU Channel (Ch) Assignments								
HDSP1	HDSP2	HDSP3	HDSP4	HDSP5	HDSP6	HDSP7	HDSP8	SIU 1
Ch-1	Ch-3	Ch-5	Ch-7	Ch-9	Ch-11	Ch-13	Ch-15	
Ch-1	Ch-3	Ch-5	Ch-7	Ch-9	Ch-11	Ch-13	Ch-15	
Ch-1	Ch-3	Ch-5	Ch-7	Ch-9	Ch-11	Ch-13	Ch-15	
Ch-2	Ch-4	Ch-6	Ch-8	Ch-10	Ch-12	Ch-14	Ch-16	
Ch-2	Ch-4	Ch-6	Ch-8	Ch-10	Ch-12	Ch-14	Ch-16	
Ch-2	Ch-4	Ch-6	Ch-8	Ch-10	Ch-12	Ch-14	Ch-16	

SIU Output (IO) Assignments								
HDSP1	HDSP2	HDSP3	HDSP4	HDSP5	HDSP6	HDSP7	HDSP8	SIU 1
IO 0	IO 6	IO 12	IO 18	IO 24	IO 30	IO 36	IO 42	
IO 1	IO 7	IO 13	IO 19	IO 25	IO 31	IO 37	IO 43	
IO 2	IO 8	IO 14	IO 20	IO 26	IO 32	IO 38	IO 44	
IO 3	IO 9	IO 15	IO 21	IO 27	IO 33	IO 39	IO 47	
IO 4	IO 10	IO 16	IO 22	IO 28	IO 34	IO 40	IO 48	
IO 5	IO 11	IO 17	IO 23	IO 29	IO 35	IO 41	IO 49	

HDSP Addresses								
HDSP1	HDSP2	HDSP3	HDSP4	HDSP5	HDSP6	HDSP7	HDSP8	SIU 1
0 (00000)	1 (00001)	2 (00010)	3 (00011)	4 (00100)	5 (000101)	6 (00110)	7 (00111)	

Model 352i ATC Cabinet I/O Assignments (Output Assembly)

ATC Cabinet 24-Channel Input Assembly #1 (7/15/2016)												
SIU Input (IO) Assignments												
2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	SIU 9
IO 6	IO 8	IO 10	IO 12	IO 14	IO 16	IO 18	IO 20	IO 22	IO 24	IO 26	IO 28	
IO 7	IO 9	IO 11	IO 13	IO 15	IO 17	IO 19	IO 21	IO 23	IO 25	IO 27	IO 29	
	*IO 6	*IO 8	*IO 10	*IO 12	*IO 14	*IO 16	*IO 18	*IO 20	*IO 22	*IO 24	*IO 26	
	*IO 7	*IO 9	*IO 11	*IO 13	*IO 15	*IO 17	*IO 19	*IO 21	*IO 23	*IO 25	*IO 27	
SIU Input (Ch) Assignments												
2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	SIU 9
Ch-1	Ch-3	Ch-5	Ch-7	Ch-9	Ch-11	Ch-13	Ch-15	Ch-17	Ch-19	Ch-21	Ch-23	
Ch-2	Ch-4	Ch-6	Ch-8	Ch-10	Ch-12	Ch-14	Ch-16	Ch-18	Ch-20	Ch-22	Ch-24	
	*Ch-1	*Ch-3	*Ch-5	*Ch-7	*Ch-9	*Ch-11	*Ch-13	*Ch-15	*Ch-17	*Ch-19	*Ch-21	
	*Ch-2	*Ch-4	*Ch-6	*Ch-8	*Ch-10	*Ch-12	*Ch-14	*Ch-16	*Ch-18	*Ch-20	*Ch-22	

* If 4-ch device being used

ATC Cabinet 24-Channel Input Assembly #2												
SIU Input (IO) Assignments												
2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	SIU 10
IO 6	IO 8	IO 10	IO 12	IO 14	IO 16	IO 18	IO 20	IO 22	IO 24	IO 26	IO 28	
IO 7	IO 9	IO 11	IO 13	IO 15	IO 17	IO 19	IO 21	IO 23	IO 25	IO 27	IO 29	
	*IO 6	*IO 8	*IO 10	*IO 12	*IO 14	*IO 16	*IO 18	*IO 20	*IO 22	*IO 24	*IO 26	
	*IO 7	*IO 9	*IO 11	*IO 13	*IO 15	*IO 17	*IO 19	*IO 21	*IO 23	*IO 25	*IO 27	
SIU Input (Ch) Assignments												
2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	2-Ch Card	SIU 10
Ch-1	Ch-3	Ch-5	Ch-7	Ch-9	Ch-11	Ch-13	Ch-15	Ch-17	Ch-19	Ch-21	Ch-23	
Ch-2	Ch-4	Ch-6	Ch-8	Ch-10	Ch-12	Ch-14	Ch-16	Ch-18	Ch-20	Ch-22	Ch-24	
	*Ch-1	*Ch-3	*Ch-5	*Ch-7	*Ch-9	*Ch-11	*Ch-13	*Ch-15	*Ch-17	*Ch-19	*Ch-21	
	*Ch-2	*Ch-4	*Ch-6	*Ch-8	*Ch-10	*Ch-12	*Ch-14	*Ch-16	*Ch-18	*Ch-20	*Ch-22	

Model 352i ATC Cabinet I/O Assignments (Input Assembly)

Section 4

ATC Cabinet Electrical, Environmental and Testing Requirements

4.1 General

The requirements called out in this specification dealing with equipment evaluation are a minimum guide and shall not limit the testing and inspection to ensure compliance.

4.2 Certification

These test procedures shall be followed by the manufacturers who shall certify that they have conducted inspection and testing in accordance with this specification.

4.3 Inspection

A visual and physical inspection shall include mechanical, dimensional and assembly conformance of all parts of this specification.

4.4 Environmental and Electrical

All components shall properly operate within the following limits unless otherwise noted:

- Applied Line Voltage: 90 to 135 Vac
- Frequency: 60 (+/-3.0) Hertz
- Humidity: 5% to 95%
- Ambient Temperature: -34.6 °F to +165.2 °F
- Shock - Test per Specification MIL-STD-810G Method 516.6
- Vibration - per Specification MIL-STD-810G Method 514.6

4.5 Commencement Operation

All circuits, unless otherwise noted, shall commence operation at or below 90 Vac as the applied voltage is raised from 50 to 90 Vac at a rate of 2 (+/-0.5) volts / second.

4.6 Equipment Compliance

All equipment shall be unaffected by transient voltages normally experienced on commercial power lines. Where applicable, equipment purchased separately from the cabinet (which normally is resident) will be tested for compliance.

4.7 Power Line Surge Protection

The power line surge protection shall enable the equipment being tested to withstand (Non-destructive) and operate normally following the discharge of a 25 μ F capacitor charged to $\pm 2,000$ volts, applied directly across the incoming AC line at a rate of once every 10 seconds for a maximum of 50 occurrences per test. The unit under test will be operated at 68 °F $\pm$ 41 °F and at 120 ($\pm$ 12) Vac.

4.8 Operating

The equipment shall withstand (Non-destructive) and operate normally when one discharge pulse of plus or minus 300 volts is synchronously added to its incoming AC power line and moved uniformly over the full wave across 360 degrees or stay at any point of Line Cycle once every second. Peak noise power shall be 5 kilowatts with a

pulse rise time of 500 ns. The unit under test will be operated at 68 °F ±41 °F and at 120 (+/-12) Vac.

4.9 UL Requirements

Equipment shall comply only with the requirements of UL Bulletin of Research No. 23, "Rain Tests of Electrical Equipment."

4.10 Normal Operation

All equipment shall continue normal operation when subjected to the following:

4.10.1 Low Temperature Test

With the item functioning at a line voltage over Electrical Range the Device in its intended operation, the ambient temperature shall be lowered from 68 °F to 34.6 °F at a rate of not more than 64.4 °F per hour. The item shall be cycled at -34.6 °F for a minimum of 5 hours and then returned to 68 °F at the same rate.

4.10.2 High Temperature Test

With the item functioning at a line voltage over Electrical Range the Device in its intended operation, the ambient temperature shall be raised from 68 °F to 165.2 °F at a rate of not more than 64.4 °F per hour. The item shall be cycled at 165.2 °F for 5 hours and then returned to 68 °F at the same rate. The test shall be repeated with the line voltage at 135 Vac.

4.10.3 Normal Operation

All equipment shall resume normal operation following a period of at least 5 hours at -34.6 °F and less than 10 percent humidity and at least 5 hours at 165.2 °F and 22% humidity, when 90 Vac is applied to the incoming AC.

4.10.4 Humidity and Ambient Temperature

The relative humidity and ambient temperature values in the following table shall not be exceeded.

Ambient Temperature/ Dry Bulb (in OF)	Relative Humidity (in percent)	Ambient Temperature/ Wet Bulb (in OF)
-34.6 to 33.98	10	1.04 to 108.86
33.98 to 114.8	95	108.86
119.84	70	108.86
129.92	50	108.86
140	38	108.86
149.72	28	108.86
160.16	21	108.86
165.2	18	108.86

Ambient Temperature versus Relative Humidity @ Barometric Pressure (29.92 In. Hg.)

4.11 QC / Final Test

A complete QC / final test report shall be supplied with the Model 352i ATC Cabinet. The test report shall indicate the name of the tester and shall be signed by a responsible manager.

4.12 Quality Control Procedure & Test Report

The quality control procedure and test report format shall be supplied to the Engineer or approval within 15 days following the award of the contract. The quality control procedure shall include the following:

- Acceptance testing of all supplied components
- Physical and functional testing of all modules and items
- A minimum 100-hour burn-in of all equipment
- Physical and functional testing of all items

4.13 Cabinet Print

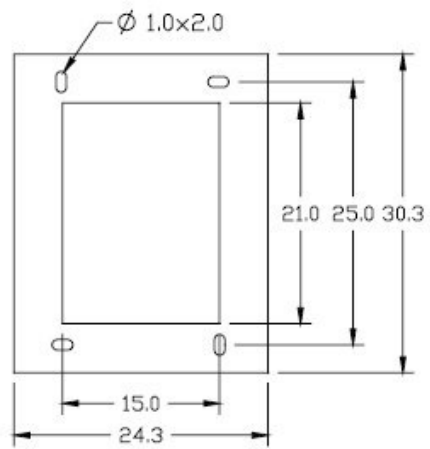
Wiring diagram sheets for the cabinet shall be furnished in a weatherproof plastic pouch placed in the cabinet. Cabinet wiring diagrams shall be on non-fading.

4.14 Manual

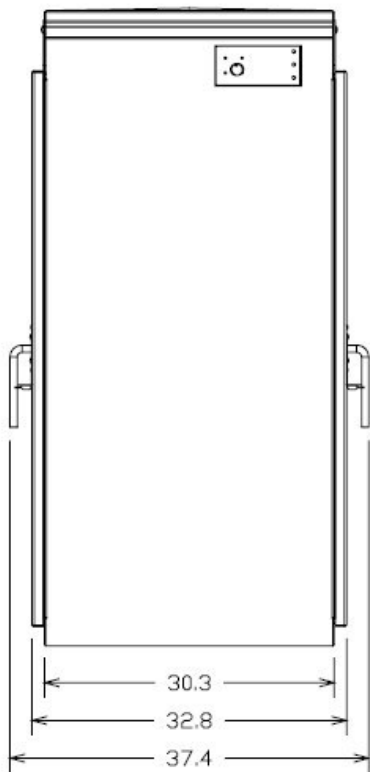
One copy of manual documentation shall be supplied for each item purchased. The manual shall be printed on 8.5 in by 11 in paper, with the exception that schematics, layouts, parts lists and plan details may be on 11 in by 17 in sheets, with each sheet neatly folded to 8.5 in by 11 in size. The manual shall be formatted per the following table:

Section	Description
N/A	Table of Contents
1	Glossary
2	General Description
3	General Characteristics
4	Installation
5	Adjustments
6	Theory of Operation
	6a. Systems Description (include block diagram)
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8	Parts List (include circuit and board designation, part type and class, power rating, component manufacturer, mechanical part manufacturer, data specification sheets for special design components and original manufacturer's part number)
9	Electrical Interconnection Details & Drawings
10	Schematic and Logic Diagram
11	Assembly Drawings and a pictorial diagram showing physical locations and identification of each component or part

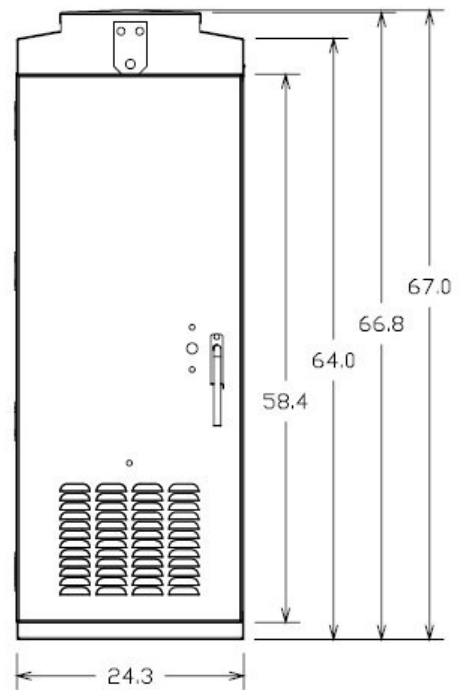
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5.1 - 352i ATC Cabinet Housing Base



5.2 - 352i ATC Cabinet Housing Side View



5.3 - 352i ATC Cabinet Housing Front View

Pin #	Function	Pin #	Function
A1	+24VDC Monitor	B1	Reserved
A2	+12VDC Monitor	B2	External Test Reset
A3	VDC Ground	B3	Serial Bus #1 Disable
A4	Monitor Interlock	B4	Reserved
A5	Address 0	B5	Address 1
A6	Reserved	B6	Reserved
A7	SB1 TxData +	B7	SB1 TxData -
A8	SB1 RxData +	B8	SB1 RxData -
A9	SB1 TxClock +	B9	SB1 TxClock -
A10	SB1 RxClock +	B10	SB1 RxClock -
A11	Reserved	B11	Reserved
A12	Reserved	B12	Reserved
A13	Reserved	B13	Reserved
A14	Reserved	B14	Reserved
A15	Line Sync +	B15	Line Sync -
A16	Nreset +	B16	Nreset -
A17	PowerDown +	B17	PowerDown -
A18	SB3 TxData +	B18	SB3 TxData -
A19	SB3 RxData +	B19	SB3 RxData -
A20	SB3 Clock+	B20	SB3 Clock-
A21	LF Status	B21	LF Status
A22	Output Relay NO	B22	Output Relay NO
A23	CB Trip Status	B23	Reserved
A24	MC Coil Status	B24	Reserved
A25	MC Secondary Status	B25	Reserved
A26	FTR Coil Drive Status	B26	Reserved
A27	Door Switch Front	B27	Reserved
A28	Door Switch Rear	B28	Reserved
A29	Reserved	B29	Reserved
A30	Reserved	B30	MAINS Power
A31	Equipment Ground	B31	Reserved
A32	Reserved	B32	MAINS Ground (Neutral)

5.4 - Model 2212-HV Cabinet Monitor Unit (CMUip) Connector
(DIN 4161264 Header Type)

PIN#	AT THE CONTROLLER	AT THE SIU	PIN#	AT THE CONTROLLER	AT THE SIU
1	SB1 TXD+	SB1 RXD+	14	SB1 TXD-	SB1 RXD-
2	SB1 RXD+	SB1 TXD+	15	SB1 RXD-	SB1 TXD-
3	SB1 TXC+	SB1 RXC+	16	SB1 TXC-	SB1 RXC-
4	SB1 RXC+	SB1 TXC+	17	SB1 RXC-	SB1 TXC-
5	SB2 TXD+	SB2 RXD+	18	SB2 TXD-	SB2 RXD-
6	SB2 RXD+	SB2 TXD+	19	SB2 RXD-	SB2 TXD-
7	SB2 TXC+	SB2 RXC+	20	SB2 TXC-	SB2 RXC-
8	SB2 RXC+	SB2 TXC+	21	SB2 RXC-	SB2 TXC-
9	LINE SYNC+	LINE SYNC+	22	LINE SYNC-	LINE SYNC+
10	NRESET+	NRESET+	23	NRESET-	NRESET-
11	PWR DWN+		24	PWR DWN-	
12	+5VDC ISO		25	EQ GND	
13	ISO GND	DC GND			

