City of Winnipeg

GENERAL SPECIFICATIONS FOR

TRAFFIC SIGNAL CONTROL EQUIPMENT

September 2010

The City of Winnipeg has been granted permission by California's Department of Transportation to duplicate CALTRANS TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS.

The following technical specifications supplement the requirements of CALTRANS TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS, dated January, 1989 and November, 1993.

1. **PCB Circuit Reference Markings** - PCBs shall have circuit reference symbols clearly and legibly marked by silkscreen, circuit printing or similar permanent marking system on the circuit side, as nearby as practicable to the component referenced. PCB circuit reference symbols shall be identical to those depicted on the pictorial diagram within the manual which shows the physical locations and identification of each component.
   This component marking requirement shall apply to all PCBs **except** those within Model 200 Switchpacks and Model 204 Flasher Units. (Reference Item 1.6.1.6 on Page 18 "General Specifications").

2. **PCB Edge Connector Contacts** - all PCB edge connectors shall contain the maximum number of gold-plated contact fingers on both sides of the PCB, including contact fingers for spare and non-assigned connector positions, such that every bifurcated contact within the PCB receptacle (edge-connector) socket makes contact with plated contact fingers on the PCB. (Reference Item 1.2.5.3.6 on Page 12 "General Specifications").

3. ***Sensed conflicting*** field output ***voltages*** 25 VAC or greater for a ***duration of 250 ms*** or longer (***CALTRANS specifies 500 ms***) shall cause a FAILED state. (Reference Item 4.5.1.3 on Page 49 "Model 208/210 Monitors").

4. ***Sensed conflicting*** field output voltages between 15 and 25 VAC and for ***durations between 200 ms and 250 ms*** (***CALTRANS specifies 200 and 500 ms***) (Reference Item 4.5.1.4 on Page 50 "Model 208 and 210 Monitors").

   The above two Conflict Monitor provisions (3. and 4.) are modified for *Winnipeg application* to permit the Monitor to properly sense flashing field output circuits which flash at a rate greater than 1 Hz, so as to be compatible with "Winnipeg Standard" Model 170E flash rate of ***100 flashes per minute*** (300 ms ON + 300 ms OFF).

5. Model 336 Cabinets need not be supplied with a "BASE ADAPTER".

TABLE of CONTENTS

ITEMS SUPPLIED
Items supplied shall be new and unused.

SPECIFICATION PRIORITIES
In case of conflict, the individual chapter shall govern over APPENDIX A and APPENDIX A shall govern over Chapter 1, General Requirements.

CHAPTER 1

GENERAL SPECIFICATIONS FOR TRAFFIC SIGNAL CONTROL EQUIPMENT

TABLE OF CONTENTS

THIS CHAPTER CONTAINS GENERAL REQUIREMENTS APPLICABLE TO ALL EQUIPMENT SPECIFIED IN THIS DOCUMENT.

1.1 SECTION 1 – GLOSSARY

1.1.1 . 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 equal.

ANSI - American National Standards Institute.

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.

AWG - American Wire Gauge.

C - Celsius

Cabinet - An outdoor enclosure for housing the controller unit and associated equipment.

Caltrans – California Department of Transportation

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 Winnipeg, Province of Manitoba, Canada. The City of Winnipeg Public Works Department, Transportation Division, Traffic Signal Systems Branch.

CMOS - Complementary Metal Oxide Semiconductor.

Component - A component shall be identified 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, as party or parties of the second part or his or their legal representative.

Controller Unit - That portion of the controller assembly devoted to the operational control of the logic decisions programmed into the assembly.

CPU - Central Processing Unit.

CR - ACIA Control Register.

CSA - Canadian Standards Association.

DAT Program - The State of California Department of Transportation's Diagnostic and Acceptance Test Program.

DC - Direct Current.

DTA - Down Time Accumulator.

dB - Decibel.

dBa - Decibels above reference noise, adjusted.

deg – Degrees.

EG - Equipment Ground.

EIA - Electronic Industries Association.

Engineer - The Manager of the Traffic Signal Systems Branch of the CITY of Winnipeg, 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.

Equal - Connectors: complying to physical dimensions, contact/pin 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. Interpretation shall be in the judgment of the Engineer.

ETL - Electrical Testing Laboratories, Inc.

HEX - Hexadecimal.

Hz - Hertz.

I.D. - Identification.

Jumper - A means of connecting/disconnecting two or more conductive points by soldering/desoldering a conductive wire jumper.

Laboratory (Shop) - The established Maintenance Shop of the City of Winnipeg Traffic Signals Assets Branch of the Transportation Division; or other laboratories authorized by the Department to test materials involved in the contract.

LED - Light Emitting Diode.

mA - Milliampere.

MIC - Hitachi HD6303X microprocessor device (or equal).

MODEM - Modulate/Demodulate 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.

MPU - Motorola 6800 microprocessor device (or equal).

ms - Millisecond.

mW - Milliwatt.

M/170E - Program Module/Model 170E Controller Unit Connector.

NA - Presently Not Assigned. Cannot be used by the contractor for other purposes.

NEMA - National Electrical Manufacturer's Association.

NETA - National Electrical Testing Association, Inc.

N.C. - Normally closed contact.

N.O. - Normally open contact.

ns - Nanosecond.

PLA/PAL - Programmable Array Logic Device.

PCB - Printed Circuit Board.

RDR - ACIA Receiver Data Register.

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 Adjustor Circuitry.

RTS - Request to Send.

R/W - Model 170E Controller Unit Read/Write Control Line.

SCI - Serial Communications Interface.

Second Sourced - Produced by more than one manufacturer.

SR - ACIA Status Register.

SRAM - Static Random Access Memory Device.

STATE - State of California

SW - Switch.

TDR - ACIA Transmit Data Register.

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

TTL - Transistor-Transistor Logic.

uA - Microampere.

UL - Underwriter's Laboratories, Inc.

us - Microsecond.

VAC - Voltage Alternating Current.

VDC - Voltage Direct Current.

VMA - Valid Memory Address.

Watchdog Timer (WDT) - A monitoring circuit, external to the Controller Unit, which senses a Controller Unit Output Line.

XX - Manufacturer's Option.

1.2 SECTION 2 – GENERAL

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

1.2.2 Documentation

1.2.2.1 Two manuals shall be supplied with each item up to a maximum of five (5) manuals.

1.2.2.2 Manuals shall be printed on 8.5 by 11 inch paper. Schematics, layouts, parts lists and plan details may be on 11 by 17 inch sheets, but the sheets must be neatly folded to 8.5 by 11 inch size. The manual shall be bound in durable covers.

1.2.2.3 Each manual shall include the following:

- General Description
- General Characteristics
- Installation
- Adjustments
- Theory of Operation
    1. Systems Description (include block diagram).
    2. Detailed Description of Circuit Operation.
- Maintenance
    1. Preventative Maintenance.
    2. Trouble Analysis.
    3. Trouble Shooting Sequence Chart.
    4. Wave Forms
    5. Voltage Measurements.
    6. Alignment Procedures.

- 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.
- Assembly drawings and a pictorial diagram showing physical locations and identification of each component.
- The serial numbers and revision numbers of equipment covered by manuals shall be printed on the front cover of the manuals.

1.2.2.4 Manuals for the Model 170E Controller Unit, Models 332, 334 and 336 Cabinets shall be furnished with the item and enclosed in the shipping container.

1.2.2.5 Prior to final printing, a preliminary draft of all manuals shall be submitted to the Engineer for approval.

1.2.3 Interchangeability - The following assemblies and their respective associated devices shall electrically and mechanically intermate and be compatible with each other:

ASSEMBLIES	ASSOCIATED DEVICES
Output File #1 and #2	Model 200 Switch Pack Model 210 Monitor Unit Model 430 Heavy Duty Relay

Input File	Models 222, 224 and 232 Detectors Models 242 and 252 Isolators
Power Distribution Assembly #1 and #2	Model 204 Flasher Unit Model 206 Power Supply Module Model 430 Heavy Duty Relay
Power Distribution Assembly #3	Model 200 Switch Pack Model 206 Power Supply Module Model 208 Monitor Unit Model 430 Heavy Duty Relay
Model 170E Controller Unit	Cabinet Models 332, 334 and 336 Model 400 MODEM Model 412C Program Module
Auxiliary Output File, Model 420	Model 200 Switch Pack Model 430 Heavy Duty Relay

1.2.4 Indicators and Character Displays

1.2.4.1 All indicators and character displays shall have a ±45 degrees 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 foot candles 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 208, 210, 222, 232, 242 and 252, and also a clearance of 30 degrees minimum shall be provided for Models 200, 204 and 206.

1.2.4.2 All indicators and character displays shall have a rated life of 100,000 hours, minimum.

1.2.4.3 Liquid Crystal Displays (LCD) shall operate at temperatures of -30 degrees to +70 degrees C without loss of visibility or bleeding.

1.2.5 Connectors

1.2.5.1 General

1.2.5.1.1 All connectors shall be keyed to prevent improper insertion of the wrong connector or PCB.

1.2.5.1.2 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.

1.2.5.1.3 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 inch, or longer, nickel plated brass binder head screws. Each terminal shall be permanently identified as to its function.

1.2.5.1.4 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).

1.2.5.2 Connectors C1, C2, C4, C5 and C6

1.2.5.2.1 Pin and socket contacts for Connectors C1, C2, C4, C5 and C6 shall be beryllium copper construction sub plated 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	C4 - 37 contacts
C2 - 14 contacts	C5 & C6 - 24 contacts

1.2.5.2.2 All pin and socket connectors of C1, C2, C4, C5 and C6 shall use the AMP #601105-1 or #91002-1 contact insertion tool, and the AMP #305183 contact extraction tool.

1.2.5.2.3 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.

1.2.5.2.4 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.

1.2.5.2.5 Connector C4, C5 and C6 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-I Rated, heat stabilized, fire resistant.

1.2.5.3 PCB Connectors

1.2.5.3.1 PCB edge connectors shall have bifurcated gold plated contacts.

1.2.5.3.2 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

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

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

1.2.5.3.5 The PCB 36/72 Connector shall have 36 independent contacts per side, dual sided with 0.1 inch contact centres.

1.2.5.3.6 **PCB Edge Connector Contacts - all PCB edge connectors shall contain the maximum number of gold-plated contact fingers on both sides of the PCB, including contact fingers for spare and non-assigned connector positions, such that every bifurcated contact within the PCB receptacle (edge-connector) socket makes contact with plated contact fingers on the PCB.**

1.2.6 Packaging - Each item delivered shall be individually packed in its own shipping container. When loose Styrofoam is used for packing, the item shall be sealed in a plastic bag to prevent

direct contact with the Styrofoam.

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

1.2.8 Metals

1.2.8.1 Aluminum

1.2.8.1.1 Sheet shall be Type 5052-H32 ASTM Designation B209.

1.2.8.1.2 Rod, Bar and Extruded shall be Type 6061-T6, or equal.

1.2.8.2 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.

1.2.8.3 Cold Rolled Steel

1.2.8.3.1 Sheet, Rod, Bar and Extruded shall be Type 1018/1020.

1.2.8.3.2 Plating - All cold roll steel shall be plated. All plating shall be either cadmium plating meeting the requirements of U.S. 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.

1.2.8.4 All sharp edges and corners shall be rounded.

1.3 SECTION 3 – COMPONENTS

1.3.1 All components shall be second sourced 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:

1.3.1.1 When a component is of such special design that it precludes the purchase of identical components from any wholesale electronics distributor or component manufacturer, one spare duplicate component shall be furnished with each 20, or fraction thereof, components used.

1.3.1.2 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 Only Memory, MPU, MIC and ACIA devices shall be socket mounted on the PCB's.

1.3.3 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.

1.3.4 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 operating in their circuit application, shall be 10 years or longer.

1.3.5 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 and transistor arrays.

1.3.6 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.

1.3.7 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.

1.3.8 Capacitors

1.3.8.1 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%.

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

1.3.8.3 Capacitor encasements shall be resistant to cracking, peeling and discolouration.

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

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

1.3.9 Potentiometers

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

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

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

1.3.10 Resistors

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

1.3.10.2 All resistors shall be insulated and shall be marked with their resistance value. Resistance values shall be indicated by the EIA colour codes.

1.3.10.3 Resistors shall be 10% or less tolerance.

1.3.10.4 The value of the resistors shall not vary by more than 5% between -37 degrees C and +74 degrees C.

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

1.3.11 Semiconductor Devices

1.3.11.1 All solid state devices, except LED's, shall be of the silicon type.

1.3.11.2 All transistors, integrated circuits, and diodes shall be a standard type listed by EIA

and clearly identifiable.

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

1.3.11.4 The device pin "1" location shall be properly marked on the PCB adjacent to each pin.

1.3.12 Transformers and Inductors

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

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

1.3.12.3 All transformer and inductor leads shall be color coded with an approved EIA color or identified such to facilitate proper installation.

1.3.13 Circuit Breakers (10 amperes or greater)

1.3.13.1 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 to 50 degrees C. Minimum interrupting capacity shall be 5,000 amperes, RMS.

1.3.13.2 Circuit breakers shall be the trip-free type.

1.3.13.3 Multi-pole breakers shall be the common-trip type.

1.3.14 Switches

1.3.14.1 DIP - Dual-in-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).

1.3.14.2 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 over brass (or equal). The switch shall be rated for a minimum of 40,000 operations.

1.3.14.3 CONTROL - The 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.

1.3.14.4 POWER - Ratings shall be same as CONTROL except that the contact rating shall be a minimum of ten amperes at 125 VAC.

1.4 SECTION 4 – MECHANICAL

1.4.1 Assemblies and PCB Design

1.4.1.1 Assemblies (including Controller Unit) -- All assemblies shall be easily replaceable and incorporate plug-in capability for their associated devices or PCB's with the following

exceptions:

- The cabinet power supply.
- Mother board assemblies.
- The power supply for the Model 170E may be a plug-in assembly.

1.4.1.2 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 inch 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. All printed circuit boards shall be mounted vertically.

1.4.1.3 PCB -- No components, traces, brackets or obstructions shall be within 0.125 inch of the board edge (guide edges).

1.4.1.4 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 208 or 210 Monitor Units, Model 400 MODEM, Model 412C Program Module and Model 414 Program Module shall be on the PCB.

1.4.2 Workmanship - Workmanship shall be in accordance with the highest industry standards.

1.4.3 Model Numbers

1.4.3.1 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.

1.4.3.2 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 0.25 inch high.

MODEL#	**TITLE**
170E	CONTROLLER UNIT
200	SWITCHPACK
204	FLASHER UNIT
206	POWER SUPPLY MODULE
208	MONITOR UNIT
210	MONITOR UNIT
222	LOOP SENSOR UNIT
224	LOOP SENSOR UNIT
231	MAGNETIC ELEMENT
232	MAGNETIC SENSOR UNIT
242DC	ISOLATOR
252AC	ISOLATOR
402	SUPPORT ASSEMBLY
412C	PROGRAM MODULE

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

1.4.5 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, -0.10 inch / Edge Guides ± 0.015 inch

1.5 SECTION 5 – ENGINEERING

1.5.1 Human Engineering

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

1.5.1.1.1 No more than 2 potentiometers, controls or switches may be mounted concentrically. Knobs for such devices shall have diameters in a ratio of 2:1 outer to inner. The outer knob shall have a diameter of at least one inch.

1.5.1.1.2 Knobs shall be of large enough diameter (at least 0.5 inch diameter) and of great enough separation (at least 0.5 inch edge to edge) to assure ease of adjustment without disturbance of adjacent knobs.

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

1.5.1.1.4 PCB's 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.

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

1.5.2 Design Engineering

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

1.5.2.1.1 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.

1.5.2.1.2 For reasons of personal safety, personnel shall be protected 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.

1.6 SECTION 6 - PRINTED CIRCUIT BOARDS

1.6.1 Design, Fabrication and Mounting

1.6.1.1 All contacts on PCB's shall be plated with a minimum thickness of 0.000030 inch gold over a minimum thickness of 0.000075 inch nickel.

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

1.6.1.3 Fabrication of PCB's shall be in compliance with U.S. Military Specification: MIL-P-13949,

except as follows:

1.6.1.3.1 Only NEMA 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 tracks 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.

1.6.1.3.2 Section 3.3.3 of U.S. 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."

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

1.6.1.3.4 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."

1.6.1.3.5 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.

1.6.1.4 The fabrication of PCB's and the mounting of parts and assemblies thereon shall conform to U.S. Military Specification: MIL-STD-275E, except as follows:

1.6.1.4.1 All semiconductor devices required to dissipate more than 250 mW or any case temperature that is 10 degrees C 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 PCB.

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

1.6.1.4.3 All PCB's shall be coated with a moisture resistant coating.

1.6.1.4.4 Where less than 0.25 inch lateral separation is provided between the PCB (or the components of a PCB) and any metal surface, a 0.03125 (-0.0 to +0.0156) inch thick Mylar (polyester) plastic cover shall be provided on the metal to protect the PCB.

1.6.1.5 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 (±0.005) inch for 0.1 inch spacing and 0.055 (±0.005) inch for 0.156 inch spacing.

1.6.1.6 **PCB Circuit Reference Markings - PCBs shall have circuit reference symbols clearly and legibly marked by silkscreen, circuit printing or similar permanent marking system on the circuit side, as nearby as practicable to the component referenced. PCB circuit reference symbols shall be identical to those depicted on the pictorial diagram within the manual which shows the physical locations and identification of each component.**

This component marking requirement shall apply to all PCBs except those within Model 200 Switchpacks and Model 204 Flasher Units.

1.6.2 Soldering

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

1.6.2.2 Automatic flow soldering shall conform to the following conditions:

1.6.2.2.1 Constant speed conveyor system.

1.6.2.2.2 Conveyor speed shall be the optimum to minimize solder peaks or points which form at component terminals.

1.6.2.2.3 Temperature shall be controlled to within ±8 degrees C of the optimum temperature.

1.6.2.2.4 The soldering process shall result in the complete coverage of all solder runs, joints and terminals with solder except that which is covered by an electroplating process.

1.6.2.2.5 Whenever clinching is not used, a method of holding the components in the proper position for the flow process shall be provided.

1.6.2.2.6 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.

1.6.3 Printed circuit board mounting. All printed circuit boards shall be mounted vertically (the copper clad surfaces shall be oriented vertically).

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

1.7 SECTION 7 - QUALITY CONTROL

The following measures shall be taken by the Contractor during the production process to ensure 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

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

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

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

1.7.3 Units

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

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

1.7.4 Pre-delivery Repair

1.7.4.1 The procedures listed below shall be followed in repair of equipment before shipment.

1.7.4.1.1 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.

1.7.4.1.2 Defects in PCB's or electronic circuit components shall be specially treated as follows:

1.7.4.1.2.1 A PCB may be flow soldered a second time if copper runs and joints are not satisfactorily coated on the first run.

1.7.4.1.2.2 Under no circumstances shall a PCB be flow soldered more than twice.

1.7.4.1.2.3 Hand soldering may be used for printed circuit repair.

1.8 SECTION 8 - ELECTRICAL, ENVIRONMENTAL AND TESTING REQUIREMENTS

1.8.1 General

1.8.1.1 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 ensure compliance of the equipment with these specifications.

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

1.8.2. 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.

1.8.3 Environmental - All components shall properly operate within the following limits:

1.8.3.1 Ambient Temperature: -37 degrees C to 74 degrees C

1.8.3.2 Humidity: 5 to 95 percent

1.8.3.3 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 deg C)	Relative Humidity (in percent)	Ambient Temperature/ Wet Bulb (in deg C)
-37 to 1.1	10	-17.2 to 42.7
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

1.8.3.4 Shock Test - per Military Specification: MIL-STD-810D Method 516.1.

1.8.3.5 Vibration - per Military Specification: MIL-STD-810D Method 514.1, equipment class G (Common Carrier).

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

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

1.8.3.7.1 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 C to -37 degrees C at a rate of not more than 18 degrees C per hour. The item shall be cycled at -37 degrees C for a minimum of 5 hours and then returned to 20 degrees C at the same rate. The test shall be repeated with the line voltage at 135 VAC.