5.5 - SB1/SB2 Connector (DB 25)

Pin	Function
1	Reserved
2	Reserved
3	Neutral (AC- Raw)
4	RxDATA +
5	RxDATA -
6	Neutral (AC- Raw)
7	TxDATA +
8	TxDATA -

5.6 - Serial Bus 3 (RJ-45) Connector

<i>Pin</i>	<i>A (Bottom Row)</i>	<i>C (Middle Row)</i>	<i>E (Top Row)</i>
2	Ch 1 Red In	Ch 1 Yellow In	Ch 1 Green In
4	Ch 2 Red In	Ch 2 Yellow In	Ch 2 Green In
6	+24VDC	DC Ground	Address 4
8	Equipment Ground	Neutral	Neutral
10	SB #3 Rx+	SB #3 Tx+	Address Common
12	SB #3 Rx-	SB #3 Tx-	Address 3
14	Address 0	Address 1	Address 2
16	Ch 1 Red Sense	Ch 1 Red Out	Ch 1 Red Out
18	Ch 1 Yellow Sense	Ch 1 Yellow Out	Ch 1 Yellow Out
20	Ch 1 Green Sense	Ch 1 Green Out	Ch 1 Green Out
22	Ch 2 Red Sense	Ch 2 Red Out	Ch 2 Red Out
24	Ch 2 Yellow Sense	Ch 2 Yellow Out	Ch 2 Yellow Out
26	Ch 2 Green Sense	Ch 2 Green Out	Ch 2 Green Out
28	LV+ Signal	LV+ Signal	LV+ Signal
30	HV+ Signal	HV+ Signal	HV+ Signal
32	LV+ MAINS	Neutral	HV+ MAINS

5.7 - Model 2202-HV High-Density Switch Pack (HDSP) Connector
(DIN 41612 Type E series, 48-pin connector)

<i>Pin</i>	<i>A (Bottom Row)</i>	<i>C (Middle Row)</i>	<i>E (Top Row)</i>
2	Reserved	Reserved	Ch 1 Aux In
4	Ch 2 Aux In	Reserved	Reserved
6	+24VDC	DC Ground	Address 4
8	Equipment Ground	Neutral	Neutral
10	SB #3 Rx+	SB #3 Tx+	Address Common
12	SB #3 Rx-	SB #3 Tx-	Address 3
14	Address 0	Address 1	Address 2
16	FL#1-1 Sense	FL#1-1 Out	FL#1-1 Out
18	FL#1-2 Sense	FL#1-2 Out	FL#1-2 Out
20	Ch 1 Aux Sense	Ch 1 Aux Out	Ch 1 Aux Out
22	Ch 2 Aux Sense	Ch 2 Aux Out	Ch 2 Aux Out
24	FL#2-1 Sense	FL#2-1 Out	FL#2-1 Out
26	FL#2-2 Sense	FL#2-2 Out	FL#2-2 Out
28	LV+ Signal	LV+ Signal	LV+ Signal
30	HV+ Signal	HV+ Signal	HV+ Signal
32	LV+ MAINS	Neutral	HV+ MAINS

5.8 - Model 2202-HV High-Density Flasher Unit (HDFU) Connector
(DIN 41612 Type E series, 48-pin connector)

Pin	Description	Pin	Description	Pin	Description
A1	+24 VDC in	B1	+24 VDC in	C1	Input / Output 47
A2	Input / Output 0	B2	Input / Output 1	C2	Input / Output 48
A3	Input / Output 2	B3	Input / Output 3	C3	Input / Output 49
A4	Input / Output 4	B4	Input / Output 5	C4	Input / Output 50
A5	Input / Output 6	B5	Input / Output 7	C5	Input / Output 51
A6	Input / Output 8	B6	Input / Output 9	C6	Input / Output 52
A7	Input / Output 10	B7	Input / Output 11	C7	Input / Output 53
A8	Input / Output 12	B8	Input / Output 13	C8	SB1 TxD +
A9	Input / Output 14	B9	Input / Output 15	C9	SB1 TxD -
A10	Input / Output 16	B10	Input / Output 17	C10	SB1 RxD +
A11	Input / Output 18	B11	Input / Output 19	C11	SB1 RxD -
A12	Input / Output 20	B12	Input / Output 21	C12	SB1 TxC +
A13	Input / Output 22	B13	Input / Output 23	C13	SB1 TxC -
A14	Input / Output 24	B14	Input / Output 25	C14	SB1 RxC +
A15	Input / Output 26	B15	Input / Output 27	C15	SB1 RxC -
A16	Input / Output 28	B16	Input / Output 29	C16	LINESYNC +
A17	Input / Output 30	B17	Input / Output 31	C17	LINESYNC -
A18	Input / Output 32	B18	Input / Output 33	C18	NRESET +
A19	Input / Output 34	B19	Input / Output 35	C19	NRESET -
A20	Input / Output 36	B20	Input / Output 37	C20	ASSEMBLY ADR
A21	Input / Output 38	B21	Input / Output 39	C21	INBUS RTS
A22	Input / Output 40	B22	Input / Output 41	C22	SB2 TxD +
A23	Input / Output 42	B23	Input / Output 43	C23	SB2 TxD -
A24	Input / Output 44	B24	Input / Output 45	C24	SB2 RxD +
A25	Input / Output 46	B25	Opto Input 1	C25	SB2 RxD -
A26	Opto Input 2	B26	Opto Input 3	C26	SB2 TxC +
A27	Opto Input 4	B27	Opto Input Ground	C27	SB2 TxC -
A28	Address – 0	B28	Address – 1	C28	SB2 RxC +
A29	Address – 2	B29	Address – 3	C29	SB2 RxC -
A30	INBUS TxD	B30	INBUS RxD	C30	INBUS TxC
A31	Equipment Ground	B31	AC Line Reference	C31	INBUS RxC
A32	24 VDC Ground	B32	24 VDC Ground	C32	SIU/BIU

5.9 - Model 2218 Serial Interface Unit (SIU) Connector

Pin	Function
1	+48VDC
2	48VDC Ground**
3	+24VDC
4	+12VDC (PS-2216-2412 only)
5	24/12 VDC Ground
6	Chassis Ground

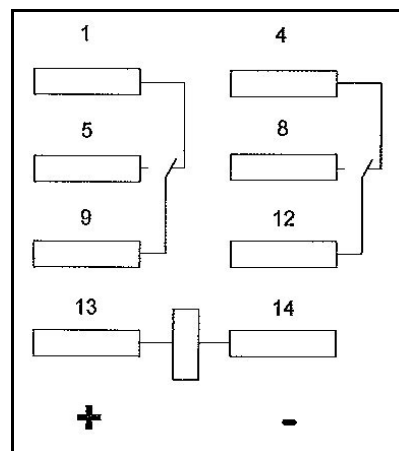
5.10 - Model 2216-24 Cabinet Power Supply (CPS) Connector (Phoenix Contact #1825161)

Switches Definitions:
Manual Control Enable (MCE) switch places call into the CU and activates stop time
Interval Adv. switch advances the CU when MCE is on
FDS (Front Door Switch) 1 or 2 to notify the CMU when Front Door is open
RDS (Rear Door Switch) 1 or 2 to notify the CMU when Rear Door is open
FLS (Front Light Switch) 1 or 2 to turn on the Front cabinet Light
RLS (Rear Light Switch) 1 or 2 to turn on the Rear cabinet Light
Fan Test 1 or 2 to verify if the Fans work
Opto 1-4 place calls into Input Assembly SIU Opto Input 1-4

5.11 - Switches Definitions

Circuit Breakers Definitions:
Service Assembly (SA) MAIN Circuit Breaker (CB) controls power to the entire ATCC
SA CLEAN POWER CB controls power to PMU
SA RAW PWR/GFCI/FAN/LIGHTS CB controls power to outlets, GFCI, fans and lights
SA HDFU1 CB controls power to SA HDSP-FU1
SA HDFU2 CB controls power to SA HDSP-FU2
SA OUTPUT ASSEMBLY (OA) CB controls power to OA
OA CB1 controls power to HDSP1 & 2
OA CB2 controls power to HDSP3 & 4
OA CB3 controls power to HDSP5 & 6
OA CB4 controls power to HDSP7 & 8
OA CB5 controls power to HDSP9 & 10
OA CB6 controls power to HDSP11 & 12
OA CB7 controls power to HDSP13 & 14
OA CB8 controls power to HDSP15 & 16

5.12 - Circuit Breakers Definitions



5.13 - Model 21H High-Density Flash Transfer Relay (HDFTR) Pin-outs

Section 6

Glossary of Terms

A	Ampere
AC	120 Volts AC, 60 Hertz
AC-	120 Volts AC, 60 Hertz grounded return to the power source
AC+	120 Volts AC, 60 Hertz ungrounded power source
ADU	Auxiliary Display Unit
ATC	Advanced Transportation Controller
AWG	American Wire Gauge
C	Celsius
CB	Circuit Breaker
Ch	Channel
CMU	Cabinet Monitor Unit
CMUip	Cabinet Monitor Unit - Internet Protocol
CPS	Cabinet Power Supply
D	Depth
DIN	Deutsche Industrie Norm
DOT	Department of Transportation
EG	Equipment Ground
EIA	Electronic Industries Association
F	Fahrenheit
FITA	Field Input Termination Assembly
FOTA	Field Output Termination Assembly
FPB	Flash Program Block
GFCI	Ground Fault Circuit Interrupter
H	Height
HDFTR	High-Density Flash Transfer Relay
HDSP	High-Density Switch Pack
HDSP/FU	High-Density Switch Pack / Flasher Unit
HDFU	High-Density Flasher Unit
HV	High-Voltage
I/O	Input /Output
IA	Input Assembly
In	Inch
iP	Internet Protocol
K	Kilo
KA	Kilo Ampere
Kbs	kilobit per Second
KHz	Kilo Hertz
lbs	Pounds
LED	Light Emitting Diode

LV	Low-Voltage
M	Mega
mA	milliampere
MHz	Mega Hertz
mm	millimeter
mph	mile per hour
ms	millisecond
N.C.	Normally Closed
N.O.	Normally Open
NA	Not Assigned
NEC	National Electric Code
OA	Output Assembly
Opto	Opto Isolator
OVA	Overlap A
OVB	Overlap B
OVC	Overlap C
OVD	Overlap D
PCB	Printed Circuit Board
Ped	Pedestrian
Ph	Phase
QC	Quality Control
RMS	Root Mean Square
Rx	Received
RYG	Red Yellow Green
SA	Service Assembly
SB	Serial Bus
SB1	Serial Bus 1
SB2	Serial Bus 2
SB3	Serial Bus 3
SDLC	Synchronous Data Link Control
SIU	Serial Interface Unit
SPST	Single Pole Single Throw
TBD	To Be Determined
Tx	Transmit
U	Rack Unit
UL	Underwriter's Laboratories, Inc.
V	Voltage
Vac	Voltage Alternate Current
Vdc	Voltage Direct Current
W	Width

Section 7

Warranty Statement and Sample Delivery

7.1 Warranty Statement

The manufacturer shall fully guarantee all equipment and components. The duration of the warranty shall be 60 months from the date of shipment of equipment and components to the City. The warranty shall cover all manufacturer's defects, labor, parts and shipping costs. The manufacturer shall perform warranty repair and return equipment and components within 30 calendar days after receiving equipment and components.

7.2 Sample Delivery

Vendor shall deliver one (1) sample cabinet within twenty one (21) working days from date of notice by the purchaser. If sample cabinet fails to meet the specification, it shall be rejected, and award may be provided to the next bidder. In this case the vendor shall make arrangements and pay all shipping costs for the return of the sample cabinets.

City of Los Angeles



Model 356i Advanced Transportation Controller (ATC) Cabinet Specification

Specification No. 95-002-00

August 31, 2016

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Section 6

Glossary of Terms

Section 1

ATC Cabinet Components

1.1 Model 2202-HV High-Density Switch Pack / Flasher Unit (HDSP-FU)

The HDSP-FU shall be compact, pluggable, modular PCB-based, and equipped with DIN connector. The HDSP-FU shall be compatible with ultra-low power LED signal heads and it shall have a current monitoring feature for each output of each channel. The HDSP-FU shall use real-time standardized high speed SB3 communications with the Cabinet Monitor Unit to send a complete set of RMS voltage and load current measurements. The HDSP-FU shall be 4.5" H x 6.5" D and shall be equipped with a handle, reset push button switch, six RYG LED indicators, four flasher LED indicators, one power LED indicator and two Rx/Tx LED indicators.

The HDSP-FU can function as either a switch pack (HDSP) or as a flasher unit (HDFU). When installed in the Output Assembly, the High-Density Switch Pack (HDSP) shall provide two RYG channels of operation (6 outputs).

When installed in the Service Assembly, the High-Density Flasher Unit (HDFU) shall function as a four output flasher.

1.2 Model 2212-HV Cabinet Monitor Unit (CMUip)

The Cabinet Monitor Unit (CMUip) shall be compact, pluggable and modular. The CMUip shall use real-time standardized 614.4 Kbs SDLC communications with the ATC to transfer command and response data on Serial Bus #1 (SB1). The CMUip shall be capable of monitoring up to 32 physical switch pack channels (RYG) and shall have optional four virtual channels. The CMUip shall provide a Flasher Alarm feature. The CMUip shall analyze the ATC output commands and field input status to isolate the failure source by channel and color. The CMUip configuration programming shall be provided by an interchangeable Datakey nonvolatile memory device. This rugged key shall store all CMUip configuration parameters and shall eliminate programming using jumpers, diodes, or DIP switches. The CMUip shall maintain a nonvolatile event log recording the complete intersection status as well as time stamped previous fault events, AC Line events, configuration changes, monitor resets, cabinet temperature and true RMS voltages and currents for all field inputs. The signal sequence history log stored in nonvolatile memory graphically shall display up to 30 seconds of signal status prior to the fault trigger event with 50 ms resolution to ease diagnosing of intermittent and transient faults.

1.3 Model 2218 Serial Interface Unit (SIU)

The Model 2218 Serial Interface Unit (SIU) shall be a compact, pluggable and modular. The SIU shall use real-time standardized 614.4 Kbs SDLC communications with the ATC to transfer command and response data on Serial Bus #1 (SB1). The SIU shall be equipped with 54 programmable input/out pins, four optically isolated input pins, one line sync reference input pin and 4 address select input pins. The optically isolated inputs shall work with either 12 Vac or 24 Vdc.

The SIU outputs shall be rated at 150 mA continuous sink current. Each output shall provide a 500 mA typical current limit and shall be rated to 50 V and utilize a voltage clamp for inductive transient protection. The SIU shall be equipped with a front panel LED indicator that can report the current SIU assembly address assignment of the SIU for cabinet configuration verification.

1.4 Model 2220 Auxiliary Display Unit (ADU)

The ADU shall install in a 1U height 19" rack space and shall provide a menu driven user interface to the enhanced features of the CMUip monitor including the built-in Diagnostic Wizard. The ADU shall provide 32 channels of Red, Yellow and Green LED indicators that display full intersection status and 32 Blue fault status LED indicators shall identify faulty channels. The ADU shall provide proper electrical termination to SB3. The ADU shall have a 4 line by 20 character menu driven liquid crystal display with backlight and heater. The ADU built-in Diagnostic Wizard shall automatically pinpoint faulty signals and offers trouble-shooting guidance and automatically isolate and identify problems. The ADU shall be equipped with Event Logging displaying the CMUip time-stamped nonvolatile event log records with the complete intersection status as well as AC Line events, monitor resets, temperature and true RMS voltages and currents.

1.5 Model 2216-24 Cabinet Power Supply (CPS)

The CPS shall install in a 1U height 19" rack space. The CPS shall be rated at 168 Watts, 48 Vdc @ 1 Amp and 24 Vdc @ 5 Amp. The CPS shall have power factor corrected features and shall ensure a full load power factor of 0.98 or better, reducing peak AC Line input current and associated stress on wiring. The CPS shall use modern switching technology and shall provide full output regulation across changes in AC Line voltage and output load over the full operating temperature range of -34C to +74C without the need for a fan. The CPS shall have separate green LED indicators that display AC input status, DC output status and associated fuse integrity. The CPS outputs shall be fused for over-current protection and shall be protected against voltage transients by a 1500 Watt suppressor.

1.6 MonitorKey Programming Tool

The Programming Tool provides the capability to Read and Write data from the Datakey device. The MonitorKey software shall be compatible with the CMUip-2212.

1.7 Model 21H High-Density Flash Transfer Relay (HDFTR)

The HDFTR shall have a hermetically sealed cover and shall be moisture proof. The HDFTR shall be filled with dry nitrogen to protect contacts from corrosion and to prevent condensation. The HDFTR shall have a shock/impact resistant metal can cover with solid and bend proof pins. The HDFTR contacts shall be rated at 120 Vac @ 5 Amp. The coil of the HDFTR shall be rated at 48 Vdc. The HDFTR shall have an LED indicator to display contact transfer position.

1.8 Main Contactor (MC)

The MC shall be mercury free and shall be rated at 120 Vac @ 60 Amp. The coil of the MC shall be rated at 48 Vdc. The MC shall be equipped with input indicator and shall have SPST- N.O. contacts.

1.9 Cabinet Suppressor-Filter

The cabinet shall be equipped with a Cabinet Suppressor–Filter. The unit shall incorporate the use of warning and failure indicators and shall have a dry relay contact remote sensing circuit. The unit shall be modular and pluggable with a 12-position Beau 5412 connector. The unit shall be rated at continuous service current of 15 Amp and maximum clamp voltage of 390 Vac. The unit shall filter noise and spike from 10 KHz to 25 MHz and shall have a peak surge current of 48 KA.

1.10 HDSP Suppressor

The HDSP Suppressor shall be modular and pluggable. The unit shall be epoxy encapsulated and equipped with 9-position 5.08 mm Phoenix Contact connector or approved equal. The unit shall be able to protect 6 circuits. The device operating voltage shall be 120 Vac and clamping voltage shall be 340 Vac. The unit dimensions shall be 2" H x 0.7" W x 2" D.

1.11 Detection Module Suppressor

The Detection Module Suppressor shall be modular and pluggable. The unit shall be epoxy encapsulated and equipped with 6-position 5.08 mm Phoenix Contact or approved equal connector. The unit shall be able to protect 6 circuits. The device operating voltage shall be 75 Vac and clamping voltage shall be 130 Vdc. The device dimensions shall be 2" H x 0.7" W x 1.2" D.

Section 2

Model 356i ATC Cabinet General Requirements

2.1 General Requirements

The cabinet shall adhere to the following requirements:

- The assemblies shall be completely removable from or installable in the cabinet without removing any other equipment and using only a standard slotted or Phillips screwdriver.
- The cabinet shall be capable of Cabinet Flash signal operation in the absence of any of the following assemblies: Input Assembly, Output Assembly, Cabinet Power Supply, and Controller.
- A momentary push button shall be provided that, when pressed, energizes the 24 Vdc to the HDSPs during Flash Mode. The button shall be labeled "24 VDC BYPASS" and shall be located on the front of the Output Assembly.
- High-voltage components (over 50 V) shall be protected from incidental contact per NEC.
- All fuses, circuit breakers, switches (except police panel switches) and indicators shall be readily visible and accessible from the area accessed by opening the front door.
- All circuit breakers located on the rack shall have covers to prevent accidental tripping.
- All Assemblies shall be modular with pluggable cabling.
- The ventilation fan shall be fastened to the cabinet via two thumb screws and shall not be fastened in a manner that requires any tools for removal or installation.
- Door switches shall be powered by 48 Vdc.
- Wire raceway shall be integrated as part of the cabinet allowing for neat internal and field wiring.
- All equipment in the cabinet shall be clearly and permanently labeled.
- The marker strips shall be made of material that can be easily and legibly written on using a pencil or ballpoint pen. Marker strips shall be located immediately below the item they are to identify and must be clearly visible with the items installed.
- Guides (top and bottom) shall be provided for assembly plug-in units. The guides shall begin 0.50 inch from the assembly front panel face.
- Each cabinet shall include City of Los Angeles identification. The name "City of Los Angeles" shall be molded, cast, or scribed in 0.250 inch letters on the outside, top center area of the front cabinet door.

Section 3

Model 356i ATC Cabinet Specification

3.1 General

This specification describes the 120 Vac High Voltage (HV) Model 356i Advanced Transportation Controller (ATC) Cabinet (“the cabinet”) for City of Los Angeles. The ATC Cabinet family is a modular, serially-interconnected cabinet architecture that is designed to fulfill a variety of transportation applications.

The cabinet shall include: Service Assembly (SA), Input Assembly (IA), Output Assembly (OA), SB1/SB2 and DC/Clean Power Bus, Field Input Termination Assembly (FITA), and Field Output Termination Assembly (FOTA).

3.2 Cabinet Housing

The housing shall include, but not be limited to, the following:

- Enclosure
- Doors
- Gasketing
- Lifting Eyes & External Bolt Heads
- Latches & Locks
- Ventilation
- Hinges and Door Catches
- Police Panel
- Cage Supports and Mounting

3.2.1 Housing Construction

The housing shall be rainproof. It shall have front and rear doors, each equipped with a lock and handle. The enclosure top shall be crowned to prevent standing water. The cabinet shall be: 46” H x 24” W x 20” D (rounded to the nearest inch).

3.2.2 Material Thickness

The enclosure, doors, lifting eyes, gasket channels, police panel door, spacer supports and all supports welded to the enclosure and doors shall be fabricated of 0.125 inch minimum thickness aluminum sheet. The filter shell, filter trough, fan support and police panel enclosure shall be fabricated of 0.080 inch minimum thickness aluminum sheet. The spacer supports shall have the option to use 0.059 inch minimum stainless steel sheet.

3.2.3 Welds

All exterior seams for enclosure and doors shall be continuously welded and shall be smooth. All edges shall be filled to a radius of 0.03125 inch minimum. Exterior cabinet

welds shall be done by gas Tungsten arc TIG process only. ER5356 aluminum alloy bare welding electrodes conforming to AWS A5.10 requirements shall be used for welding on aluminum. Procedures, welders and welding operators shall conform to the requirements and practices in AWS B3.0 and C5.6 for aluminum. Internal cabinet welds shall be done by gas metal arc MIG or gas Tungsten arc TIG process.

3.2.4 Aluminum Surface Protection

The aluminum surface protection shall be LADOT Anti-Graffiti Paint.

3.2.4.1 Anti-Graffiti Paint

If Anti-Graffiti Paint is requested, each stage in the process shall be as follows:

- Perform treatment with a moderately acidic, liquid cleaner concentrate for thorough cleaning.
- Clean water rinse from reverse osmosis system (< 2500 PPM).
- Clean water rinse from reverse osmosis system (< 500 PPM).
- Apply a conversion coating to form an excellent base for bonding powder to parts and producing good resistance to corrosion.
- Clean water rinse from reverse osmosis system (< 800 PPM).
- Clean water rinse from reverse osmosis system to decrease any solids on surfaces (< 100 PPM).
- Final seal rinse to enhance corrosion resistance.
- Convey through a dry-off oven at a cycle of 10 to 20 minutes at 380° F. This eliminates any trapped water and gases in the parts.
- Apply polyester dry powder at 90,000 volts for maximum mil transfer. Thickness of the powder coating shall nominally be 2 to 5 mils.
- Convey into the cure oven for a thermal setting [cure] cycle of 10 to 20 minutes at 380 - 425° F.

The City, at its option, may require the winning the Vendor to submit written certification of compliance to the requirements listed in this section of the specification.

3.2.5. Enclosure Door Frames and Door Seals

The enclosure door frames shall be double-flanged out on all four sides and shall have strikers to hold tension on, and to form a firm seal between, the door gasketing and the frame. The dimension between the door edge and the enclosure external surface when the door is closed and locked shall be 0.156 inch (+/-0.08 inches).

3.2.6 Gasketing

Gasketing shall be provided on all door openings and shall be dust-tight. Gaskets shall be 0.25 inches minimum thickness closed cell neoprene or silicone (BOYD R- 108480 or approved equal) and shall be permanently bonded to the metal. A gasket top and

side channels shall be provided to support the top gasket on the door to prevent gasket gravitational fatigue.

3.2.7 Lifting Eyes and Exterior Bolt Heads

The housing shall be provided with 2 lifting eyes for placing the cabinet on its foundation. Each eye opening shall have a minimum diameter of 0.75 inch. Each eye shall be able to support the weight load of 1000 lbs. All bolt heads shall be tamperproof type.

3.2.8 Door Latches and Lock Mechanism

Each door shall be equipped with a removable hex handle and "U" handle.

The latching mechanism shall be a three-point draw type. When the door is closed and latched, the door shall be locked. The lock and lock support shall be rigidly mounted on the door. In the locked position, the bolt throw shall extend a minimum of 0.25 inch (+/- 0.03125 inches) into the latch cam area. A seal shall be provided to prevent dust or water entry through the lock opening.

3.2.8.1 Locks & Keys

The locks shall be BEST type. One key shall be supplied with each lock. The keys shall be removable in the locked position only. The locks shall have rectangular, spacing loaded bolts.

The bolt shall have a 0.281 inch throw and shall be 0.75 inch wide by 0.375 inch thick. Tolerance is 0.035 inch. A swing away cover shall be placed over the key entrance to protect the lock mechanism. The lock shall be mounted in the center.

Best Lock numbers are:

- Right Hand - 5L6RL3XA7559-606
- Left Hand - 5L6RL4X47559-606

Each cabinet will be supplied with two (2) locks, each with a "LA-1" core, keyed alike. LA-1 Keys and Core Keys shall be supplied separately, the quantity will be specified at the time of each purchase order. Contractor cores must be available upon request through the parts contract.

3.2.8.2 Center Latch Cam

The center latch cam shall be fabricated of a minimum thickness 0.1875 in steel or aluminum. The bolt surface shall horizontally cover the cam thickness. The cam shall be structured to only allow the door to open when the handle is moved toward the center of the door.

3.2.8.3 Rollers

Rollers shall have a minimum diameter of 0.875 in with nylon wheels and steel ball bearings.

3.2.9 Hinges

Stainless steel hinges (two bolts per leaf) shall be provided to bolt the enclosure to the doors.

Each door shall have three hinges per door. Each hinge shall be 3.5 inch minimum length and have a fixed pin. The pin ends shall be welded to hinge and ground smooth. The pins and bolts shall be covered by the door edge and not accessible when the door is closed. A ground strap between the door and the main cabinet housing shall be required when 120 Vac devices are mounted on the door.

3.2.10 Door Catches

Front and rear doors shall be provided with catches to hold the door open at both 90 and 165 (+/-10) Degrees. The catch minimum diameter shall be 0.375 inch aluminum rods. The catches must be capable of holding the door open at 90 degrees in a 60 mph wind acting at an angle perpendicular to the plane of the door.

3.2.11 Police Panel

A police panel assembly shall be provided to allow limited control access. The panel door shall be equipped with a lock and master police key. The front and back of the panel shall be enclosed with a rigid metal covering so that no parts having live voltage are exposed. The panel assembly shall have a drain to prevent water from collecting within the assembly. The drain shall be channeled to the outside. The cabinet shall have one switch provided and labeled "SIGNALS ON / OFF" and one switch provided and labeled "FLASH / AUTO".

3.2.12 Rack Cage

A standard rack cage shall be installed inside the housing for mounting of the ATC and cabinet assemblies. The EIA rack portion of the cage shall consist of four continuous, adjustable equipment mounting angles. The mounting angle nominal thickness shall be 11- gauge plated steel. The mounting angles shall be tapped with 10-32 threads with EIA universal spacing. The mounting angle shall comply with standard EIA-310-B and shall be supported at the top and bottom by either welded or bolted support angles to form a cage. The mounting angles shall provide holes to mount the side panels.

3.2.12.1 Cage Connection

The cage shall be bolted to the cabinet at four points via the housing cage supports and four points via associated spacer brackets (top and bottom).

3.2.12.2 Cage Location

The cage shall be centered within the cabinet door opening(s).

3.2.12.3 Cage Mounting Supports

Cage mounting supports shall be provided on either side, level with the bottom edge of the door opening, for horizontal support and bolt attachment; side cage supports provided for the bracket cage supports; and bracket cage support attachments.

3.2.12.4 Clearance between Rails

Clearance between rails for mounting assemblies shall be 17.75 inch.

3.2.13 Housing Ventilation

Housing ventilation shall include intake, exhaust, filtration, fan and thermostat.

3.2.13.1 Intake & Filter

The louvered vent depth shall be a maximum of 0.25 inch. A removable and reusable air filter shall be housed behind the door vents. The filter filtration shall cover the vent opening area. A filter shell shall be provided that fits over the filter providing mechanical support for the filter. The shell shall be louvered to direct the incoming air downward. The shell sides and top shall be bent over a minimum of 0.25 inch to house the filter. The filter resident in its shell shall be held firmly in place with a bottom trough and spring loaded upper clamp. No incoming air shall bypass the filter. The bottom filter shall be formed into a waterproof sump with drain holes to the outside housing. The filter shall be 16 inch wide by 12 inch high by 0.875 inch thick. The filter shall be an ECO-AIR Product E35S or approved equal.

3.2.13.2 Fan

The electric fan shall be equipped with ball or roller bearings and shall have a minimum capacity of 100 cubic feet of free air delivery per minute. The fan shall be equipped a finger guard and a Fan Test switch.

3.2.13.3 Temperature Controlling

The fan shall be thermostatically controlled and shall be manually adjustable to turn on between 32 Fahrenheit and 140 Fahrenheit with a differential of not more than 20 Fahrenheit between automatic turn on and off. The fan circuit shall be protected at 125% of the fan motor ampacity. The manual adjustment shall be graded in 20 Fahrenheit increment scale. The Thermostat shall be an Omega KT01101141900 or approved equal.

3.2.14 Cabinet Light

The cabinet shall have two LED cabinet lights activated by door switches and equipped with a manual switch and fuse.

3.3 Model 356i ATC Cabinet Assemblies

3.3.1 Output Assembly (16-Channel)

The Output Assembly shall be a 3U high rack mounted assembly. The Output Assembly shall accommodate eight Model 2202-HV High-Density Switch Pack / Flasher Units (HDSP/FU), providing 48 output circuits.

The Output Assembly shall accommodate one Model 2218 Serial Interface Unit (SIU) to provide interface and control via system SB1/SB2.

The Output Assembly shall accommodate one Model 2212-HV Cabinet Monitor Unit (CMUip), Main Contactor, Flash / Auto Switch, four Circuit Breakers and Momentary 24 Vdc Bypass Switch.

3.3.2 Field Output Termination Assembly (16-Channel)

The 16-Channel Field Output Termination Assembly shall be coupled with the 16-Channel Output Assembly and shall house eight Model 21H High-Density Flash Transfer Relays (HDFTR). The HDFTRs and Flash Program Blocks (FPB) shall be provided to control and select the color (red, yellow, or dark) during ATC Cabinet flash mode. HDSP Suppressors shall be provided at the field terminals for the protection of the HDSP. Each HDFTR position shall be labeled with the number of its associated HDSP (1-16). Each FPB position shall be labeled with the number of its associated channel (1-16).

The Field Output Termination Assembly shall be provided with 16, 6-position Phoenix Contact terminal block model number 18-04-94-6 plugs and 18-61-19-6 sockets or approved equal. Each Load Terminal Block receptacle shall be labeled with the number of its associated channel (1-16). Additional labels shall be provided to clearly indicate which terminals correspond to the red, yellow, and green switch pack outputs. The color of these labels shall match the color of their associated output (red, yellow, or green). One Field Output Termination Assembly shall be provided with each 16 channel cabinet, while two Field Output Termination Assemblies shall be provided with each 32 Channel Output Assembly.

The 16-Channel Field Output Termination Assembly shall be mounted across the EIA rails and it shall swing down to provide access to the HDSP Suppressors.