1.8.3.7.2 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 C to 70 degrees C at a rate of not more than 18 degrees C per hour. The item shall be cycled at 70 degrees C for a minimum of 5 hours and then returned to 20 degrees C at the same rate. The test shall be repeated with the line voltage at 135 VAC.

1.8.4 Electrical - All components shall operate properly within the following limits:

1.8.4.1 Applied Line Voltage: 90 to 135 VAC

1.8.4.2. Frequency: 60 (±3.0) Hertz

1.8.4.3 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.

1.8.4.4 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 a City of Winnipeg Accepted Model 332 Cabinet and the cabinet connected to the commercial power lines.

1.8.4.4.1 The power line surge protection, (including the cabinet's 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 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) C and at 120 (±12) VAC.

1.8.4.4.2 The Model 400 MODEM will be housed in a City Accepted Model 170E Controller Unit which in turn is housed in the cabinet during the test described above.

1.8.4.5 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:

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

1.8.4.5.2 Equipment properly housed and connected within a City of Winnipeg Accepted Model 332 Cabinet.

1.8.4.5.3 The Cabinet Power Surge Protectors deactivated or removed.

1.8.4.5.4 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 (+/-5) degrees C and at 120 (±12) VAC.

1.8.4.5.4.1 The Model 400 MODEM shall comply to the above conditions when housed in a City Accepted Model 170E Controller Unit and with DAT Program operating, and tested under the above conditions.

1.8.4.5.4.2 Within the circuit of any device, module or PCB, electrical isolation shall be provided between DC logic ground, equipment ground and the AC grounded conductor. The DC logic ground 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.

1.8.4.6 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.

1.8.4.7 All equipment shall resume normal operation following a period of at least 5 hours at -37 degrees C and less than 10% humidity, when 90 VAC is applied to the input terminals of the cabinet.

1.8.5 Contractor's Testing Certification

1.8.5.1 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.

1.8.5.2 The Contractor shall submit his quality control procedure and format of test reports to the Engineer for approval within 15 working days following the approval of the contract.

1.8.5.3 The quality control procedure shall include the following:

1.8.5.3.1 Acceptance testing of all supplied components.

1.8.5.3.2 Physical and functional testing of all modules.

1.8.5.3.3 A minimum 100-hour burn-in of all modules.

1.8.5.3.4 Physical and functional testing of all items.

1.8.5.3.5 A minimum 24 hour operation of all controller units and cabinets.

CHAPTER 2

SPECIFICATIONS FOR MODEL 170 ENHANCED CONTROLLER UNIT AND ASSOCIATED MODEL 412C AND MODEL 172 MODULES

TABLE of CONTENTS

2.1 SECTION 1 – GENERAL

2.1.1 Power Failure - A power failure is said to have occurred when the incoming line voltage falls below 92 (+/-2) VAC for 50 ms. The determination of the 50 ms interval shall be completed within 67 ms of the time the voltage falls below 92 (+/-2) VAC.

2.1.2 Power Restoration - Power is said to be restored when the incoming line voltage equals or exceeds 97 (+/-2) VAC for 50 ms. The determination of the 50 ms interval shall be completed within 67 ms of the time the voltage first reaches 97 (+/-2) VAC.

2.1.3 The hysteresis between power failure and power restoration voltage settings shall be a minimum of 5 Volts with a threshold drift of no more than 0.2 VAC.

2.1.4 System READ Access Time - With Model 412C Module Resident in the Controller Unit, valid data shall be present at the MPU at least 100 ns prior to the end of the machine cycle.

2.1.5 The Diagnostic and Acceptance Test (DAT) Programs.

2.4.5.1 ***The DAT-170E Program shall be provided resident on the Model 412C Program Module U1 memory device and on the CPU U6 memory device.***

2.4.5.2 A copy of the DAT Programs will be available to the contractor at no charge.

2.1.6 If a PAL, EPROM, or ROM device is used in address decoding and timing algorithms, the device code listing together with data sheet(s) and any specific coding requirements shall be included in the unit or module documentation. The device coding shall be delivered in the same form that the Contractor uses to directly reproduce the device.

2.1.7 The system address organization of the Model 170E shall consist of two addressing configurations. The Decoder Input shall be furnished jumpered in address configuration 1. The internal module address organization shall be as specified in the appropriate module section.

2.1.7.1 The two addressing configurations shall be selectable by use of one post jumper. The jumper shall control the logic state of one Decoder Circuit Input. The logic line shall be a three post type with the two logic levels on the outer posts. The following input line state conditions shall cause the Decoder circuit to provide the associated address configurations:

CONFIGURATION	LINE	FUNCTION
1	+5 VDC	170E/412C
2	DC GND	170E Internal/170

2.1.7.2 CONFIGURATION 1 Address Organization

FUNCTION	ADDRESS RANGE	COMMENTS
CPU SRAM	0000 - 0FFF	
U4 Memory	1000 - 3FFF	412C
Reserved	4000 - 4FFF	
DTA Minutes	5000 - READ	
DTA Reset	5000 - WRITE	
INPUT/OUTPUT	5001 - 5008	
	5009 - 500A WRITE	
RESTART State	5004 - BIT 1 READ	
DTA Seconds	500F - READ	

Reserve	5009 - 500E READ	
	500B - 500F WRITE	
	5010 - 5FFE	
CPU STATUS	5FFF - READ	Bit 1 - ACIA #1 IRQ
		Bit 2 - ACIA #2 IRQ
		Bit 3 - ACIA #3 IRQ
		Bit 4 - ACIA #4 IRQ
		Bit 5 - Reserved
		Bit 6 - Address Configuration
		Bit 7 - DTA Timeout
		Bit 8 - RTC IRQ
RTC Reset	5FFF - WRITE	
ACIA #1	6000	WRITE CR, READ SR
ACIA #1	6001	WRITE TDR, READ RDR
ACIA #2	6002	WRITE CR, READ SR
ACIA #2	6003	WRITE TDR, READ RDR
ACIA #3	6004	WRITE CR, READ SR
ACIA #3	6005	WRITE TDR, READ RDR
ACIA #4	6006	WRITE CR, READ SR
ACIA #4	6007	WRITE TDR, READ RDR
Reserve	6008 - 600F	
CPU SRAM	6010 - 6FFF	
PROGRAM MODULE		
Memory Write Protect	7000 - WRITE	
I.D. Feature	7000 - READ	
I.D. Location	7001 - READ	
	7001 - WRITE Reserve	
Reserve	7002 - 7009	
	700B - 700E WRITE	
	700F - READ	
RTCA Valid/ Reset	700A	
RTCA Counters 1 to 4	700B - 700E READ	
U3 Memory	7010 - 7FFF	
U1 & U2 Memory	8000 - FFFF	

NOTE -- Address locations noted as "Reserve" are assignable by the State only and shall not be used. ***CPU STATUS Bit 6: "0" equals Address Configuration 1 and "1" equals Address Configuration 2.***

2.1.7.3 CONFIGURATION 2 Address Organization - This configuration provides all Model 412C Program Module features internal to the controller unit. The address organization is the same as CONFIGURATION 1 with the following exceptions:

CPU SRAM	0000 - 3FFF	U3 & U4 Memory internal
	6010 - 6FFF	
	7010 - 7FFF	
U6 EPROM	8000 - FFFF	U1 & U2 Memory internal

2.1.8 Each memory device shall stabilize to normal operation within 10 ms following Power

Restoration and shall be in standby until addressed. Each device shall have the following maximum power drain at +5 VDC in its various states:

MEMORY	ACTIVE	STANDBY	POWERDOWN
EPROM	100 ma	40 ma	
SRAM	85 ma	20 ma	100 us (non-internal power)

2.1.9 CPU EPROM memory sockets shall be a 28 pin AMP Diplomate LF #64184-2, or equal. The MPU, ACIA and other memory sockets shall be an AUGAT #500/800 series AG10DPC or equal. Each socket number shall be permanently marked on the PCB adjacent to its Pin 1. Should the "... or equal MPU" pin/package be other than the 40 pin package, the MPU socket used shall match the above specified socket features.

2.2 SECTION 2 - MODEL 170E CONTROLLER UNIT

2.2.1 Unit Composition

2.2.1.1 The Model 170E Controller Unit shall consist of the following:

Central Processing Unit (CPU)
Input/Output Interface
Unit Chassis
M170E Auxiliary Board
Model 412C Program Module
Unit Power Supply with external power connection
Unit Standby Power
Front Panel Assembly
Internal System Interface
Connectors C1S, C2S, C20S, C30S, C40S, and T-1
Communications System Interface

2.2.1.2 The 170E shall be delivered pinned for Configuration 1 Addressing.

2.2.1.3 The composition weight shall not exceed 25 pounds.

2.2.2 Central Processing Unit (CPU)

2.2.2.1 The CPU shall be provided with an MPU and shall properly execute object programs developed to operate on the MPU. The MPU Interrupt requirements shall be as follows:

2.2.2.1.1 Non-Maskable Interrupt (NMI) - The NMI is exclusively assigned to the Power Failure Function. A Power Failure shall cause the MPU NMI line to immediately go LOW. The line shall be held LOW until the RES goes LOW to prevent multiple NMI issuance.

2.2.2.1.2 Reset Interrupt (RES) - The RES is exclusively assigned to Power Restoration and MPU Startup. The RES line shall go LOW 3 (+/-1) ms following the NMI going LOW. The line shall remain LOW until 150 (+/-75) ms after Power Restoration.

2.2.2.1.3 Interrupt Request (IRQ) - The IRQ Line shall be jointly used by the RTC and the

four ACIA's to initiate IRQ to the MPU

2.2.2.1.3.1 Real Time Clock (RTC) - Real Time Clock circuitry shall be provided to trigger an interrupt to the MPU on the IRQ line once every 1/60 of a second during the 270 to 330 degree portion of the AC Sine Wave. The AC Sine Wave shall be derived from the local power company's 120 VAC 60 Hz frequency. The RTC shall be READ at Bit 8, Address 5FFF (STATUS) and reset by a WRITE to Address 5FFF.