3.3.3 Input Assembly (48-Channel)

The Input Assembly shall be a 3U high rack mounted assembly providing twelve slots of 22/44 pin PCB sockets. Two Model 2218 Serial Interface Units (SIU) shall be provided and mated to two DIN 96-pin connectors. The SIU shall provide interface and control between the Controller and the detection modules via system SB1/SB2. The Input Assembly shall house either a 2-channel or a 4-channel half width device, up to twelve detection modules providing a maximum of 48 channels.

3.3.4 Field Input Termination Assembly (48-Channel)

The 48-Channel Field Input Termination Assembly shall be coupled with the 48-Channel Input Assembly and shall have positions for landing 48, two-wire inputs and their associated earth ground wires. The 48-Channel Field Input Termination Assembly shall be mounted across the EIA rails and it shall swing down to provide access to the back of the assemblies mounted in the opposite side.

3.3.5 Service Assembly (1-HDFU)

The Service Assembly shall be modular and shall be mounted on the left of the EIA rail when viewed from the front. It shall house: one Model 2202-HV High-Density Switch Pack / Flasher Units (HDSP/FU), Cabinet Suppressor–Filter, BBS landing wire terminals, GFCI, one convenience outlet NEMA 15-5 format, four HDFU output fuses, five Circuit Breakers and a Raw AC+ terminal block having 5 screw terminals.

3.3.6 SB1/SB2 and DC Power Bus

SB1/SB2 and DC Power Bus shall include eight DB25 connectors to interconnect the SB1/SB2 communication ports of the assemblies and controller. It shall include a termination circuit at the end of the connections (S8) to prevent radio frequency signal reflection. SB1/SB2 and DC Power Bus shall include one Phoenix plug block or equal to bring the DC power to the SB1/SB2 and DC Power Bus; such power shall be distributed to the ATC Cabinet Assemblies through seven Phoenix receptacle blocks or equal. The copper traces for the DC voltages shall support at least 10 Amps.

The SB1/SB2 and DC Power Bus shall be mounted in the EIA rails and it shall swing out to provide access to the back of the assemblies mounted in the opposite side.

3.3.7 AC Clean Power Bus

The AC Clean Power Bus shall include eight single NEMA 5-15 receptacles, to provide AC clean power to the ATC Cabinet Assemblies, the controller and DC power supply. It shall be mounted on the EIA rails and it shall swing out to provide access to the back of the assemblies mounted in opposite side.

3.3.8 Drawer Shelf Unit

A telescopic slide out drawer to storage document shall be provided. The Drawer Shelf Unit shall be mounted across the EIA rails and shall have a non-conductive top, locking provision when fully extended and lip or handle for pulling.

3.3.9 Communication Panel

3.3.9.1 Communications Cable Terminal Block (CTB-1)

Communications Cable Terminal Blocks shall be quick-connected blocks consisting of 25 horizontal rows of six (6) clips per row, mounted in a molded self-extinguishing plastic case. The horizontal rows of six (6) clips shall be divided into two (2) sets of

three (3) electrically common clips. The two (2) sets of three (3) clips shall be connected by a bridge clip. These blocks, commonly referred to "66B Type" blocks, shall terminate 25 pairs of 20 through 24 AWG solid unstripped conductors. The blocks shall be equipped with integral fanning strips and an enclosed back to prevent grounding of clips to the panel.

3.3.9.2 Termination Block (CTB-2)

A four (4) position, double row, closed back design terminal block, **Kulka** part No. 671-GP-04 or equivalent, labeled CTB-2 shall be mounted on the Communications Termination Panel. The strip shall be rated at 15 Amps and shall be provided with 6-32 by 0.250 inch nickel plated brass binder head screws.

3.3.9.3 C-20 Termination Block (CTB-3)

A four (4) position, double row, closed back design terminal block, **Kulka** part No. 671-GP-04 or equivalent, labeled CTB-3 shall be mounted on the Communications Termination Panel. The strip shall be rated at 15 Amps and shall be provided with 6-32 by 0.250 inch nickel plated brass binder head screws.

3.3.9.4 Over-Voltage Protection

An over voltage surge protector shall be provided for each active communications cable pair (Audio-In pair, and Audio-Out pair) terminating at CTB-2 and CTB-3. Protectors shall be of the Three-Electrode Gas Tube type, and shall have the following ratings:

- Impulse Life (1,000 Amp, 10/1000 waveshape at one minute intervals each direction, with 500 Amps on each side to ground simultaneously): 1,000 surges minimum, 2,500 surges typical.
- AC Discharge Current, 11 cycles, 60 Hz: 400 Amps RMS, 200 Amps on each side to ground simultaneously
- Maximum Single Impulse Discharge Current, 8/20 waveshape: 40 kA maximum, 20 kA/side simultaneously
- Capacitance: Line-ground = 4 pf, Line-line = 2 pf
- DC Holdover: 180 VDC typical at 200 mA, 150 VDC minimum
- DC Arc Voltage: 30 volts typical
- Glow to Arc Transition Current: 1.0 Amp typical
- Transition Time: 0.5 microseconds maximum
- Line-Ground Impulse Breakdown Voltage at 10 kV/sec: 1000 volts maximum average

3.3.9.5 Insulation Resistance

1,000 megohms minimum at 100 VDC (line-ground). The protectors shall be encapsulated, and shall be equipped with minimum 2 inches long, spade lug tipped

leads. Maximum size of each protector shall be 0.5 x 0.5 x 2.0 -inches. The grounding lead shall be attached to the panel's grounding stud.

3.3.9.6 Grounding Stud

A grounding stud shall be provided. The stud shall extend through the panel. The over voltage protection devices' ground leads shall be attached to the stud on the front side of the panel. A No. 8 AWG copper conductor shall connect to the stud on the back side of the panel, and shall connect to the cabinet's Equipment Grounding Bus.

3.3.9.7 C2P Harness and Connector

4-conductor jacketed cables shall each be attached to terminal blocks CTB-2 and CTB-3 with soldered ring lugs. The cables shall terminate with a standard C2P and C20P connectors, and shall be routed through the cabinet, 2 feet in length to reach the back of the 2070 Controller Unit, when the unit is installed in the equipment rack.

3.3.9.8 Feed-Through Opening

A feed-through openings, complete with protective grommets, shall be provided on the panel to protect the C2P and C20P harnesses. A strain relief device shall also be provided for each.

3.3.9.9 Cable-Tie Openings

Six (6) 0.250 inch diameter holes shall be provided for installation of cable ties.

3.3.9.10 Allen Tel Distribution Ring

Allen Tel Distribution Ring model #GB 13 or equivalent shall be installed at the bottom of the panel CTB-1.

3.3.9.11 Attachment to Equipment Rack

The panel shall be securely attached to the equipment rack using mounting keyholes sized to facilitate removal of the panel without removing the mounting screws.

3.4. Components Requirements

3.4.1 Service Assembly Components Requirements

- Service Assembly (1-HDFU)
 - (1 each) Model 2202-HV HDFU or approved equal
 - (1 each) Cabinet Suppressor–Filter

3.4.2 Output Assembly Components Requirements

- Output Assembly (16-Channel)
 - (8 each) Model 2202-HV HDSP or approved equal
 - (1 each) Model 2218 SIU or approved equal
 - (1 each) Model 2212-HV CMUp or approved equal

3.4.3 Field Output Termination Assembly Components Requirements

- Field Output Termination Assembly (16-Channel)
 - (8 each) Model 21H HDFTR or approved equal
 - (8 each) HDSP Suppressor
 - (16 each) Red Flash Program Block
 - (4 each) Yellow Flash Program Block
 - (4 each) White Flash Program Block

3.4.4 Input Assembly Components Requirements

- Input Assembly (48-Channel)
 - (2 each) Model 2218 SIU or approved equal
 - (10 each) Model LMD624H 4-Channel Half Width Detector or approved equal
 - (2 each) Model 244L DC Isolator or approved equal

3.4.5 Field Input Termination Assembly Components Requirements

- Field Input Termination Assembly (48-Channel)
 - (N/A) Detection Module Suppressor

3.4.6 Cabinet Components

- (1 each) Model 2220 ADU or approved equal
- (1 each) Model 2216-24 CPS or approved equal
- (1 each) Mounting Hardware

3.5 Model 356i ATC Cabinet Configuration Example

The ATC Cabinet shall consist of Assemblies and Components needed to carry out a specific application. ATC Cabinet version provided here is an EXAMPLE of many possible configurations.

Item #	Modules / Assemblies	Quantity
1	356i Housing / 356i Cage / (2) 356i Side Panels	1
2	Service Assembly (1 - HDFU)	1
3	Output Assembly (16 - Channel)	1
	Field Output Termination Assembly (16 - Channel)	1
4	Input Assembly (48 - Channel)	1
	Field Input Termination Assembly (48 - Channel)	1
5	SB1/SB2 and DC Power Bus	1
6	AC Clean Power Bus	1
7	Model 2216-24 Cabinet Power Supply	1
8	CMU Auxiliary Display Unit	1
9	LED - Cabinet Light Assembly	1
10	Drawer Shelf Unit	1

Model 356i ATC Cabinet Configuration Example

3.6 Model 356i ATC Cabinet I/O Assignments

ATC Cabinet 48-Channel Input Assembly #1													
SIU Input (IO) Assignments													
4-Ch Card	4-Ch Card	4-Ch Card	4-Ch Card	4-Ch Card	4-Ch Card	SIU 9	4-Ch Card	4-Ch Card	4-Ch Card	4-Ch Card	4-Ch Card	4-Ch Card	SIU 10
IO 6	IO 10	IO 14	IO 18	IO 22	IO 26		IO 6	IO 10	IO 14	IO 18	IO 22	IO 26	
IO 7	IO 11	IO 15	IO 19	IO 23	IO 27		IO 7	IO 11	IO 15	IO 19	IO 23	IO 27	
IO 8	IO 12	IO 16	IO 20	IO 24	IO 28		IO 8	IO 12	IO 16	IO 20	IO 24	IO 28	
IO 9	IO 13	IO 17	IO 21	IO 25	IO 29		IO 9	IO 13	IO 17	IO 21	IO 25	IO 29	

Model 356i ATC Cabinet I/O Assignments (Input Assembly)

ATC Cabinet 16-Channel (Ch) Output Assembly								
Controller Phase/Overlap/Pedestrian Assignments								
Ch1/2	Ch3/4	Ch5/6	Ch7/8	Ch9/10	Ch11/12	Ch13/14	Ch15/16	
HDSP1	HDSP2	HDSP3	HDSP4	HDSP5	HDSP6	HDSP7	HDSP8	SIU 1
R	R	R	R	R	R	R	R	
Y	Y	Y	Y	Y	Y	Y	Y	
G	G	G	G	G	G	G	G	
R	R	R	R	R	R	R	R	
Y	Y	Y	Y	Y	Y	Y	Y	
G	G	G	G	G	G	G	G	
CMU Channel (Ch) Assignments								
HDSP1	HDSP2	HDSP3	HDSP4	HDSP5	HDSP6	HDSP7	HDSP8	
Ch-1	Ch-3	Ch-5	Ch-7	Ch-9	Ch-11	Ch-13	Ch-15	SIU 1
Ch-1	Ch-3	Ch-5	Ch-7	Ch-9	Ch-11	Ch-13	Ch-15	
Ch-1	Ch-3	Ch-5	Ch-7	Ch-9	Ch-11	Ch-13	Ch-15	
Ch-2	Ch-4	Ch-6	Ch-8	Ch-10	Ch-12	Ch-14	Ch-16	
Ch-2	Ch-4	Ch-6	Ch-8	Ch-10	Ch-12	Ch-14	Ch-16	
Ch-2	Ch-4	Ch-6	Ch-8	Ch-10	Ch-12	Ch-14	Ch-16	
SIU Output (IO) Assignments								
HDSP1	HDSP2	HDSP3	HDSP4	HDSP5	HDSP6	HDSP7	HDSP8	
IO 0	IO 6	IO 12	IO 18	IO 24	IO 30	IO 36	IO 42	SIU 1
IO 1	IO 7	IO 13	IO 19	IO 25	IO 31	IO 37	IO 43	
IO 2	IO 8	IO 14	IO 20	IO 26	IO 32	IO 38	IO 44	
IO 3	IO 9	IO 15	IO 21	IO 27	IO 33	IO 39	IO 47	
IO 4	IO 10	IO 16	IO 22	IO 28	IO 34	IO 40	IO 48	
IO 5	IO 11	IO 17	IO 23	IO 29	IO 35	IO 41	IO 49	
HDSP Addresses								
HDSP1	HDSP2	HDSP3	HDSP4	HDSP5	HDSP6	HDSP7	HDSP8	
0 (00000)	1 (00001)	2 (00010)	3 (00011)	4 (00100)	5 (000101)	6 (00110)	7 (00111)	SIU 1

Model 356i ATC Cabinet I/O Assignments (Output Assembly)

Section 4

ATC Cabinet Electrical, Environmental and Testing Requirements

4.1 General

The requirements called out in this specification dealing with equipment evaluation are a minimum guide and shall not limit the testing and inspection to ensure compliance.

4.2 Certification

These test procedures shall be followed by the manufacturers who shall certify that they have conducted inspection and testing in accordance with this specification.

4.3 Inspection

A visual and physical inspection shall include mechanical, dimensional and assembly conformance of all parts of this specification.

4.4 Environmental and Electrical

All components shall properly operate within the following limits unless otherwise noted:

- Applied Line Voltage: 90 to 135 Vac
- Frequency: 60 (+/-3.0) Hertz
- Humidity: 5% to 95%
- Ambient Temperature: -34.6 °F to +165.2 °F
- Shock - Test per Specification MIL-STD-810G Method 516.6
- Vibration - per Specification MIL-STD-810G Method 514.6

4.5 Commencement Operation

All circuits, unless otherwise noted, shall commence operation at or below 90 Vac as the applied voltage is raised from 50 to 90 Vac at a rate of 2 (+/-0.5) volts / second.

4.6 Equipment Compliance

All equipment shall be unaffected by transient voltages normally experienced on commercial power lines. Where applicable, equipment purchased separately from the cabinet (which normally is resident) will be tested for compliance.

4.7 Power Line Surge Protection

The power line surge protection shall enable the equipment being tested to withstand (Non-destructive) and operate normally following the discharge of a 25 µF capacitor charged to $\pm 2,000$ volts, applied directly across the incoming AC line at a rate of once every 10 seconds for a maximum of 50 occurrences per test. The unit under test will be operated at $68\text{ }^{\circ}\text{F} \pm 41\text{ }^{\circ}\text{F}$ and at 120 (± 12) Vac.

4.8 Operating

The equipment shall withstand (Non-destructive) and operate normally when one discharge pulse of plus or minus 300 volts is synchronously added to its incoming AC power line and moved uniformly over the full wave across 360 degrees or stay at any point of Line Cycle once every second. Peak noise power shall be 5 kilowatts with a pulse rise time of 500 ns. The unit under test will be operated at 68 °F $\pm$ 41 °F and at 120 (+/-12) Vac.

4.9 UL Requirements

Equipment shall comply only with the requirements of UL Bulletin of Research No. 23, "Rain Tests of Electrical Equipment."

4.10 Normal Operation

All equipment shall continue normal operation when subjected to the following:

4.10.1 Low Temperature Test

With the item functioning at a line voltage over Electrical Range the Device in its intended operation, the ambient temperature shall be lowered from 68 °F to 34.6 °F at a rate of not more than 64.4 °F per hour. The item shall be cycled at -34.6 °F for a minimum of 5 hours and then returned to 68 °F at the same rate.

4.10.2 High Temperature Test

With the item functioning at a line voltage over Electrical Range the Device in its intended operation, the ambient temperature shall be raised from 68 °F to 165.2 °F at a rate of not more than 64.4 °F per hour. The item shall be cycled at 165.2 °F for 5 hours and then returned to 68 °F at the same rate. The test shall be repeated with the line voltage at 135 Vac.

4.10.3 Normal Operation

All equipment shall resume normal operation following a period of at least 5 hours at -34.6 °F and less than 10 percent humidity and at least 5 hours at 165.2 °F and 22% humidity, when 90 Vac is applied to the incoming AC.

4.10.4 Humidity and Ambient Temperature

The relative humidity and ambient temperature values in the following table shall not be exceeded.

Ambient Temperature/ Dry Bulb (in 0F)	Relative Humidity (in percent)	Ambient Temperature/ Wet Bulb (in 0F)
-34.6 to 33.98	10	1.04 to 108.86
33.98 to 114.8	95	108.86
119.84	70	108.86
129.92	50	108.86
140	38	108.86
149.72	28	108.86
160.16	21	108.86
165.2	18	108.86

Ambient Temperature versus Relative Humidity @ Barometric Pressure (29.92 In. Hg.)

4.11 QC / Final Test

A complete QC / final test report shall be supplied with the Model 356i ATC Cabinet. The test report shall indicate the name of the tester and shall be signed by a responsible manager.

4.12 Quality Control Procedure & Test Report

The quality control procedure and test report format shall be supplied to the Engineer or approval within 15 days following the award of the contract. The quality control procedure shall include the following:

- Acceptance testing of all supplied components
- Physical and functional testing of all modules and items
- A minimum 100-hour burn-in of all equipment
- Physical and functional testing of all items

4.13 Cabinet Print

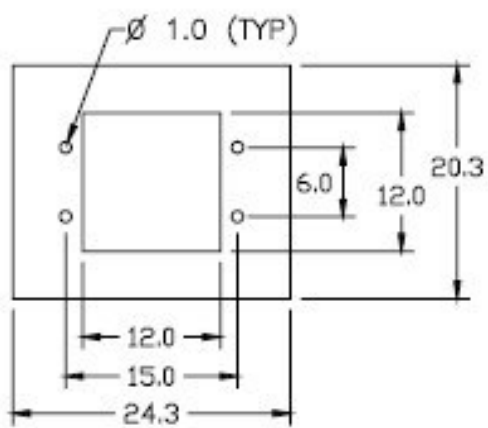
Wiring diagram sheets for the cabinet shall be furnished in a weatherproof plastic pouch placed in the cabinet. Cabinet wiring diagrams shall be on non-fading.

4.14 Manual

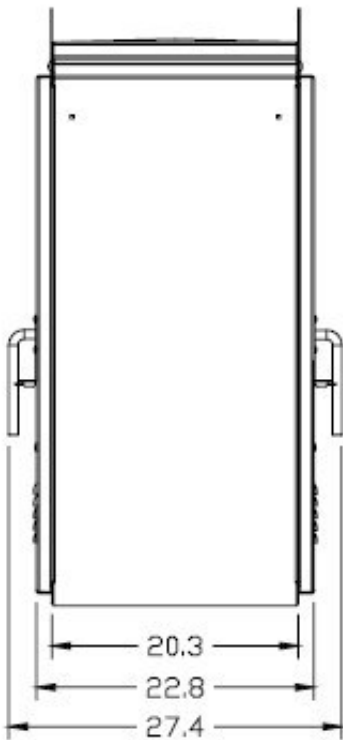
One copy of manual documentation shall be supplied for each item purchased. The manual shall be printed on 8.5 in by 11 in paper, with the exception that schematics, layouts, parts lists and plan details may be on 11 in by 17 in sheets, with each sheet neatly folded to 8.5 in by 11 in size. The manual shall be formatted per the following table:

Section	Description
N/A	Table of Contents
1	Glossary
2	General Description
3	General Characteristics
4	Installation
5	Adjustments
6	Theory of Operation
	6a. Systems Description (include block diagram)
	6b. Detailed Description of Circuit Operation
7	Maintenance
	7a. Preventive Maintenance
	7b. Trouble Analysis
	7c. Trouble Shooting Sequence Chart
	7d. Wave Forms
	7e. Voltage Measurements
	7f. Alignment Procedures
8	Parts List (include circuit and board designation, part type and class, power rating, component manufacturer, mechanical part manufacturer, data specification sheets for special design components and original manufacturer's part number)
9	Electrical Interconnection Details & Drawings
10	Schematic and Logic Diagram
11	Assembly Drawings and a pictorial diagram showing physical locations and identification of each component or part

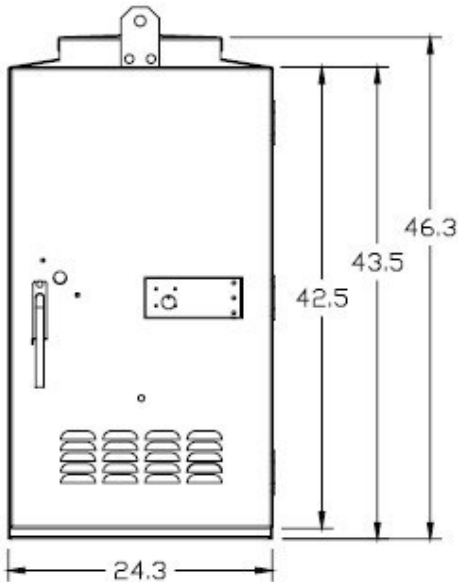
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Drawings



5.1 – Model 356i ATC Cabinet Housing Base



5.2 – Model 356i ATC Cabinet Housing Side View



5.3 – Model 356i ATC Cabinet Housing Rear View

Pin #	Function	Pin #	Function
A1	+24VDC Monitor	B1	Reserved
A2	+12VDC Monitor	B2	External Test Reset
A3	VDC Ground	B3	Serial Bus #1 Disable
A4	Monitor Interlock	B4	Reserved
A5	Address 0	B5	Address 1
A6	Reserved	B6	Reserved
A7	SB1 TxData +	B7	SB1 TxData -
A8	SB1 RxData +	B8	SB1 RxData -
A9	SB1 TxClock +	B9	SB1 TxClock -
A10	SB1 RxClock +	B10	SB1 RxClock -
A11	Reserved	B11	Reserved
A12	Reserved	B12	Reserved
A13	Reserved	B13	Reserved
A14	Reserved	B14	Reserved
A15	Line Sync +	B15	Line Sync -
A16	Nreset +	B16	Nreset -
A17	PowerDown +	B17	PowerDown -
A18	SB3 TxData +	B18	SB3 TxData -
A19	SB3 RxData +	B19	SB3 RxData -
A20	SB3 Clock+	B20	SB3 Clock-
A21	LF Status	B21	LF Status
A22	Output Relay NO	B22	Output Relay NO
A23	CB Trip Status	B23	Reserved
A24	MC Coil Status	B24	Reserved
A25	MC Secondary Status	B25	Reserved
A26	FTR Coil Drive Status	B26	Reserved
A27	Door Switch Front	B27	Reserved
A28	Door Switch Rear	B28	Reserved
A29	Reserved	B29	Reserved
A30	Reserved	B30	MAINS Power
A31	Equipment Ground	B31	Reserved
A32	Reserved	B32	MAINS Ground (Neutral)

5.4 - Model 2212-HV Cabinet Monitor Unit (CMUp) Connector
(DIN 4161264 Header Type)

PIN#	AT THE CONTROLLER	AT THE SIU	PIN#	AT THE CONTROLLER	AT THE SIU
1	SB1 TXD+	SB1 RXD+	14	SB1 TXD-	SB1 RXD-
2	SB1 RXD+	SB1 TXD+	15	SB1 RXD-	SB1 TXD-
3	SB1 TXC+	SB1 RXC+	16	SB1 TXC-	SB1 RXC-
4	SB1 RXC+	SB1 TXC+	17	SB1 RXC-	SB1 TXC-
5	SB2 TXD+	SB2 RXD+	18	SB2 TXD-	SB2 RXD-
6	SB2 RXD+	SB2 TXD+	19	SB2 RXD-	SB2 TXD-
7	SB2 TXC+	SB2 RXC+	20	SB2 TXC-	SB2 RXC-
8	SB2 RXC+	SB2 TXC+	21	SB2 RXC-	SB2 TXC-
9	LINE SYNC+	LINE SYNC+	22	LINE SYNC-	LINE SYNC+
10	NRESET+	NRESET+	23	NRESET-	NRESET-
11	PWR DWN+		24	PWR DWN-	
12	+5VDC ISO		25	EQ GND	
13	ISO GND	DC GND			

5.5 - SB1/SB2 Connector (DB 25)

Pin	Function
1	Reserved
2	Reserved
3	Neutral (AC- Raw)
4	RxDATA +
5	RxDATA -
6	Neutral (AC- Raw)
7	TxDATA +
8	TxDATA -

5.6 - Serial Bus 3 (RJ-45) Connector

<i>Pin</i>	<i>A (Bottom Row)</i>	<i>C (Middle Row)</i>	<i>E (Top Row)</i>
2	Ch 1 Red In	Ch 1 Yellow In	Ch 1 Green In
4	Ch 2 Red In	Ch 2 Yellow In	Ch 2 Green In
6	+24VDC	DC Ground	Address 4
8	Equipment Ground	Neutral	Neutral
10	SB #3 Rx+	SB #3 Tx+	Address Common
12	SB #3 Rx-	SB #3 Tx-	Address 3
14	Address 0	Address 1	Address 2
16	Ch 1 Red Sense	Ch 1 Red Out	Ch 1 Red Out
18	Ch 1 Yellow Sense	Ch 1 Yellow Out	Ch 1 Yellow Out
20	Ch 1 Green Sense	Ch 1 Green Out	Ch 1 Green Out
22	Ch 2 Red Sense	Ch 2 Red Out	Ch 2 Red Out
24	Ch 2 Yellow Sense	Ch 2 Yellow Out	Ch 2 Yellow Out
26	Ch 2 Green Sense	Ch 2 Green Out	Ch 2 Green Out
28	LV+ Signal	LV+ Signal	LV+ Signal
30	HV+ Signal	HV+ Signal	HV+ Signal
32	LV+ MAINS	Neutral	HV+ MAINS

5.7 - Model 2202-HV High-Density Switch Pack (HDSP) Connector
(DIN 41612 Type E series, 48-pin connector)

<i>Pin</i>	<i>A (Bottom Row)</i>	<i>C (Middle Row)</i>	<i>E (Top Row)</i>
2	Reserved	Reserved	Ch 1 Aux In
4	Ch 2 Aux In	Reserved	Reserved
6	+24VDC	DC Ground	Address 4
8	Equipment Ground	Neutral	Neutral
10	SB #3 Rx+	SB #3 Tx+	Address Common
12	SB #3 Rx-	SB #3 Tx-	Address 3
14	Address 0	Address 1	Address 2
16	FL#1-1 Sense	FL#1-1 Out	FL#1-1 Out
18	FL#1-2 Sense	FL#1-2 Out	FL#1-2 Out
20	Ch 1 Aux Sense	Ch 1 Aux Out	Ch 1 Aux Out
22	Ch 2 Aux Sense	Ch 2 Aux Out	Ch 2 Aux Out
24	FL#2-1 Sense	FL#2-1 Out	FL#2-1 Out
26	FL#2-2 Sense	FL#2-2 Out	FL#2-2 Out
28	LV+ Signal	LV+ Signal	LV+ Signal
30	HV+ Signal	HV+ Signal	HV+ Signal
32	LV+ MAINS	Neutral	HV+ MAINS

5.8 - Model 2202-HV High-Density Flasher Unit (HDFU) Connector
(DIN 41612 Type E series, 48-pin connector)

Pin	Description	Pin	Description	Pin	Description
A1	+24 VDC in	B1	+24 VDC in	C1	Input / Output 47
A2	Input / Output 0	B2	Input / Output 1	C2	Input / Output 48
A3	Input / Output 2	B3	Input / Output 3	C3	Input / Output 49
A4	Input / Output 4	B4	Input / Output 5	C4	Input / Output 50
A5	Input / Output 6	B5	Input / Output 7	C5	Input / Output 51
A6	Input / Output 8	B6	Input / Output 9	C6	Input / Output 52
A7	Input / Output 10	B7	Input / Output 11	C7	Input / Output 53
A8	Input / Output 12	B8	Input / Output 13	C8	SB1 TxD +
A9	Input / Output 14	B9	Input / Output 15	C9	SB1 TxD -
A10	Input / Output 16	B10	Input / Output 17	C10	SB1 RxD +
A11	Input / Output 18	B11	Input / Output 19	C11	SB1 RxD -
A12	Input / Output 20	B12	Input / Output 21	C12	SB1 TxC +
A13	Input / Output 22	B13	Input / Output 23	C13	SB1 TxC -
A14	Input / Output 24	B14	Input / Output 25	C14	SB1 RxC +
A15	Input / Output 26	B15	Input / Output 27	C15	SB1 RxC -
A16	Input / Output 28	B16	Input / Output 29	C16	LINESYNC +
A17	Input / Output 30	B17	Input / Output 31	C17	LINESYNC -
A18	Input / Output 32	B18	Input / Output 33	C18	NRESET +
A19	Input / Output 34	B19	Input / Output 35	C19	NRESET -
A20	Input / Output 36	B20	Input / Output 37	C20	ASSEMBLY ADR
A21	Input / Output 38	B21	Input / Output 39	C21	INBUS RTS
A22	Input / Output 40	B22	Input / Output 41	C22	SB2 TxD +
A23	Input / Output 42	B23	Input / Output 43	C23	SB2 TxD -
A24	Input / Output 44	B24	Input / Output 45	C24	SB2 RxD +
A25	Input / Output 46	B25	Opto Input 1	C25	SB2 RxD -
A26	Opto Input 2	B26	Opto Input 3	C26	SB2 TxC +
A27	Opto Input 4	B27	Opto Input Ground	C27	SB2 TxC -
A28	Address – 0	B28	Address – 1	C28	SB2 RxC +
A29	Address – 2	B29	Address – 3	C29	SB2 RxC -
A30	INBUS TxD	B30	INBUS RxD	C30	INBUS TxC
A31	Equipment Ground	B31	AC Line Reference	C31	INBUS RxC
A32	24 VDC Ground	B32	24 VDC Ground	C32	SIU/BIU

5.9 - Model 2218 Serial Interface Unit (SIU) Connector

Pin	Function
1	+48VDC
2	48VDC Ground**
3	+24VDC
4	+12VDC (PS-2216-2412 only)
5	24/12 VDC Ground
6	Chassis Ground

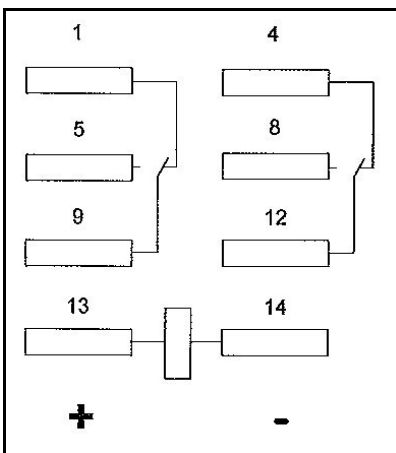
5.10 - Model 2216-24 Cabinet Power Supply (CPS) Connector (Phoenix Contact #1825161)

Circuit Breakers Definitions
FDS (Front Door Switch) to notify the CMUip when Front Door is open
RDS (Rear Door Switch) to notify the CMUip when Rear Door is open
FLS (Front Light Switch) to turn on the cabinet Front Light
RLS (Rear Light Switch) to turn on the cabinet Rear Light
Fan Test to verify Fan operation
"24 VDC BYPASS" Switch when pressed, energizes the 24 Vdc to the HDSPs during Flash Mode
Opto 1-4 place calls into Input Assembly SIU Opto Input 1-4

5.11 - Switches Definitions

Circuit Breakers Definitions:				
Service Assembly (SA) MAIN Circuit Breaker (CB) controls power to the entire ATCC				
SA CLEAN POWER CB controls power to CU, CPS and detection modules				
Service Assembly RAW PWR/GFCI CB controls Raw Power and GFCI				
SA HDFU CB controls power to SA HDSP-FU				
SA OUTPUT ASSEMBLY (OA) CB controls power to OA				
OA CB1 controls power to HDSP1 & 2				
OA CB2 controls power to HDSP3 & 4				
OA CB3 controls power to HDSP5 & 6				
OA CB4 controls power to HDSP7 & 8				