2.2.2.1.3.2 ACIA - Four ACIA's shall be provided, each capable of receiving and transmitting up to eight-bits of parallel data from the MPU for serial data communications. The ACIA shall have 4 registers which are addressable by the MPU. The MPU shall be capable of reading the Status Register (SR) and the Receiver Data Register (RDR), and writing in the Transmit Data Register (TDR) and in the Control Register (CR).

2.2.2.1.3.3 Each ACIA shall be provided with a 2 post type jumper between its IRQ output and the MPU IRQ input. The 170E shall be delivered with these jumpers installed.

2.2.2.2 CPU Clock Timing - The CPU clock circuitry shall be provided to generate the MPU clock timing. The clock circuitry and the MPU shall provide two selectable MPU machine cycle times of 0.651 and 1.302 (+/-0.0015) us. The machine cycle time selection shall be by Post Jumper (Three Post Type) with jumper in for 1.302 us. The CPU clock circuitry shall be located no further than 2 inches from the MPU clock pin inputs.

2.2.2.3 SRAM Memory, DALLAS 1235Y or equal, shall be provided.

2.2.2.4 A EPROM Memory, INTEL 27256A or equal, shall be provided in socket U6.

2.2.2.5 Restart Timer - A Restart Timer Circuitry shall be provided to react to the duration of power outage. The Restart Timer output is normally HIGH. When the NMI line goes LOW, the Restart Timer shall begin timing. If the timer reaches 1.75 (+/-0.25) seconds, its output state shall go to LOW and remain in that state for 50 (+/-24) ms after the RES line goes HIGH. If power is restored prior to the timer timing out, the output shall remain HIGH and the timer shall be reset to "0".

2.2.3 Downtime Accumulator (DTA)

2.2.3.1 A DTA shall be provided to accumulate time between Power Failure and Restoration. The DTA shall start counting immediately upon Power Failure and continue counting until the RES line goes HIGH following Power Restoration.

2.2.3.2 The DTA shall have 2 eight-bit binary registers counting the number of minutes and seconds. DTA accuracy shall be +/- 1 second over the 255 minute range. The DTA shall stop counting when the Minutes register equals 255 decimal. The DTA registers shall reset to 0 by a WRITE to address 5000. The DTA shall READ Minutes at Address 5000 and Seconds at Address 500F. The Seconds Register shall count 0 to 59 seconds decimal in 1 second increments. At 60 seconds, the Minutes Register shall be incremented and the Seconds Register reset to "0".

2.2.4 Total current drain for DTA and Restart Timer Circuitry (powerdown mode) shall not exceed 400 uA at 5 VDC, 35 degrees C while timing and 100 uA at 5 VDC when timeout is latched.

2.2.5 Input/Output Interface

2.2.5.1 Input/Output Interface shall utilize a ground true logic. The transfer of data between interface and working registers within the MPU shall be in eight-bit word increments, minimum. The steering of data from inputs or outputs for a given address shall be controlled by the state of MPU read/write command at the time the given address is valid.

2.2.5.2. Output Interface - The output interface shall consist of a minimum of 80 bits of buffered storage. Output data shall be latched at the time of writing from the MPU. This interface shall provide an NPN open collector output capable of driving up to 40 VDC and sinking up to 100 ma. A "1" from the MPU shall be presented as a grounded collector, and a "0" presented as an open circuit. Once a port is written into, the data shall remain present and stable until either another word is written into it or until the power is turned off. The state of these output ports at the time of power up or below power failure threshold shall be an open circuit.

2.2.5.3 Input Interface - The input interface shall consist of a minimum of 64 bits of gated inputs from external devices. Each logic level input shall be turned ON (true) when the input voltage is less than 3.5 VDC, shall be turned OFF (false) when the input current is less than 100 uA or the input voltage exceeds 8.5 VDC, shall pull up to 12 VDC, and shall not deliver in excess of 20 mA to a short circuit to logic level common. When the appropriate input address is impressed upon the input interface, the interface shall place its data on the data bus, which will be read by the MPU. Ground on any input shall be interpreted by the MPU as a "1" and an open on any input or the presence of a voltage greater than 8.5 VDC shall be interpreted as a "0" by the MPU when that input is read.

2.2.6 Unit Chassis - The controller unit shall be housed in a compact, portable metal enclosure suitably protected against corrosion. The controller until shall mount in a standard EIA 19 inch rack. The enclosure shall be designed for convenient removal of PCBs without use of tools.

2.2.7 Unit Power Supply

2.2.7.1 A power supply shall be provided to produce all DC power necessary to operate the controller unit. In addition, the supply shall provide the following voltages and current:

1000 mA at +12 VDC
300 mA at -12 VDC
500 mA at + 5 VDC
400 mA at - 5 VDC

2.2.7.2 The DC ground shall not be connected to equipment ground.

2.2.7.3 Controller unit power shall be held up (DC logic voltages at normal operating levels) for a minimum of 50 +/- 17 ms beyond the NMI line going LOW.

2.2.7.4 The maximum DC voltage generated shall not exceed 45 volts.

2.2.7.5 The Power Supply shall be so designed that no further filtering regulation is needed for the required DC voltages.

2.2.7.6 Radio frequency suppressors shall be provided on the AC+ and AC- power lines. The part shall be a COR COM 3VS1 or equal.

2.2.8 Unit Standby Power

2.2.8.1 A standby power shall be provided to retain power (minimum of 72 hours) to the CPU Restart Timer, DTA and Internal RTCA during power failure in the controller unit. The supply shall consist of holdup Capacitors, capacitor charging circuitry and power

sense/transfer circuitry.

2.2.8.2 The power sense/transfer circuitry shall sense power loss and transfer capacitor power immediately to the required circuits. The transfer circuitry shall isolate the capacitors by transistor or relay until power loss transfer. The circuitry shall sense power restoration and transfer back to the normal isolation mode.

2.2.8.3 A charging circuit which shall, under normal operating conditions, fully charge and float the standby capacitors consistent with manufacturer's recommendations.

2.2.9 Front Panel Assembly

2.2.9.1 The front panel shall be securely fastened to the chassis and removable without the need for tools. A continuous hinge shall be provided on the left side of the unit to permit opening of the front panel and ready access to the interior of the controller unit.

2.2.9.2 The front panel shall be electrically connected by means of Connector C3. The front panel shall be connected to equipment ground through Connector C3.

2.2.9.3 The character displays shall be hexadecimal with circuits to accept, store, and display four-bit binary data. The characters shall be 0.40 inches high, minimum. Each character shall have latch strobe and blanking inputs. The second character from the right (lower row) shall have a decimal point. The face of the character display shall be scratch and solvent-resistant. The transfer of data from the MPU through the output interface to the display shall result in the display of each character in its non-inverted state.

2.2.9.4 The front panel shall be provided with 10 LED CALL/ACTIVE indicators.

2.2.9.5 A keyboard shall be provided. The transfer of data from the keyboard by way of the input interface to the MPU shall result in each character being received in its non-inverted state. The character shall consist of 4 bits of binary data, while the character control shall consist of 1 bit. A low state on the character control to the interface shall indicate the presence of a valid character. Each key shall be engraved or embossed with its function character, shall have a minimum surface area of 0.075 square inch and shall be mounted on a minimum of 0.50 inch centers, shall have an actuation force between 50 and 100 grams, and shall provide a positive tactical indication of contact. Key contacts shall 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 opening.

2.2.9.6 The front panel shall be provided with a toggle LOGIC switch to enable the stop timing function and shall be labelled "STOP TIMING".

2.2.9.7 An ON-OFF toggle CONTROL switch and fuse shall be provided for AC power. The switch and fuse shall protrude through the front panel, but shall remain with the controller unit chassis when the front panel is removed. The fuse shall be a 3AG Slow Blow type, rated at either 1 or 2 amperes, dependent upon the controller unit power requirements.

2.2.9.8 The front panel, under the legend "OPERATING INSTRUCTIONS", shall include a framework to retain a card, 4 inches wide by 6 inches high by 0.0625 inch thick.

2.2.10 Internal System Interface

2.2.10.1 PCB to PCB Connector spacing shall be a minimum of 1.0 inch. Continuous nylon card guides (permanent locking type) shall be provided for the modules and all internal PCBs.

2.2.10.2 Two PCB 22/44S Connectors shall be provided for the MODEM Modules MC1 and MC2, and two PCB 36/72S Connectors shall be provided for the M170 Connector/Program Module and the M170E Connector/M170E Auxiliary Board.

2.2.10.3 The depth placement of the vertical M170 Connector shall be such that the Program Module Front Panel shall be flush with the Model 170E Controller Unit Front Panel when the module is connected.

2.2.11 Data and Address Bus Requirements

2.2.11.1 All Data Bus Buffers and Data Bus Drivers shall be tri-state buffered devices enabling them to drive a load consisting of 10 TTL gates and 200 picofarads. The propagation delay time shall be less than 30 ns.

2.2.11.2 All Address Bus Inputs shall be buffered and shall load the bus by 1 TTL gate load and 100 picofarads.

2.2.12 Connector Requirements

2.2.12.1 Connector C1S shall be mounted on the controller unit providing 44 inputs and 56 outputs of control interface to and from external devices or files.

2.2.12.2 The Model 400 MODEM and ACIA connections into and out of the controller unit shall be made through Connector C2S, C20S, C30S, C40S, and Terminal Block T-1 (Type T Connector). The control and data transmission lines for ACIA 1 shall be paralleled through C2S and T-1 connectors. ACIA 2 lines shall be routed to C20S connector, ACIA 3 to C30S, and ACIA 4 to C40S.

2.2.12.3 ACIA 4 RS-232 Signal Lines and Buffered mirrored signals NMI, RES and ROT Shall be internally routed to M170 and M170E as noted in Pin Assignments under Section 5 Details.

2.2.13 Communication System Interface

2.2.13.1 The communication system shall consist of the CPU, ACIAs, motherboard connectors and lines, MODEM module connectors MC1 and MC2 and interfaces between ACIA and MODEM and both MODEM and ACIA to C2S, C20S, C30S, C40S, and Connector/T-1 terminal. ***The interface between the ACIA and MODEM shall comply with EIA RS-232-C Standards and all functions under T-1, C2, C20S, C30S, and C40S connectors are referenced to the ACIA. AUDIO IN and AUDIO OUT are referenced to the MODEM***. The RTS and TX data lines to the MODEM shall have MARK and SPACE voltages of -12 and 12 VDC respectively.