5.12 - Circuit Breakers Definitions



5.13 - Model 21H High-Density Flash Transfer Relay (HDFTR) Pin-outs

Section 6

Glossary of Terms

A	Ampere
AC	120 Volts AC, 60 Hertz
AC-	120 Volts AC, 60 Hertz grounded return to the power source
AC+	120 Volts AC, 60 Hertz ungrounded power source
ADU	Auxiliary Display Unit
ATC	Advanced Transportation Controller
AWG	American Wire Gauge
C	Celsius
CB	Circuit Breaker
Ch	Channel
CMU	Cabinet Monitor Unit
CMUip	Cabinet Monitor Unit - Internet Protocol
CPS	Cabinet Power Supply
D	Depth
DIN	Deutsche Industrie Norm
DOT	Department of Transportation
EG	Equipment Ground
EIA	Electronic Industries Association
F	Fahrenheit
FITA	Field Input Termination Assembly
FOTA	Field Output Termination Assembly
FPB	Flash Program Block
GFCI	Ground Fault Circuit Interrupter
H	Height
HDFTR	High-Density Flash Transfer Relay
HDSP	High-Density Switch Pack
HDSP/FU	High-Density Switch Pack / Flasher Unit
HDFU	High-Density Flasher Unit
HV	High-Voltage
I/O	Input /Output
IA	Input Assembly
In	Inch
iP	Internet Protocol
K	Kilo
KA	Kilo Ampere
Kbs	kilobit per Second
KHz	Kilo Hertz
lbs	Pounds
LED	Light Emitting Diode

LV	Low-Voltage
M	Mega
mA	milliampere
MHz	Mega Hertz
mm	millimeter
mph	mile per hour
ms	millisecond
N.C.	Normally Closed
N.O.	Normally Open
NA	Not Assigned
NEC	National Electric Code
OA	Output Assembly
Opto	Opto Isolator
OVA	Overlap A
OVB	Overlap B
OVC	Overlap C
OVD	Overlap D
PCB	Printed Circuit Board
Ped	Pedestrian
Ph	Phase
QC	Quality Control
RMS	Root Mean Square
Rx	Received
RYG	Red Yellow Green
SA	Service Assembly
SB	Serial Bus
SB1	Serial Bus 1
SB2	Serial Bus 2
SB3	Serial Bus 3
SDLC	Synchronous Data Link Control
SIU	Serial Interface Unit
SPST	Single Pole Single Throw
TBD	To Be Determined
Tx	Transmit
U	Rack Unit
UL	Underwriter's Laboratories, Inc.
V	Voltage
Vac	Voltage Alternate Current
Vdc	Voltage Direct Current
W	Width

City of Los Angeles



Model 357i Advanced Transportation Controller (ATC) Cabinet Specification

Specification No. 95-003-00

August 31, 2016

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Section 6

Glossary of Terms

Section 1

ATC Cabinet Components

1.1 Model 2202-HV High-Density Switch Pack / Flasher Unit (HDSP-FU)

The HDSP-FU shall be compact, pluggable, modular PCB-based, and equipped with DIN connector. The HDSP-FU shall be compatible with ultra-low power LED signal heads and it shall have a current monitoring feature for each output of each channel. The HDSP-FU shall use real-time standardized high speed SB3 communications with the Cabinet Monitor Unit to send a complete set of RMS voltage and load current measurements. The HDSP-FU shall be 4.5" H x 6.5" D and shall be equipped with a handle, reset push button switch, six RYG LED indicators, four flasher LED indicators, one power LED indicator and two Rx/Tx LED indicators.

The HDSP-FU can function as either a switch pack (HDSP) or as a flasher unit (HDFU). When installed in the Output Assembly, the High-Density Switch Pack (HDSP) shall provide two RYG channels of operation (6 outputs).

When installed in the Service Assembly, the High-Density Flasher Unit (HDFU) shall function as a four output flasher.

1.2 Model 2212-HV Cabinet Monitor Unit (CMUip)

The Cabinet Monitor Unit (CMUip) shall be compact, pluggable and modular. The CMUip shall use real-time standardized 614.4 Kbs SDLC communications with the ATC to transfer command and response data on Serial Bus #1 (SB1). The CMUip shall be capable of monitoring up to 32 physical switch pack channels (RYG) and shall have optional four virtual channels. The CMUip shall provide a Flasher Alarm feature. The CMUip shall analyze the ATC output commands and field input status to isolate the failure source by channel and color. The CMUip configuration programming shall be provided by an interchangeable Datakey nonvolatile memory device. This rugged key shall store all CMUip configuration parameters and shall eliminate programming using jumpers, diodes, or DIP switches. The CMUip shall maintain a nonvolatile event log recording the complete intersection status as well as time stamped previous fault events, AC Line events, configuration changes, monitor resets, cabinet temperature and true RMS voltages and currents for all field inputs. The signal sequence history log stored in nonvolatile memory graphically shall display up to 30 seconds of signal status prior to the fault trigger event with 50 ms resolution to ease diagnosing of intermittent and transient faults.

1.3 Model 2218 Serial Interface Unit (SIU)

The Model 2218 Serial Interface Unit (SIU) shall be a compact, pluggable and modular. The SIU shall use real-time standardized 614.4 Kbs SDLC communications with the ATC to transfer command and response data on Serial Bus #1 (SB1). The SIU shall be

equipped with 54 programmable input/out pins, four optically isolated input pins, one line sync reference input pin and 4 address select input pins. The optically isolated inputs shall work with either 12 Vac or 24 Vdc.

The SIU outputs shall be rated at 150 mA continuous sink current. Each output shall provide a 500 mA typical current limit and shall be rated to 50 V and utilize a voltage clamp for inductive transient protection. The SIU shall be equipped with a front panel LED indicator that can report the current SIU assembly address assignment of the SIU for cabinet configuration verification.

1.4 Model 2220 Auxiliary Display Unit (ADU)

The ADU shall install in a 1U height 19" rack space and shall provide a menu driven user interface to the enhanced features of the CMUip monitor including the built-in Diagnostic Wizard. The ADU shall provide 32 channels of Red, Yellow and Green LED indicators that display full intersection status and 32 Blue fault status LED indicators shall identify faulty channels. The ADU shall provide proper electrical termination to SB3. The ADU shall have a 4 line by 20 character menu driven liquid crystal display with backlight and heater. The ADU built-in Diagnostic Wizard shall automatically pinpoint faulty signals and offers trouble-shooting guidance and automatically isolate and identify problems. The ADU shall be equipped with Event Logging displaying the CMUip time-stamped nonvolatile event log records with the complete intersection status as well as AC Line events, monitor resets, temperature and true RMS voltages and currents.

1.5 Model 2217 Cabinet Power Supply (CPS)

The CPS is a card style rack mounted high efficiency switching power supply. The CPS shall provide a regulated 24VDC output and a 48VDC output. The CPS shall provide output regulation across changes in AC Line voltage and output load over the full operating temperature range of -34C to +74C. The CPS 24VDC output shall be protected against voltage transients by a 1500 Watt suppressor. The CPS shall be equipped with a LED AC Line indicator to display input status and fuse integrity and two green LED indicators to display output status and fuse integrity for each DC output. The CPS shall be rated at 120 Watts, 48 Vdc @ 1 Amp and 24 Vdc @ 3 Amp.

1.7 Model 21H High-Density Flash Transfer Relay (HDFTR)

The HDFTR shall have a hermetically sealed cover and shall be moisture proof. The HDFTR shall be filled with dry nitrogen to protect contacts from corrosion and to prevent condensation. The HDFTR shall have a shock/impact resistant metal can cover with solid and bend proof pins. The HDFTR contacts shall be rated at 120 Vac @ 5 Amp. The coil of the HDFTR shall be rated at 48 Vdc. The HDFTR shall have an LED indicator to display contact transfer position.

1.8 Main Contactor (MC)

The MC shall be mercury free and shall be rated at 120 Vac @ 60 Amp. The coil of the MC shall be rated at 48 Vdc. The MC shall be equipped with input indicator and shall have SPST- N.O. contacts.

1.9 Cabinet Suppressor-Filter

The cabinet shall be equipped with a Cabinet Suppressor–Filter. The unit shall incorporate the use of warning and failure indicators and shall have a dry relay contact remote sensing circuit. The unit shall be modular and pluggable with a 12-position Beau 5412 connector. The unit shall be rated at continuous service current of 15 Amp and maximum clamp voltage of 390 Vac. The unit shall filter noise and spike from 10 KHz to 25 MHz and shall have a peak surge current of 48 KA.

1.10 HDSP Suppressor

The HDSP Suppressor shall be modular and pluggable. The unit shall be epoxy encapsulated and equipped with 9-position 5.08 mm Phoenix Contact connector or approved equal. The unit shall be able to protect 6 circuits. The device operating voltage shall be 120 Vac and clamping voltage shall be 340 Vac. The unit dimensions shall be 2" H x 0.7" W x 2" D.

1.11 Detection Module Suppressor

The Detection Module Suppressor shall be modular and pluggable. The unit shall be epoxy encapsulated and equipped with 6-position 5.08 mm Phoenix Contact or approved equal connector. The unit shall be able to protect 6 circuits. The device operating voltage shall be 75 Vac and clamping voltage shall be 130 Vdc. The device dimensions shall be 2" H x 0.7" W x 1.2" D.

Section 2

Model 357i ATC Cabinet General Requirements

2.1 General Requirements

The cabinet shall adhere to the following requirements:

- The assemblies shall be completely removable from or installable in the cabinet without removing any other equipment and using only a standard slotted or Phillips screwdriver.
- The cabinet shall be capable of Cabinet Flash signal operation in the absence of any of the following assemblies: Combo Input and Output Assembly, Cabinet Power Supply, and Controller.
- A momentary push button shall be provided that, when pressed, energizes the 24 Vdc to the HDSPs during Flash Mode. The button shall be labeled "24 VDC BYPASS" and shall be located on the front of the Combo Input and Output Assembly.
- High-voltage components (over 50 V) shall be protected from incidental contact per NEC.
- All fuses, circuit breakers, switches (except police panel switches) and indicators shall be readily visible and accessible from the area accessed by opening the front door.
- All circuit breakers located on the rack shall have covers to prevent accidental tripping.
- All Assemblies shall be modular with pluggable cabling.
- The ventilation fans shall be fastened to the cabinet via two thumb screws and shall not be fastened in a manner that requires any tools for removal or installation.
- Door switches shall be powered by 48 Vdc.
- Wire raceway shall be integrated as part of the cabinet allowing for neat internal and field wiring.
- All equipment in the cabinet shall be clearly and permanently labeled.
- The marker strips shall be made of material that can be easily and legibly written on using a pencil or ballpoint pen. Marker strips shall be located immediately below the item they are to identify and must be clearly visible with the items installed.
- Guides (top and bottom) shall be provided for assembly plug-in units. The guides shall begin 0.50 inch from the assembly front panel face.
- Each cabinet shall include City of Los Angeles identification. The name "City of Los Angeles" shall be molded, cast, or scribed in 0.250 inch letters on the outside, top center area of the front cabinet door.

Section 3

Model 357i ATC Cabinet Specification

3.1 General

This specification describes the 120 Vac High Voltage (HV) Model 357i Advanced Transportation Controller (ATC) Cabinet ("the cabinet") for City of Los Angeles. The ATC Cabinet family is a modular, serially-interconnected cabinet architecture that is designed to fulfill a variety of transportation applications.

The cabinet shall include: Service Assembly (SA), Combo Input and Output Assembly, Combo Field Input and Output Termination Assembly and Communication Panel.

3.2 Cabinet Housing

The housing shall include, but not be limited to, the following:

- Enclosure & Doors
- Gasketing
- Lifting Eyes & External Bolt Heads
- Door Latch & Lock
- Ventilation
- EIA Rails
- Door Hinges & Catches
- Police Panel
- Aluminum Surfaces

3.2.1 Housing Construction

The housing shall be rainproof. It shall have front and rear doors, each equipped with a lock and handle. The enclosure top shall be crowned to prevent standing water. The cabinet shall be 35.50 inch tall, 20.68 inch wide and 17.88 inch deep.

3.2.2 Material Thickness

The enclosure, doors, lifting eyes, police panel door and all supports welded to the enclosure and doors fabricated of 0.125 inch minimum thickness aluminum sheet. The filter shell, filter trough, fan support and police panel enclosure shall be fabricated of 0.080 inch minimum thickness aluminum sheet.

3.2.3 Welds

All exterior seams for enclosure and doors shall be continuously welded and shall be smooth. All edges shall be filled to a radius of 0.03125 inch minimum. Exterior cabinet welds shall be done by gas Tungsten arc TIG process only. ER5356 aluminum alloy bare welding electrodes conforming to AWS A5.10 requirements shall be used for welding on aluminum. Procedures, welders and welding operators shall conform to the

requirements and practices in AWS B3.0 and C5.6 for aluminum. Internal cabinet welds shall be done by gas metal arc MIG or gas Tungsten arc TIG process.

3.2.4 Aluminum Surface Protection

The aluminum surface shall be shall be LADOT Anti-Graffiti Paint.

3.2.4.1 Anti-Graffiti Paint

If Anti-Graffiti Paint is requested, each stage in the process shall be as follows:

- Perform treatment with a moderately acidic, liquid cleaner concentrate for thorough cleaning.
- Clean water rinse from reverse osmosis system (< 2500 PPM).
- Clean water rinse from reverse osmosis system (< 500 PPM).
- Apply a conversion coating to form an excellent base for bonding powder to parts and producing good resistance to corrosion.
- Clean water rinse from reverse osmosis system (< 800 PPM).
- Clean water rinse from reverse osmosis system to decrease any solids on surfaces (< 100 PPM).
- Final seal rinse to enhance corrosion resistance.
- Convey through a dry-off oven at a cycle of 10 to 20 minutes at 380° F. This eliminates any trapped water and gases in the parts.
- Apply polyester dry powder at 90,000 volts for maximum mil transfer. Thickness of the powder coating shall nominally be 2 to 5 mils.
- Convey into the cure oven for a thermal setting [cure] cycle of 10 to 20 minutes at 380 - 425° F.

The City, at its option, may require the winning the Vendor to submit written certification of compliance to the requirements listed in this section of the specification.

3.2.5 Enclosure Door Frames and Door Seals

The enclosure door frames shall be hemmed on all four sides and shall have strikers to hold tension on, and to form a firm seal between, the door gasketing and the frame. The dimension between the door edge and the enclosure external surface when the door is closed and locked shall be 0.156 inch (+/-0.08 inches).

3.2.6 Gasketing

Gasketing shall be provided on all door openings and shall be dust-tight. Gaskets shall be 0.25 inches minimum thickness closed cell neoprene or silicone (BOYD R- 108480 or equal) and shall be permanently bonded to the metal. A gasket top and side channels shall be provided to support the top gasket on the door to prevent gasket gravitational fatigue.

3.2.7 Lifting Eyes and Exterior Bolt Heads

The housing shall be provided with 2 lifting eyes for placing the cabinet on its foundation. Each eye opening shall have a minimum diameter of 0.75 inch. Each eye shall be able to support the weight load of 1000 lbs. All bolt heads shall be tamperproof type.

3.2.8 Door Latches and Lock Mechanism

Each door shall be equipped with a removable hex handle and "U" handle.

The latching mechanism shall be a three-point draw type. When the door is closed and latched, the door shall be locked. The lock and lock support shall be rigidly mounted on the door. In the locked position, the bolt throw shall extend a minimum of 0.25 inch (+/- 0.03125 inches) into the latch cam area. A seal shall be provided to prevent dust or water entry through the lock opening.

3.2.9 Locks & Keys

The locks shall be BEST type. One key shall be supplied with each lock. The keys shall be removable in the locked position only. The locks shall have rectangular, spacing loaded bolts.

The bolt shall have a 0.281 inch throw and shall be 0.75 inch wide by 0.375 inch thick. Tolerance is 0.035 inch. A swing away cover shall be placed over the key entrance to protect the lock mechanism. The lock shall be mounted in the center.

Best Lock numbers are:

- Right Hand - 5L6RL3XA7559-606
- Left Hand - 5L6RL4X47559-606

Each cabinet will be supplied with two (2) locks, each with a "LA-1" core, keyed alike. LA-1 Keys and Core Keys shall be supplied separately, the quantity will be specified at the time of each purchase order. Contractor cores must be available upon request through the parts contract.

3.2.10 Cam

The center latch cam shall be fabricated of a minimum thickness of 0.104 inch stainless-steel. The cam shall be structured to only allow the door to open when the handle is moved toward the center of the door.

3.2.11 Hinges

Three stainless steel hinges shall be provided to bolt the enclosure to the doors.

Each hinge shall be 3.5 inch minimum length and have a fixed pin. The pin ends shall be welded to hinge and ground smooth. The pins and bolts shall be covered by the door edge and not accessible when the door is closed. A ground strap between the door and the main cabinet housing shall be required when 120 Vac components are mounted on the door.

3.2.12 Door Catches

Front and rear doors shall be provided with catches to hold the door open at both 90 and 165 (+/- 10) Degrees. The catch minimum diameter shall be 0.250 inch stainless steel rods. The catches must be capable of holding the door open at 90 degrees in a 60 mph wind acting at an angle perpendicular to the plane of the door.

3.2.13 Police Panel

A police panel assembly shall be provided to allow limited control access. The panel door shall be equipped with a lock and master police key. The front and back of the panel shall be enclosed with a rigid metal covering so that no parts having live voltage are exposed. The panel assembly shall have a drain to prevent water from collecting within the assembly. The drain shall be channeled to the outside. The 357i ATC Cabinet shall have one switch provided and labeled "SIGNALS ON - OFF" and one switch provided and labeled "FLASH - AUTO".

3.2.14 Rack Cage

The EIA rack shall consist of two continuous, adjustable equipment mounting angles. The mounting angle nominal thickness shall be 10-gauge plated steel. The mounting angles shall be tapped with 10-32 threads with EIA universal spacing. The mounting angle shall comply with standard EIA-310-B. Clearance between rails for mounting assemblies shall be 17.75 inch.

3.2.15 Housing Ventilation

Housing ventilation shall including intake, exhaust, filtration, and a thermostat controlled fan.

3.2.15.1 Intake & Filter

The louvered vent depth shall be a maximum of 0.25 inch. A removable and reusable air filter shall be housed behind the door vents. The filter filtration area shall cover the vent opening area. A filter shell shall be provided that fits over the filter providing mechanical support for the filter.

This shell shall be louvered to direct the incoming air downward. The shell sides and top shall be bent over a minimum of 0.25 inch to house the filter. The filter resident in its shell shall be held firmly in place with a bottom trough and spring loaded upper clamp. No incoming air shall bypass the filter. The bottom filter shall be formed into a waterproof sump with drain holes to the outside housing. The filter shall be 15 inch wide by 8 inch high by 1 inch thick. The filter shall be an ECO-AIR Product E35S or equal. The intake (including filter with shell) and exhaust areas shall pass a minimum of 60 cubic feet of air per minute.

3.2.15.2 Fan

Each electric fan shall be equipped with ball or roller bearings and shall have a minimum capacity of 100 cubic feet of free air delivery per minute. The fan shall be mounted within the housing and protected with a finger guard. The fan should be powered by 24 Vdc and shall be equipped with fan test switch.

3.2.16 Cabinet Light

The cabinet shall be equipped with an LED light, activated by door switches. The LED light shall have a manual switch and fuse.

3.3 Cabinet Assemblies

3.3.1 Combo Input and Output Assembly

The Combo Input and Output Assembly shall be a 19-inch rack mounted assembly and shall house four Model 2202-HV High-Density Switch Pack / Flasher Units (HDSP/FU) and either a 2-channel or a 4-channel half width device, up to four detection modules providing a maximum of 16 channels. Two resident Model 2218 Serial Interface Units (SIU) shall provide interface and control via SB1/SB2.

The Combo Input and Output Assembly shall house one CMUip-2212-HV Cabinet Monitor Unit (CMUip), Main Contactor, Stop Time Switch, Flash / Auto Switch, four Opto Switches, four Circuit Breakers and Momentary 24 Vdc Bypass Switch.

3.3.2 Combo Field Input and Output Termination Assembly

The Combo Field Input and Output Termination Assembly shall be coupled with the Combo Input and Output Assembly and shall house four HDFTRs. Each HDFTR position shall be labeled with the number of its associated HDSP (1-4). Flash Program Blocks (FPB) shall be provided to control and select the color (red, yellow, or dark) during cabinet Flash mode. Each FPB position shall be labeled with the number of its associated channel (1-8).

The Combo Field Input and Output Termination Assembly shall be provided with eight, 6-position Phoenix Contact terminal block model number 1804946 plugs and 1861196 sockets or approved equal. Each Load Terminal Block receptacle shall be labeled with the number of its associated channel (1-8). Additional labels shall be provided to clearly indicate which terminals correspond to the red, yellow, and green switch pack outputs. The color of these labels shall match the color of their associated output (red, yellow, or green).

The Field Input and Output Termination Assembly shall have positions for landing 16, two-wire inputs and their associated earth ground wires. The Combo Field Input and Output Termination Assembly shall have positions for 8 Detection Module Suppressors.

HDSP Suppressors and Detection Module Suppressors shall be supplied with the cabinet if procurement requires.

3.3.3 Service Assembly

The Service Assembly shall be modular and mounted across the EIA rails. It shall house: one HDFU, Cabinet Power Supply, Cabinet Filter-Suppressor HESO HE1750R or approved equal, GFCI, Convenient Outlets, five Circuit Breakers, four HDFU output fuses, AC+ raw terminal block and one 6-postion TBS terminal with BBS landing provision.

3.3.4 SB1/SB2 and DC Power Bus

SB1/SB2 and DC Power Bus shall be embedded into the Service Assembly to accommodate interconnection between the assemblies.

3.3.5 AC Clean Power Bus

The AC Clean Power Bus shall be embedded into the Service Assembly to provide Clean Power for the Controller Unit, Cabinet Power Supply and detection modules.

3.3.6 Communication Panel

3.3.6.1 Communications Cable Terminal Block (CTB-1)

Communications Cable Terminal Blocks shall be quick-connected blocks consisting of 25 horizontal rows of six (6) clips per row, mounted in a molded self-extinguishing plastic case. The horizontal rows of six (6) clips shall be divided into two (2) sets of three (3) electrically common clips. The two (2) sets of three (3) clips shall be connected by a bridge clip. These blocks, commonly referred to "66B Type" blocks, shall terminate 25 pairs of 20 through 24 AWG solid unstripped conductors. The blocks shall be equipped with integral fanning strips and an enclosed back to prevent grounding of clips to the panel.

3.3.6.2 Termination Block (CTB-2)

A four (4) position, double row, closed back design terminal block, **Kulka** part No. 671-GP-04 or equivalent, labeled CTB-2 shall be mounted on the Communications Termination Panel. The strip shall be rated at 15 Amps and shall be provided with 6-32 by 0.250 inch nickel plated brass binder head screws.

3.3.6.3 C-20 Termination Block (CTB-3)

A four (4) position, double row, closed back design terminal block, **Kulka** part No. 671-GP-04 or equivalent, labeled CTB-3 shall be mounted on the Communications Termination Panel. The strip shall be rated at 15 Amps and shall be provided with 6-32 by 0.250 inch nickel plated brass binder head screws.

3.3.6.4 Over-Voltage Protection

An over voltage surge protector shall be provided for each active communications cable pair (Audio-In pair, and Audio-Out pair) terminating at CTB-2 and CTB-3. Protectors shall be of the Three-Electrode Gas Tube type, and shall have the following ratings:

- Impulse Life (1,000 Amp, 10/1000 waveshape at one minute intervals each direction, with 500 Amps on each side to ground simultaneously): 1,000 surges minimum, 2,500 surges typical.
- AC Discharge Current, 11 cycles, 60 Hz: 400 Amps RMS, 200 Amps on each side to ground simultaneously
- Maximum Single Impulse Discharge Current, 8/20 waveshape: 40 kA maximum, 20 kA/side simultaneously
- Capacitance: Line-ground = 4 pf, Line-line = 2 pf
- DC Holdover: 180 VDC typical at 200 mA, 150 VDC minimum
- DC Arc Voltage: 30 volts typical
- Glow to Arc Transition Current: 1.0 Amp typical
- Transition Time: 0.5 microseconds maximum
- Line-Ground Impulse Breakdown Voltage at 10 kV/sec: 1000 volts maximum average

3.3.6.5 Insulation Resistance

1,000 megohms minimum at 100 VDC (line-ground). The protectors shall be encapsulated, and shall be equipped with minimum 2 inches long, spade lug tipped leads. Maximum size of each protector shall be 0.5 x 0.5 x 2.0 -inches. The grounding lead shall be attached to the panel's grounding stud.

3.3.6.6 Grounding Stud

A grounding stud shall be provided. The stud shall extend through the panel. The over voltage protection devices' ground leads shall be attached to the stud on the front side of the panel. A No. 8 AWG copper conductor shall connect to the stud on the back side of the panel, and shall connect to the cabinet's Equipment Grounding Bus.

3.3.6.7 C2P Harness and Connector

4-conductor jacketed cables shall each be attached to terminal blocks CTB-2 and CTB-3 with soldered ring lugs. The cables shall terminate with a standard C2P and C20P connectors, and shall be routed through the cabinet, 2 feet in length to reach the back of the 2070 Controller Unit, when the unit is installed in the equipment rack.

3.3.6.8 Feed-Through Opening

A feed-through openings, complete with protective grommets, shall be provided on the panel to protect the C2P and C20P harnesses. A strain relief device shall also be provided for each.

3.3.6.9 Cable-Tie Openings

Six (6) 0.250 inch diameter holes shall be provided for installation of cable ties.

3.3.6.10 Allen Tel Distribution Ring

Allen Tel Distribution Ring model #GB 13 or equivalent shall be installed at the bottom of the panel CTB-1.

3.3.6.11 Attachment to Equipment Rack

The panel shall be securely attached to the equipment rack using mounting keyholes sized to facilitate removal of the panel without removing the mounting screws.

3.4 Components requirements

3.4.1 Combo Input and Output Assembly Components Requirements

- (4 each) Model 2202-HV HDSP or approved equal
- (2 each) Model 2218 SIU or approved equal
- (1 each) Model 2212-HV CMUp or approved equal
- (3 each) Module LMD624H 4-Channel Half Width Detector or approved equal
- (1 each) Model 244L DC Isolator or approved equal

3.4.2 Combo Field Input and Output Termination Assembly Components Requirements

- (4 each) Model 21H HDFTR or approved equal
- (4 each) HDSP Suppressor
- (N/A) Detection Module Suppressor
- (8 each) Red Flash Program Block
- (2 each) Yellow Flash Program Block
- (2 each) White Flash Program Block

3.4.3 Service Assembly Components Requirements

- (1 each) Model 2202-HV HDFU or approved equal
- (1 each) Cabinet Suppressor-Filter

- (1 each) Model 2217 Cabinet Power Supply (CPS) or approved equal

3.4.4 Cabinet Components Requirements

- (1 each) Model 2220 ADU or approved equal
- (1 each) Mounting Hardware

3.5 Model 357i ATC Cabinet I/O Assignments

357i ATC Cabinet (rev. 7-6-2016)											
Combo Input/output Modules											
		Ch1/2	Ch3/4	Ch5/6	Ch7/8	SIU 1	Ch1/2	Ch3/4	Ch5/6	Ch7/8	SIU 9
		HDSP1	HDSP2	HDSP3	HDSP4		4-ch	4-ch	4-ch	4-ch	
		R	R	R	R		Input	Input	Input	Input	
		Y	Y	Y	Y		Card	Card	Card	Card	
SIU 9	CMU	G	G	G	G	SIU 1	Ch-1	Ch-1	Ch-1	Ch-1	SIU 9
Opto 1&2		R	R	R	R		Ch-2	Ch-2	Ch-2	Ch-2	
Opro 3&4		Y	Y	Y	Y		Ch-3	Ch-3	Ch-3	Ch-3	
		G	G	G	G		Ch-4	Ch-4	Ch-4	Ch-4	
* Can be assigned to any phase, ped or overlap											
CMU Channel (Ch) Assignments											
		HDSP1	HDSP2	HDSP3	HDSP4						
	CMU	Ch-1	Ch-3	Ch-5	Ch-7						
		Ch-1	Ch-3	Ch-5	Ch-7						
		Ch-1	Ch-3	Ch-5	Ch-7						
		Ch-2	Ch-4	Ch-6	Ch-8						
		Ch-2	Ch-4	Ch-6	Ch-8						
		Ch-2	Ch-4	Ch-6	Ch-8						
SIU 1 Output Assignments (CU SIU Address = 1)											
		HDSP1	HDSP2	HDSP3	HDSP4						
		IO 0	IO 6	IO 12	IO 18						
		IO 1	IO 7	IO 13	IO 19						
		IO 2	IO 8	IO 14	IO 20	SIU 1					
		IO 3	IO 9	IO 15	IO 21						
		IO 4	IO 10	IO 16	IO 22						
		IO 5	IO 11	IO 17	IO 23						
SIU 9 Input Assignments (CU SIU Address = 9)											
							4-Ch	4-Ch	4-Ch	4-Ch	
							Input	Input	Input	Input	
							Card	Card	Card	Card	
							IO 6	IO 10	IO 14	IO 18	SIU 9
							IO 7	IO 11	IO 15	IO 19	
							IO 8	IO 12	IO 16	IO 20	
							IO 9	IO 13	IO 17	IO 21	

Model 357i ATC Cabinet I/O Assignments

Section 4

ATC Cabinet Electrical, Environmental and Testing Requirements

4.1 General

The requirements called out in this specification dealing with equipment evaluation are a minimum guide and shall not limit the testing and inspection to ensure compliance.

4.2 Certification

These test procedures shall be followed by the manufacturers who shall certify that they have conducted inspection and testing in accordance with this specification.

4.3 Inspection

A visual and physical inspection shall include mechanical, dimensional and assembly conformance of all parts of this specification.

4.4 Environmental and Electrical

All components shall properly operate within the following limits unless otherwise noted:

- Applied Line Voltage: 90 to 135 Vac
- Frequency: 60 (+/-3.0) Hertz
- Humidity: 5% to 95%
- Ambient Temperature: -34.6 °F to +165.2 °F
- Shock - Test per Specification MIL-STD-810G Method 516.6
- Vibration - per Specification MIL-STD-810G Method 514.6

4.5 Commencement Operation

All circuits, unless otherwise noted, shall commence operation at or below 90 Vac as the applied voltage is raised from 50 to 90 Vac at a rate of 2 (+/-0.5) volts / second.

4.6 Equipment Compliance

All equipment shall be unaffected by transient voltages normally experienced on commercial power lines. Where applicable, equipment purchased separately from the cabinet (which normally is resident) will be tested for compliance.

4.7 Power Line Surge Protection

The power line surge protection shall enable the equipment being tested to withstand (Non-destructive) and operate normally following the discharge of a 25 µF capacitor charged to $\pm 2,000$ volts, applied directly across the incoming AC line at a rate of once every 10 seconds for a maximum of 50 occurrences per test. The unit under test will be operated at $68\text{ }^{\circ}\text{F} \pm 41\text{ }^{\circ}\text{F}$ and at $120 (\pm 12)\text{ Vac}$.

4.8 Operating

The equipment shall withstand (Non-destructive) and operate normally when one discharge pulse of plus or minus 300 volts is synchronously added to its incoming AC power line and moved uniformly over the full wave across 360 degrees or stay at any point of Line Cycle once every second. Peak noise power shall be 5 kilowatts with a pulse rise time of 500 ns. The unit under test will be operated at 68 °F $\pm$ 41 °F and at 120 (+/-12) Vac.

4.9 UL Requirements

Equipment shall comply only with the requirements of UL Bulletin of Research No. 23, "Rain Tests of Electrical Equipment."

4.10 Normal Operation

All equipment shall continue normal operation when subjected to the following:

4.10.1 Low Temperature Test

With the item functioning at a line voltage over Electrical Range the Device in its intended operation, the ambient temperature shall be lowered from 68 °F to 34.6 °F at a rate of not more than 64.4 °F per hour. The item shall be cycled at -34.6 °F for a minimum of 5 hours and then returned to 68 °F at the same rate.