2.2.13.2 C20S, C30S, and C40S connectors shall meet the requirements for the C2S connector.

2.2.13.3 A minimum of four baud rate frequencies, 19.2 kHz, 38.4 kHz, 76.8 kHz and 153.6 kHz shall be provided at the ACIA Rx/Tx clock inputs (pins 3 & 4). The frequency selection shall be by post type jumpers. Each ACIA shall have independent baud rate selection with jumpers delivered pinned for 19.2 kHz.

2.2.14 Electrical Requirements

2.2.14.1 The front panel and chassis shall be connected to equipment ground.

2.2.14.2 A surge arrestor shall be provided between the AC+ and AC- for protection against

power line noise transients. The surge arrestor shall meet the following requirements:

Recurrent Peak Voltage:	212 volts
Energy Rating Maximum:	20 Joules
Power Dissipation, Average:	0.85 Watt
Peak Current for Pulse less than 6 us:	200 Amperes
Standby Currents:	less than 1 ma

2.2.14.3 Two 0.5 ohm, 10 watt wire-wound power resistors with a 0.2 uH inductance shall be provided (1 on the AC+ power line and 1 on the AC- line). Three surge arresters rated for 20 Joules shall be supplied between AC+ and ground, AC- and ground, and between AC+ and AC-. A 0.68 uF capacitor shall be added between AC+ and AC- coming off the 0.5 Ohm resistor going to the surge arresters.

2.2.14.4 The AC power to the controller unit shall be supplied by a three conductor cable at least three feet in length. The cable shall terminate in a NEMA Type 5-15P grounding type plug.

2.2.14.5 Test points shall be provided for monitoring all power supply voltages. All test points shall be readily accessible when the front panel is opened. Any provided test point shall be isolated such that attaching a test probe shall not impact the operation of the controller unit. The test points shall be post type, 0.0625 inch diameter and 0.1875 inch high, minimum. The clearance between test points and other components shall be 0.25 inch, minimum.

2.2.15 **M170E Auxiliary Board**

2.2.15.1 The M170E Auxiliary Board shall contain the RTCA circuitry and the identification switches. (See Section 3 for the RTCA circuitry and the identification switch requirements). The RTCA circuitry and the identification switches on the M170E Auxiliary Board shall be disabled when a Model 412C is installed. The M170 connector pins 71 and/or 72 shall provide a DC ground path via the Model 412C module (pins 69 & 70) to M170E connector (pins 71 & 72). A ground true present shall cause board feature disablement.

2.2.15.2 The M170E Auxiliary Board's PCB dimensions shall be identical to the Model 400 Modem except for the PCB edge connector dimensions.

2.2.15.3 The M170E Auxiliary Board's PCB connector shall be a PCB 36/72P and shall mate with the M170E connector.

2.3 SECTION 3 - MODEL 412C PROGRAM MODULE

2.3.1 General Requirements

2.3.1.1 A device shall be provided to prevent the module, when inserted upside down, from making contact with the module's mating connector within the controller unit.

2.3.1.2 The module PCB connector shall be provided with electrostatic charge protection to prevent CMOS device damage.

2.3.1.3 The VMA/Phase 2 (E) Clock Signal (M170 Pin 25) shall not be used in a memory device READ operation.

2.3.1.4 The total module current requirements shall not exceed 450 mA at +12 VDC and 100 mA at +5 VDC.

2.3.1.5 Address 700E, Bit 8 shall permanently read as "1". This bit state is used to differentiate between past delivered Model 412/64 modules (Bit 8 decoded "0") and the Model 412 module.

2.3.1.6 The module PCB connector shall be a PCB 36/72P.

2.3.1.7 The module front panel shall be connected to equipment ground at M170 Pin 34.

2.3.1.8 All addressable devices shall be fully decoded.

2.3.1.9 All memory sockets shall be a 28 pin AUGAT #528/828 series AG10DPC or equal.

2.3.2 Feature Requirements

2.3.2.1 Bus Inputs and Outputs

2.3.2.1.1 All data lines shall be tri-state buffered on the module enabling them to drive a load consisting of 10 TTL gates and 200 picofarads. When this module is not being addressed, the data output shall be disabled into a high impedance state and the data lines shall not source or sink more than 100 uA.

2.3.2.1.2 All addressed input lines shall load the bus by 1 TTL gate load and 100 picofarads. The propagation delay time shall be less than 30 ns.

2.3.2.2. Memory

2.3.2.2.1 Four numbered memory sockets shall be provided and fully decoded using the following method. The module shall be delivered with MEMORY SELECT #3 Configuration designated memory devices (or equal), address decoders and jumpers.

2.3.2.2.2 Device manufacturer is designated as INT-Intel, D-Dallas and HD-Hitachi. The sockets shall be decoded by block jumper selection as follows:

MEMORY SELECT	SOCKET ADDRESS RANGE AND DEVICE				JUMPER PATTERN		
	U1	U2	U3	U4	1	2	3
1.	E000-FFFF INT2764A	C000-DFFF INT2764A	7010-7FFF DAL1225	1000-4FFF HD6264 or HD62256	IN	IN	OUT
2.	C000-FFFF INT128A	8000-BFFF INT128A	SAME	SAME	OUT	IN	IN
3.	8000-FFFF	NOT ADRS	SAME	SAME*	OUT	IN	IN
4.	8000-FFFF INT27256A	3000-4FFF DAL1225	SAME	1000-2FFF SAME*	OUT	OUT	OUT

*The Pin #26 jumper pattern shall provide either address line 13 for the HD62256 device or tied HIGH for CS2 function in HD6264. Pin 27 shall be assigned to WE function.

2.3.2.2.3 Jumper positions for Sockets U2 and U4 shall be provided to convert the sockets

from an EPROM socket to a SRAM socket or vice versa. Jumper positions for Sockets U2, U3 and U4 shall be provided to convert the socket from a nonstandby power socket to a standby power socket or vice versa. Sockets U2 and U3 shall be jumpered for nonstandby power. Socket U4 shall be jumpered for standby power.

2.3.2.2.4 A Write Protect Circuit (WPC) shall be provided to prevent writing to SRAM memory during the controller unit MPU RESET interrupt line in a LOW state. A WRITE to ADDRESS 7000 shall be decoded and shall activate the WPC to place the R/W in a READ ONLY state. A subsequent WRITE to ADDRESS 7000 shall be decoded and shall deactivate the WPC allowing R/W function. The WPC state shall be brought out to Address 700E, Bit 7 ("1" State means "active"). The WPC power drain shall not exceed 40 uA at +5 VDC.

2.3.2.3 Module Power Supply

2.3.2.3.1 A power supply shall be provided onboard the module consisting of a DC Regulation Circuit, standby power and all necessary support circuitry.

2.3.2.3.2 A DC Regulator device with its circuitry shall be provided to reduce the +12 VDC to +5 VDC for module use. The Regulator shall have a minimum efficiency of 75% and provide +5 +/-0.25 VDC from no load to full load with a maximum of 2% ripple.

2.3.2.3.3 Standby power shall be provided to holdup WPC, SRAM and RTCA circuits during a Model 170E controller unit power failure. A circuit shall be provided to sense the +12 VDC M170 power line and switch to standby power when the line falls below +9 VDC. The standby power circuit shall switch off when the power line is greater than +11 VDC. The standby power shall be a standard "AA" cap terminal cell battery rated at a minimum of 1.6 ampere-hours at 3.7 +/-0.2 VDC. All module circuitry and devices shall not exceed a maximum power drain of 2 mA at 3.7 VDC on the Standby Battery.

2.3.2.3.4 The battery shall be delivered separate from the module. It shall not be used except for test loading check by the Contractor.

2.3.2.3.5 A battery holder for "AA" battery shall be provided securely mounted to the back of the front panel. The holder shall have a TAB header type connector attached to the battery pus mounting terminal.

2.3.2.4 Identification Switch Circuitry

2.3.2.4.1 Two identification switch packages and associated circuitry shall be provided. The switch packages shall be decoded at Address 7000 (features) and 7001 (locations). Each package shall have 8 SPST switch positions with each switch associated to a DATA Bit (Switch 1 to Bit 1 and so on). Switch ON shall denote bit state "1" to the 170 CPU and switch OFF shall denote bit state "0" to the 170 CPU.

2.3.2.4.2 The switch package shall be a DIP slide type and shall have recessed switches to prevent accidental switching.

2.3.2.5 Real Time Clock Adjuster (RTCA)

2.3.2.5.1 A RTCA shall be provided to adjust for missing RTC timing interrupts.

2.3.2.5.2 The RTCA shall be continuously powered and not affected by a controller unit power failure. RTCA accuracy shall be +/-10 ppm at 25 degrees C. Integral devices incorporating RTCA features and functions may be used in lieu of individual components. The RTCA current drain shall not exceed 1.0 mA at +3.7 VDC.

2.3.2.5.3 The RTCA shall include a free running 60 Hz Pulse PG, a 24 bit binary counter counting 60 Hz pulses, 4 eight-bit buffer ports and port decode/PG interrupt logic. The PG shall trigger binary counter to increment on every input pulse, counting continuously until reset to 0 by its reset line. Bits 21, 22, 23 and 24 in an all "1"'s state shall cause that PG to be disabled (Binary Counter Bit 1 is the least significant bit).

2.3.2.5.4 The counter bits shall be continuously read out to four 8 bit buffer ports. The ports shall be addressed and bits assigned as follows:

CPU ADDRESS	**PORT BITS**	**COUNTER BITS**	**COMMENTS**
700A	This address shall normally READ (decode) "55 HEX". If the standby power supply fails or is removed, it shall decode "54 HEX". A WRITE to this address will RESET the RTCA Binary Counter.		
700B	1-6	1-6	READ only
700C	1-6	7-12	READ only
700D	1-6	13-18	READ only
700E	1-6	19-24	READ only

2.3.2.5.5 A SPST finger throw LOGIC switch shall be provided on the board to activate/deactivate standby power to the RTCA circuitry. With the switch in deactivated state the RTCA circuitry shall present NO power drain to the standby power supply.

2.4 SECTION 4 - MODEL 172 CONTROLLER MODULE

2.4.1 (FUTURE)

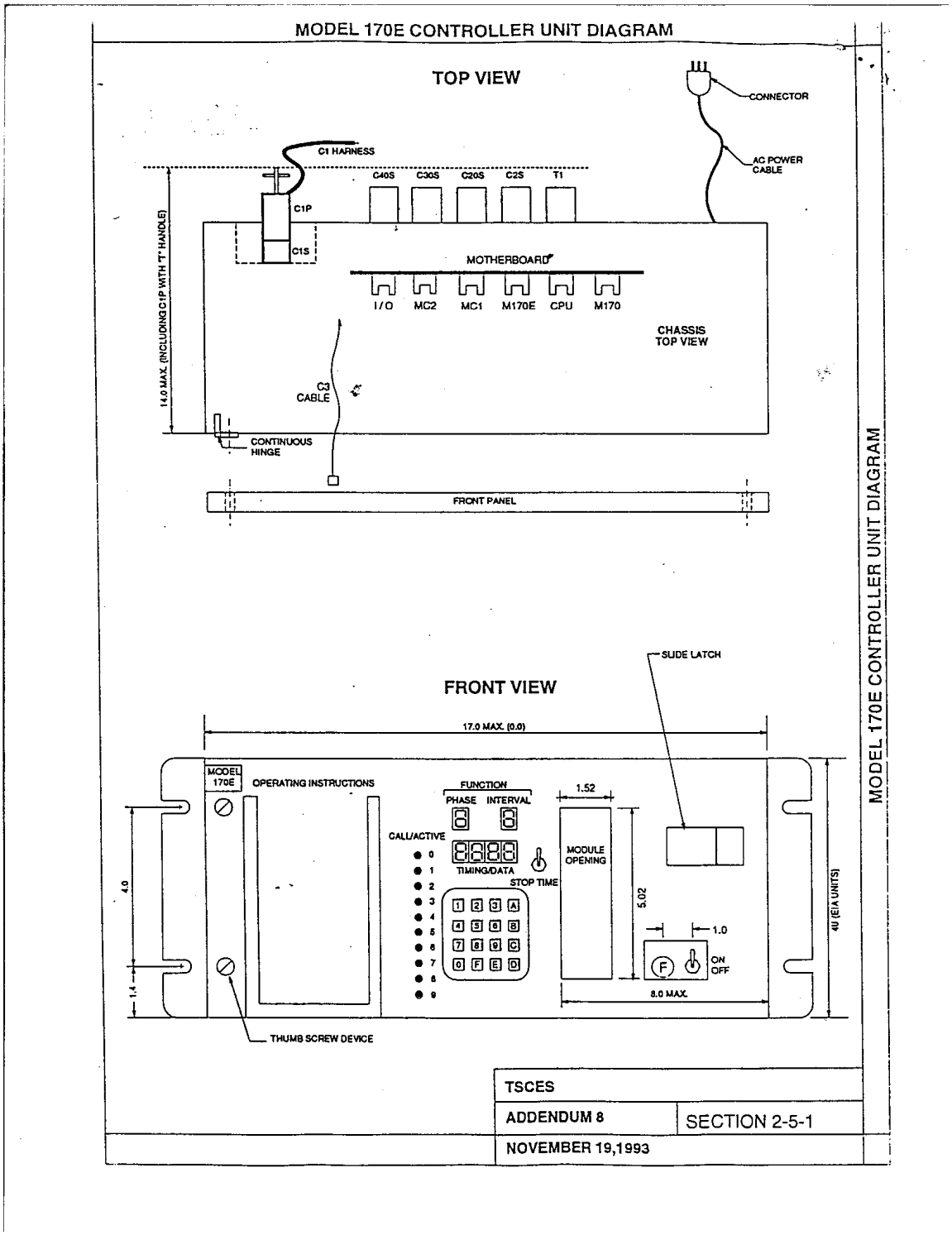
2.5 SECTION 5 - CHAPTER DETAILS

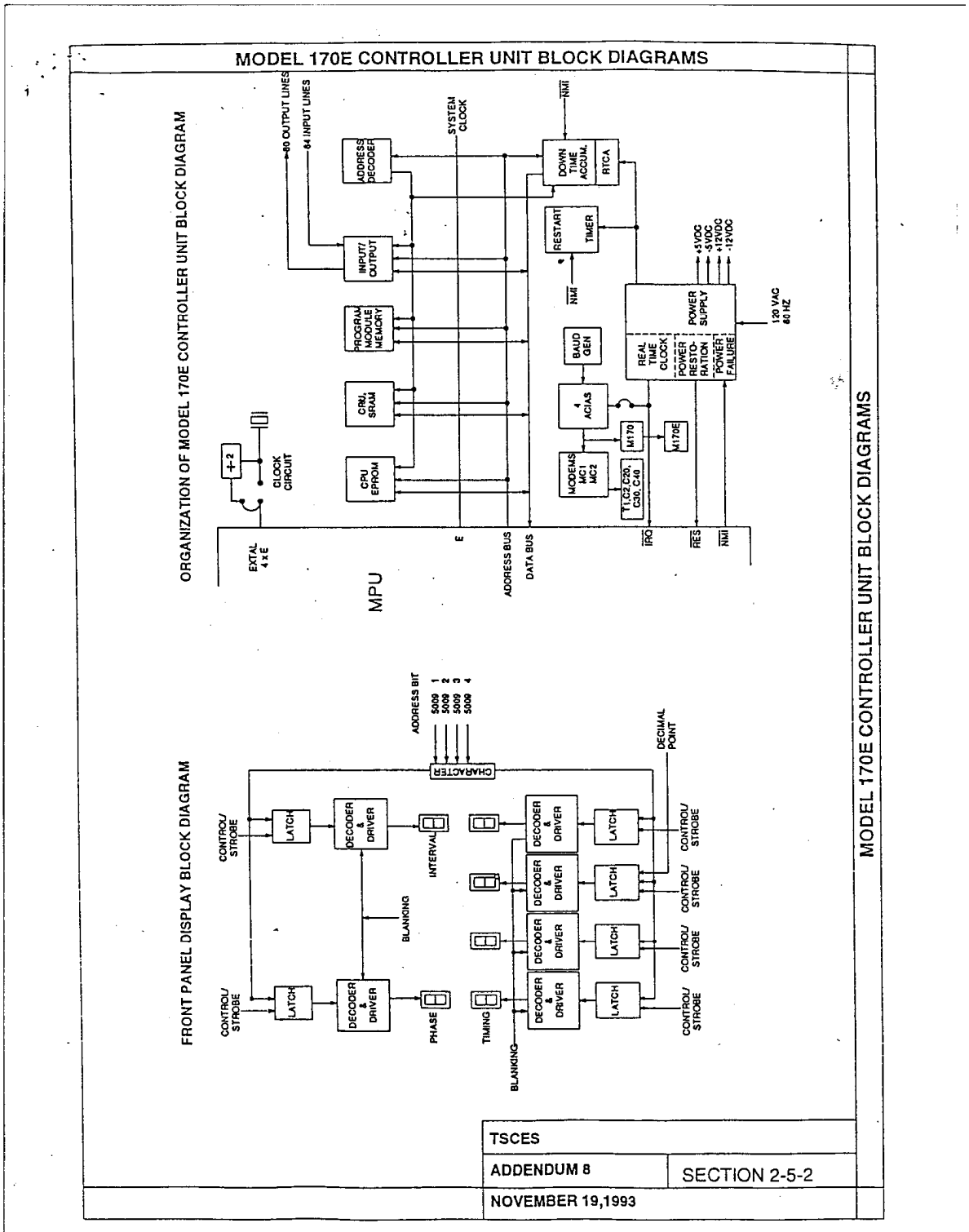
SECTION

NOTES for these sections:

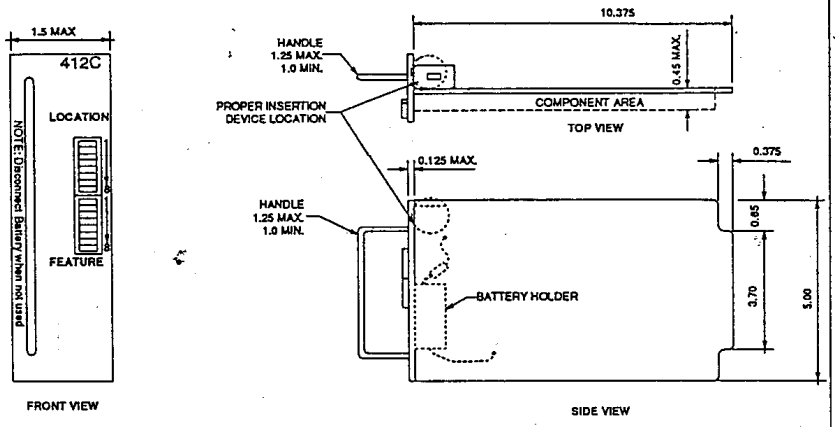
1. All dimensions are in inches unless otherwise noted.