4.10.2 High Temperature Test

With the item functioning at a line voltage over Electrical Range the Device in its intended operation, the ambient temperature shall be raised from 68 °F to 165.2 °F at a rate of not more than 64.4 °F per hour. The item shall be cycled at 165.2 °F for 5 hours and then returned to 68 °F at the same rate. The test shall be repeated with the line voltage at 135 Vac.

4.10.3 Normal Operation

All equipment shall resume normal operation following a period of at least 5 hours at -34.6 °F and less than 10 percent humidity and at least 5 hours at 165.2 °F and 22% humidity, when 90 Vac is applied to the incoming AC.

4.10.4 Humidity and Ambient Temperature

The relative humidity and ambient temperature values in the following table shall not be exceeded.

Ambient Temperature/ Dry Bulb (in 0F)	Relative Humidity (in percent)	Ambient Temperature/ Wet Bulb (in 0F)
-34.6 to 33.98	10	1.04 to 108.86
33.98 to 114.8	95	108.86
119.84	70	108.86
129.92	50	108.86
140	38	108.86
149.72	28	108.86
160.16	21	108.86
165.2	18	108.86

Ambient Temperature versus Relative Humidity @ Barometric Pressure (29.92 In. Hg.)

4.11 QC / Final Test

A complete QC / final test report shall be supplied with the Model 357i ATC Cabinet. The test report shall indicate the name of the tester and shall be signed by a responsible manager.

4.12 Quality Control Procedure & Test Report

The quality control procedure and test report format shall be supplied to the Engineer or approval within 15 days following the award of the contract. The quality control procedure shall include the following:

- Acceptance testing of all supplied components
- Physical and functional testing of all modules and items
- A minimum 100-hour burn-in of all equipment
- Physical and functional testing of all items

4.13 Cabinet Print

Wiring diagram sheets for the cabinet shall be furnished in a weatherproof plastic pouch placed in the cabinet. Cabinet wiring diagrams shall be on non-fading.

4.13 Manual

One copy of manual documentation shall be supplied for each item purchased. The manual shall be printed on 8.5 in by 11 in paper, with the exception that schematics, layouts, parts lists and plan details may be on 11 in by 17 in sheets, with each sheet neatly folded to 8.5 in by 11 in size. The manual shall be formatted per the following table:

Section	Description
N/A	Table of Contents
1	Glossary
2	General Description
3	General Characteristics
4	Installation
5	Adjustments
6	Theory of Operation
	6a. Systems Description (include block diagram)
	6b. Detailed Description of Circuit Operation
7	Maintenance
	7a. Preventive Maintenance
	7b. Trouble Analysis
	7c. Trouble Shooting Sequence Chart
	7d. Wave Forms
	7e. Voltage Measurements
	7f. Alignment Procedures
8	Parts List (include circuit and board designation, part type and class, power rating, component manufacturer, mechanical part manufacturer, data specification sheets for special design components and original manufacturer's part number)
9	Electrical Interconnection Details & Drawings
10	Schematic and Logic Diagram
11	Assembly Drawings and a pictorial diagram showing physical locations and identification of each component or part

Section 5 Drawings

Pin #	Function	Pin #	Function
A1	+24VDC Monitor	B1	Reserved
A2	+12VDC Monitor	B2	External Test Reset
A3	VDC Ground	B3	Serial Bus #1 Disable
A4	Monitor Interlock	B4	Reserved
A5	Address 0	B5	Address 1
A6	Reserved	B6	Reserved
A7	SB1 TxData +	B7	SB1 TxData -
A8	SB1 RxData +	B8	SB1 RxData -
A9	SB1 TxClock +	B9	SB1 TxClock -
A10	SB1 RxClock +	B10	SB1 RxClock -
A11	Reserved	B11	Reserved
A12	Reserved	B12	Reserved
A13	Reserved	B13	Reserved
A14	Reserved	B14	Reserved
A15	Line Sync +	B15	Line Sync -
A16	Nreset +	B16	Nreset -
A17	PowerDown +	B17	PowerDown -
A18	SB3 TxData +	B18	SB3 TxData -
A19	SB3 RxData +	B19	SB3 RxData -
A20	SB3 Clock+	B20	SB3 Clock-
A21	LF Status	B21	LF Status
A22	Output Relay NO	B22	Output Relay NO
A23	CB Trip Status	B23	Reserved
A24	MC Coil Status	B24	Reserved
A25	MC Secondary Status	B25	Reserved
A26	FTR Coil Drive Status	B26	Reserved
A27	Door Switch Front	B27	Reserved
A28	Door Switch Rear	B28	Reserved
A29	Reserved	B29	Reserved
A30	Reserved	B30	MAINS Power
A31	Equipment Ground	B31	Reserved
A32	Reserved	B32	MAINS Ground (Neutral)

5.1 - Model 2212-HV Cabinet Monitor Unit (CMUip) Connector
(DIN 4161264 Header Type)

PIN#	AT THE CONTROLLER	AT THE SIU	PIN#	AT THE CONTROLLER	AT THE SIU
1	SB1 TXD+	SB1 RXD+	14	SB1 TXD-	SB1 RXD-
2	SB1 RXD+	SB1 TXD+	15	SB1 RXD-	SB1 TXD-
3	SB1 TXC+	SB1 RXC+	16	SB1 TXC-	SB1 RXC-
4	SB1 RXC+	SB1 TXC+	17	SB1 RXC-	SB1 TXC-
5	SB2 TXD+	SB2 RXD+	18	SB2 TXD-	SB2 RXD-
6	SB2 RXD+	SB2 TXD+	19	SB2 RXD-	SB2 TXD-
7	SB2 TXC+	SB2 RXC+	20	SB2 TXC-	SB2 RXC-
8	SB2 RXC+	SB2 TXC+	21	SB2 RXC-	SB2 TXC-
9	LINE SYNC+	LINE SYNC+	22	LINE SYNC-	LINE SYNC+
10	NRESET+	NRESET+	23	NRESET-	NRESET-
11	PWR DWN+		24	PWR DWN-	
12	+5VDC ISO		25	EQ GND	
13	ISO GND	DC GND			

5.2 - SB1/SB2 Connector (DB 25)

Pin	Function
1	Reserved
2	Reserved
3	Neutral (AC- Raw)
4	RxDATA +
5	RxDATA -
6	Neutral (AC- Raw)
7	TxDATA +
8	TxDATA -

5.3 - Serial Bus 3 (RJ-45) Connector

<i>Pin</i>	<i>A (Bottom Row)</i>	<i>C (Middle Row)</i>	<i>E (Top Row)</i>
2	Ch 1 Red In	Ch 1 Yellow In	Ch 1 Green In
4	Ch 2 Red In	Ch 2 Yellow In	Ch 2 Green In
6	+24VDC	DC Ground	Address 4
8	Equipment Ground	Neutral	Neutral
10	SB #3 Rx+	SB #3 Tx+	Address Common
12	SB #3 Rx-	SB #3 Tx-	Address 3
14	Address 0	Address 1	Address 2
16	Ch 1 Red Sense	Ch 1 Red Out	Ch 1 Red Out
18	Ch 1 Yellow Sense	Ch 1 Yellow Out	Ch 1 Yellow Out
20	Ch 1 Green Sense	Ch 1 Green Out	Ch 1 Green Out
22	Ch 2 Red Sense	Ch 2 Red Out	Ch 2 Red Out
24	Ch 2 Yellow Sense	Ch 2 Yellow Out	Ch 2 Yellow Out
26	Ch 2 Green Sense	Ch 2 Green Out	Ch 2 Green Out
28	LV+ Signal	LV+ Signal	LV+ Signal
30	HV+ Signal	HV+ Signal	HV+ Signal
32	LV+ MAINS	Neutral	HV+ MAINS

5.4 - Model 2202-HV High-Density Switch Pack (HDSP) Connector
(DIN 41612 Type E series, 48-pin connector)

<i>Pin</i>	<i>A (Bottom Row)</i>	<i>C (Middle Row)</i>	<i>E (Top Row)</i>
2	Reserved	Reserved	Ch 1 Aux In
4	Ch 2 Aux In	Reserved	Reserved
6	+24VDC	DC Ground	Address 4
8	Equipment Ground	Neutral	Neutral
10	SB #3 Rx+	SB #3 Tx+	Address Common
12	SB #3 Rx-	SB #3 Tx-	Address 3
14	Address 0	Address 1	Address 2
16	FL#1-1 Sense	FL#1-1 Out	FL#1-1 Out
18	FL#1-2 Sense	FL#1-2 Out	FL#1-2 Out
20	Ch 1 Aux Sense	Ch 1 Aux Out	Ch 1 Aux Out
22	Ch 2 Aux Sense	Ch 2 Aux Out	Ch 2 Aux Out
24	FL#2-1 Sense	FL#2-1 Out	FL#2-1 Out
26	FL#2-2 Sense	FL#2-2 Out	FL#2-2 Out
28	LV+ Signal	LV+ Signal	LV+ Signal
30	HV+ Signal	HV+ Signal	HV+ Signal
32	LV+ MAINS	Neutral	HV+ MAINS

5.5 - Model 2202-HV High-Density Flasher Unit (HDFU) Connector
(DIN 41612 Type E series, 48-pin connector)

Pin	Description	Pin	Description	Pin	Description
A1	+24 VDC in	B1	+24 VDC in	C1	Input / Output 47
A2	Input / Output 0	B2	Input / Output 1	C2	Input / Output 48
A3	Input / Output 2	B3	Input / Output 3	C3	Input / Output 49
A4	Input / Output 4	B4	Input / Output 5	C4	Input / Output 50
A5	Input / Output 6	B5	Input / Output 7	C5	Input / Output 51
A6	Input / Output 8	B6	Input / Output 9	C6	Input / Output 52
A7	Input / Output 10	B7	Input / Output 11	C7	Input / Output 53
A8	Input / Output 12	B8	Input / Output 13	C8	SB1 TxD +
A9	Input / Output 14	B9	Input / Output 15	C9	SB1 TxD -
A10	Input / Output 16	B10	Input / Output 17	C10	SB1 RxD +
A11	Input / Output 18	B11	Input / Output 19	C11	SB1 RxD -
A12	Input / Output 20	B12	Input / Output 21	C12	SB1 TxC +
A13	Input / Output 22	B13	Input / Output 23	C13	SB1 TxC -
A14	Input / Output 24	B14	Input / Output 25	C14	SB1 RxC +
A15	Input / Output 26	B15	Input / Output 27	C15	SB1 RxC -
A16	Input / Output 28	B16	Input / Output 29	C16	LINESYNC +
A17	Input / Output 30	B17	Input / Output 31	C17	LINESYNC -
A18	Input / Output 32	B18	Input / Output 33	C18	NRESET +
A19	Input / Output 34	B19	Input / Output 35	C19	NRESET -
A20	Input / Output 36	B20	Input / Output 37	C20	ASSEMBLY ADR
A21	Input / Output 38	B21	Input / Output 39	C21	INBUS RTS
A22	Input / Output 40	B22	Input / Output 41	C22	SB2 TxD +
A23	Input / Output 42	B23	Input / Output 43	C23	SB2 TxD -
A24	Input / Output 44	B24	Input / Output 45	C24	SB2 RxD +
A25	Input / Output 46	B25	Opto Input 1	C25	SB2 RxD -
A26	Opto Input 2	B26	Opto Input 3	C26	SB2 TxC +
A27	Opto Input 4	B27	Opto Input Ground	C27	SB2 TxC -
A28	Address – 0	B28	Address – 1	C28	SB2 RxC +
A29	Address – 2	B29	Address – 3	C29	SB2 RxC -
A30	INBUS TxD	B30	INBUS RxD	C30	INBUS TxC
A31	Equipment Ground	B31	AC Line Reference	C31	INBUS RxC
A32	24 VDC Ground	B32	24 VDC Ground	C32	SIU/BIU

5.6 - Model 2218 Serial Interface Unit (SIU) Connector

Pin	Function
1	Chassis Ground
2	AC- Neutral
3	AC+ Power
4	24VDC Ground
5	+24VDC Output
6	48VDC Ground
7	+48VDC Output

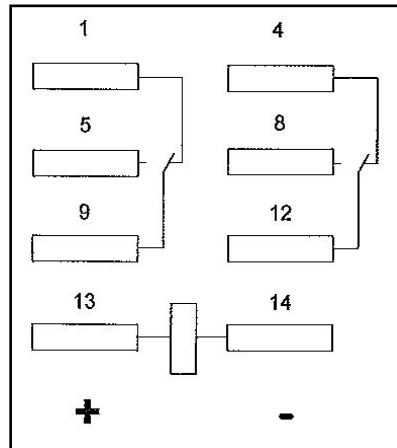
5.7 - Model 2217 Cabinet Power Supply (CPS) Connector (Phoenix Contact #1776553)

Circuit Breakers Definitions
FDS (Front Door Switch) to notify the CMU when Front Door is open
RDS (Rear Door Switch) to notify the CMU when Rear Door is open
FLS (Front Light Switch) to turn on the Front cabinet Light
RLS (Rear Light Switch) to turn on the Rear cabinet Light
Fan Test to verify Fan operation
"24 VDC BYPASS" Switch when pressed, energizes the 24 Vdc to the HDSPs during Flash Mode
Opto 1-4 place calls into Input Assembly SIU Opto Input 1-4

5.8 - Switches Definitions

Circuit Breakers Definitions
Service Assembly (SA) MAIN Circuit Breaker (CB) controls power to the entire ATCC
Service Assembly CLEAN POWER CB controls power to CU, CPS & detection modules
Service Assembly RAW PWR/GFCI CB controls Raw Power and GFCI
Service Assembly HDFU CB controls power to HDFU
Service Assembly Combo I/O CB controls power to HDSPs

5.9 - Circuit Breakers Definitions



5.10 - Model 21H High-Density Flash Transfer Relay (HDFTR) Pin-outs

Section 6

Glossary of Terms

A	Ampere
AC	120 Volts AC, 60 Hertz
AC-	120 Volts AC, 60 Hertz grounded return to the power source
AC+	120 Volts AC, 60 Hertz ungrounded power source
ADU	Auxiliary Display Unit
ATC	Advanced Transportation Controller
AWG	American Wire Gauge
C	Celsius
CB	Circuit Breaker
Ch	Channel
CMU	Cabinet Monitor Unit
CMUip	Cabinet Monitor Unit - Internet Protocol
CPS	Cabinet Power Supply
D	Depth
DIN	Deutsche Industrie Norm
DOT	Department of Transportation
EG	Equipment Ground
EIA	Electronic Industries Association
F	Fahrenheit
FITA	Field Input Termination Assembly
FOTA	Field Output Termination Assembly
FPB	Flash Program Block
GFCI	Ground Fault Circuit Interrupter
H	Height
HDFTR	High-Density Flash Transfer Relay
HDSP	High-Density Switch Pack
HDSP/FU	High-Density Switch Pack / Flasher Unit
HDFU	High-Density Flasher Unit
HV	High-Voltage
I/O	Input /Output
IA	Input Assembly
In	Inch
iP	Internet Protocol
K	Kilo
KA	Kilo Ampere
Kbs	kilobit per Second
KHz	Kilo Hertz
lbs	Pounds
LED	Light Emitting Diode

LV	Low-Voltage
M	Mega
mA	milliampere
MHz	Mega Hertz
mm	millimeter
mph	mile per hour
ms	millisecond
N.C.	Normally Closed
N.O.	Normally Open
NA	Not Assigned
NEC	National Electric Code
OA	Output Assembly
Opto	Opto Isolator
OVA	Overlap A
OVB	Overlap B
OVC	Overlap C
OVD	Overlap D
PCB	Printed Circuit Board
Ped	Pedestrian
Ph	Phase
QC	Quality Control
RMS	Root Mean Square
Rx	Received
RYG	Red Yellow Green
SA	Service Assembly
SB	Serial Bus
SB1	Serial Bus 1
SB2	Serial Bus 2
SB3	Serial Bus 3
SDLC	Synchronous Data Link Control
SIU	Serial Interface Unit
SPST	Single Pole Single Throw
TBD	To Be Determined
Tx	Transmit
U	Rack Unit
UL	Underwriter's Laboratories, Inc.
V	Voltage
Vac	Voltage Alternate Current
Vdc	Voltage Direct Current
W	Width