2. Pins not assigned can not be used by the Contractor for other purposes.


MODEL 170E CONTROLLER UNIT DIAGRAM
TOP VIEW
CONNECTOR
AC POWER CABLE
C1 HARNESS
C40S C30S C20S C2S T1
C1P
C1S
14.0 MAX. (INCLUDING C1P WITH "T" HANDLE)
MOTHERBOARD
I/O MC2 MC1 M170E CPU M170
CHASSIS TOP VIEW
C3 CABLE
CONTINUOUS HINGE
FRONT PANEL
FRONT VIEW
SLIDE LATCH
17.0 MAX. (0.0)
MODEL 170E
OPERATING INSTRUCTIONS
FUNCTION
PHASE INTERVAL
CALL/ACTIVE
TIMING/DATA
STOP TIME
1.52
MODULE OPENING
5.02
1.0
ON OFF
8.0 MAX.
4.0
1.4
4U (EIA UNITS)
THUMB SCREW DEVICE
MODEL 170E CONTROLLER UNIT DIAGRAM
TSCES
ADDENDUM 8
SECTION 2-5-1
NOVEMBER 19,1993


MODEL 170E CONTROLLER UNIT BLOCK DIAGRAMS
ORGANIZATION OF MODEL 170E CONTROLLER UNIT BLOCK DIAGRAM
80 OUTPUT LINES
64 INPUT LINES
SYSTEM CLOCK
NMI
ADDRESS DECODER
DOWN TIME ACCUM.
RTCA
INPUT/ OUTPUT
RESTART TIMER
PROGRAM MODULE MEMORY
CPU SRAM
CPU EPROM
BAUD GEN
4 ACIAS
MODEMS MC1 MC2
T1,C2,C20, C30,C40
M170
M170E
REAL TIME CLOCK
POWER RESTO-RATION
POWER FAILURE
POWER SUPPLY
+5VDC
-5VDC
+12VDC
-12VDC
120 VAC 60 HZ
÷2
CLOCK CIRCUIT
EXTAL 4 x E
MPU
E
ADDRESS BUS
DATA BUS
IRQ
RES
NMI
FRONT PANEL DISPLAY BLOCK DIAGRAM
ADDRESS BIT
5009 1
5009 2
5009 3
5009 4
CHARACTER
DECIMAL POINT
CONTROL/ STROBE
LATCH
DECODER & DRIVER
INTERVAL
BLANKING
PHASE
TIMING
MODEL 170E CONTROLLER UNIT BLOCK DIAGRAMS
TSCES
ADDENDUM 8
SECTION 2-5-2
NOVEMBER 19,1993

MODEL 412C PROGRAM MODULE AND CONNECTORS M170 & M170E



M170, M170E, AND 412C PROGRAM MODULE CONNECTOR ASSIGNMENTS

CIRCUIT SIDE		COMPONENT SIDE		M170 ONLY
FUNCTION	PCB CONNECTOR	NUMBER	FUNCTION	NOT REQUIRED BY 412C
A0	1	2	A1	
A2	3	4	A3	
A4	5	6	A5	
A6	7	8	A7	
A8	9	10	A9	
A10	11	12	A11	
A12	13	14	A13	
A14	15	16	A15	
D0	17	18	D1	
D2	19	20	D3	
D4	21	22	D5	
D6	23	24	D7	
VMA /Q2(E)	25	26	NA	RES
READ/WRITE	27	28	NA	NMI
NA	29	30	NA	ROT
NA	31	32	NA	
NA	33	34	EQUIP GND	
NA	35	36	NA	RTS ACIA 4
NA	37	38	NA	CTS ACIA 4
NA	39	40	NA	DCD ACIA 4
NA	41	42	NA	TXD ACIA 4 ** (SEE NOTE)
NA	43	44	NA	RXD ACIA 4 ** (SEE NOTE)
NA	45	46	NA	
NA	47	48	NA	
NA	49	50	NA	
NA	51	52	NA	
NA	53	54	NA	
NA	55	56	NA	
NA	57	58	NA	
12 VDC	59	60	12 VDC	
-12 VDC	61	62	-12 VDC	
			KEY	
-5 VDC	63	64	-5 VDC	
5 VDC	65	66	5 VDC	
5 VDC	67	68	5 VDC	
GND	69	70	GND	
NA	*71	*72	NA	

* PINS 71 & 72 ON M170 AND M170E CONNECTORS SHALL BE COMMONED. PINS 71 AND 72 ON THE MODEL 412C SHALL BE TIED TO PINS 69 AND 70.

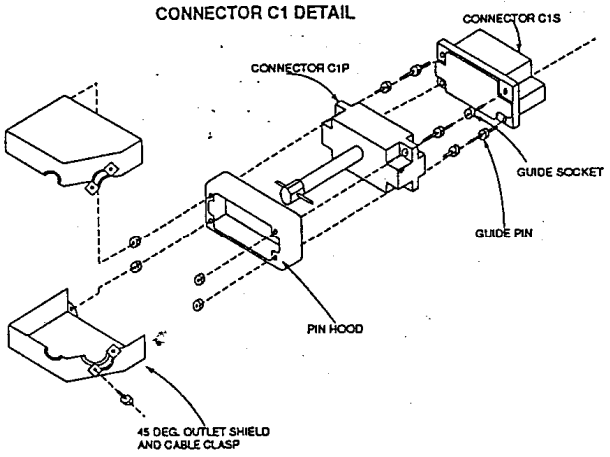
** RELATIVE TO THE ACIA

MODEL 412C PROGRAM MODULE AND CONNECTORS M170 & M170E

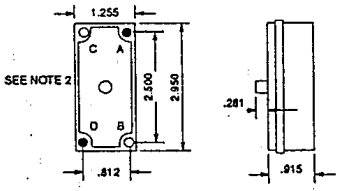
TSCES	
ADDENDUM 8	SECTION 2-5-3
NOVEMBER 19,1993	

C1 CONNECTOR DETAIL

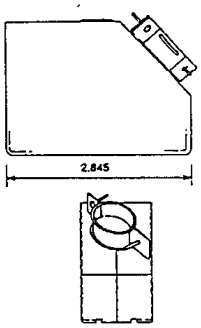
CONNECTOR C1 DETAIL



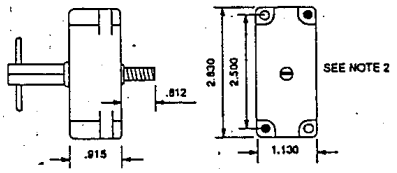
CONNECTOR C1S



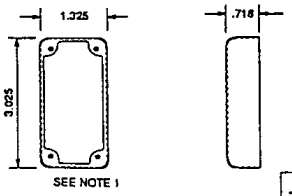
SHIELD FOR C1P



CONNECTOR C1P



HOOD FOR C1P

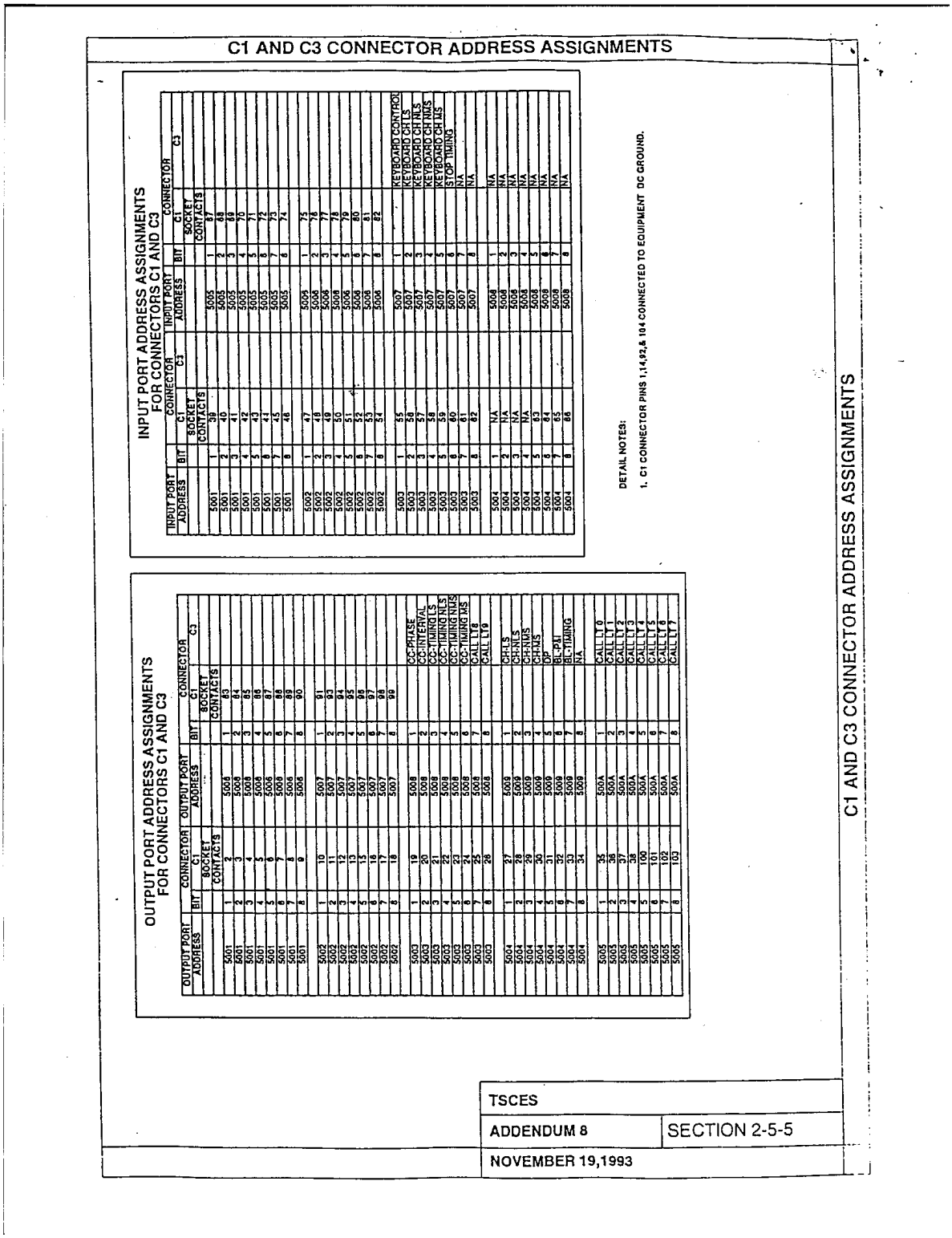


NOTES:

1. PROVIDE CLEARANCE FOR C1P WITH HOOD WHEN MOUNTING TO CONNECTOR C1S ON THE 170E CONTROLLER UNIT.
2. THE DARKER CIRCLES IN THE C1S AND C1P CONNECTOR DETAILS DENOTE GUIDE PIN 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.

C1 CONNECTOR DETAIL

TSCES	
ADDENDUM 8	SECTION 2-5-4
NOVEMBER 19,1993	



C1 AND C3 CONNECTOR ADDRESS ASSIGNMENTS

INPUT PORT ADDRESS ASSIGNMENTS FOR CONNECTORS C1 AND C3

INPUT PORT ADDRESS	BIT	CONNECTOR C1 SOCKET CONTACTS	CONNECTOR C3	INPUT PORT ADDRESS	BIT	CONNECTOR C1 SOCKET CONTACTS	CONNECTOR C3	
5001	1	39		5005	1	87		
5001	2	40		5005	2	48		
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 NXS
5003	5	59		5007	5			KEYBOARD CH DIS
5003	6	60		5007	6			STOP TIMING
5003	7	61		5007	7			NA
5003	8	62		5007	8			NA
5004	1	NA		5008	1			NA
5004	2	NA		5008	2			NA
5004	3	NA		5008	3			NA
5004	4	NA		5008	4			NA
5004	5	63		5008	5			NA
5004	6	64		5008	6			NA
5004	7	65		5008	7			NA
5004	8	66		5008	8			NA

OUTPUT PORT ADDRESS ASSIGNMENTS FOR CONNECTORS C1 AND C3

OUTPUT PORT ADDRESS	BIT	CONNECTOR C1 SOCKET CONTACTS	OUTPUT PORT ADDRESS	BIT	CONNECTOR C1 SOCKET CONTACTS	CONNECTOR C3	
5001	1	2	5008	1	83		
5001	2	3	5008	2	84		
5001	3	4	5008	3	85		
5001	4	5	5008	4	86		
5001	5	6	5008	5	87		
5001	6	7	5008	6	88		
5001	7	8	5008	7	89		
5001	8	9	5008	8	90		
5002	1	10	5007	1	91		
5002	2	11	5007	2	92		
5002	3	12	5007	3	93		
5002	4	13	5007	4	94		
5002	5	14	5007	5	95		
5002	6	15	5007	6	97		
5002	7	16	5007	7	98		
5002	8	17	5007	8	99		
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 NXS
5003	6	24	5008	6			CC-TIMING XLS
5003	7	25	5008	7			CALL L16
5003	8	26	5008	8			CALL L15
5004	1	27	5009	1			CH-LS
5004	2	28	5009	2			CH-NLS
5004	3	29	5009	3			CH-NXS
5004	4	30	5009	4			CH-XLS
5004	5	31	5009	5			DP
5004	6	32	5009	6			BL-PXI
5004	7	33	5009	7			BL-TIMING
5004	8	34	5009	8			NA
5005	1	35	500A	1			CALL L10
5005	2	36	500A	2			CALL L11
5005	3	37	500A	3			CALL L12
5005	4	38	500A	4			CALL L13
5005	5	100	500A	5			CALL L14
5005	6	101	500A	6			CALL L15
5005	7	102	500A	7			CALL L16
5005	8	103	500A	8			CALL L17

DETAIL NOTES:

1. C1 CONNECTOR PINS 1,14,92,& 104 CONNECTED TO EQUIPMENT DC GROUND.

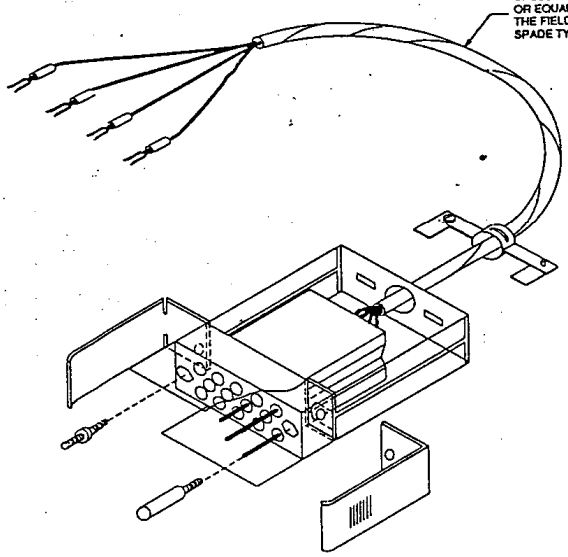
C1 AND C3 CONNECTOR ADDRESS ASSIGNMENTS

TSCES	
ADDENDUM 8	SECTION 2-5-5
NOVEMBER 19,1993	

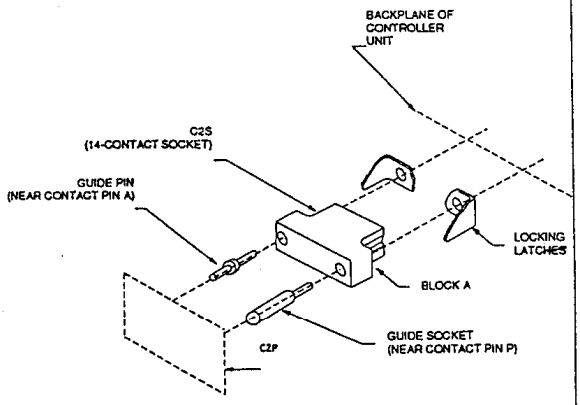
C2, C20, C30 AND C40 CONNECTOR DETAIL

CXP MODEM INTERCONNECT HARNESS

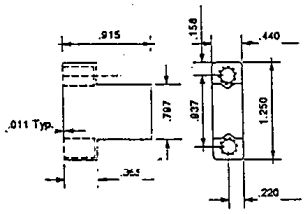
CABLE SHALL BE 2 PAIR #20, BELDEN 9402 OR EQUALAND LENGTH SHALL BE 3.0 FEET MINIMUM. THE FIELD END CONNECTORS SHALL BE SPRING SPADE TYPE.



CONNECTOR CX DETAIL



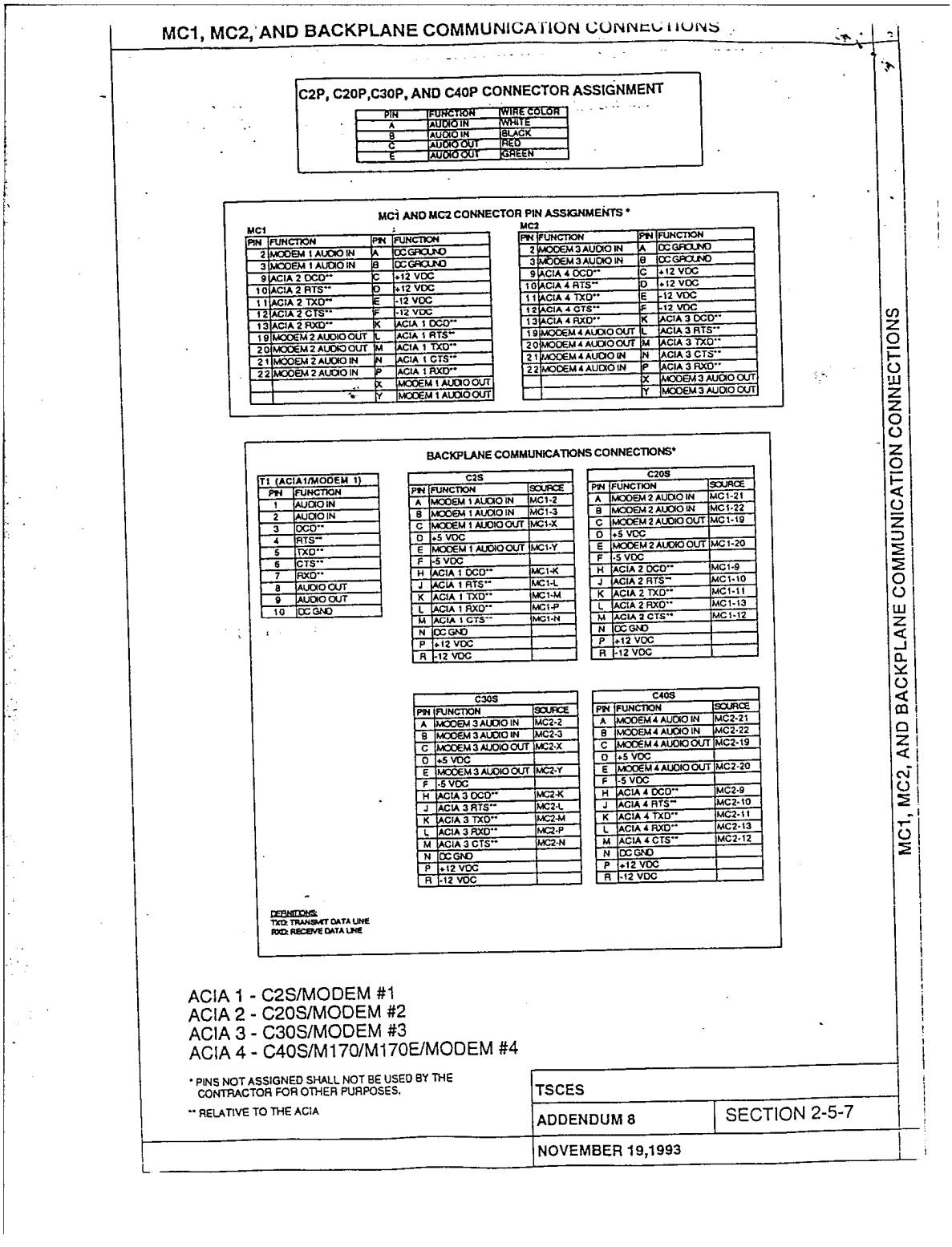
CONNECTOR CXS



* 'X' DENOTES CONNECTOR NUMBER

C2, C20, C30, AND C40 CONNECTOR DETAIL

TSCES	
ADDENDUM 8	SECTION 2-5-6
NOVEMBER 19,1993	



MC1, MC2, AND BACKPLANE COMMUNICATION CONNECTIONS

C2P, C20P,C30P, AND C40P CONNECTOR ASSIGNMENT

PIN	FUNCTION	WIRE COLOR
A	AUDIO IN	WHITE
B	AUDIO IN	BLACK
C	AUDIO OUT	RED
E	AUDIO OUT	GREEN

MC1 AND MC2 CONNECTOR PIN ASSIGNMENTS *

MC1

PIN	FUNCTION	PIN	FUNCTION
2	MODEM 1 AUDIO IN	A	DC GROUND
3	MODEM 1 AUDIO IN	B	DC GROUND
9	ACIA 2 DCD**	C	+12 VDC
10	ACIA 2 RTS**	D	+12 VDC
11	ACIA 2 TXD**	E	-12 VDC
12	ACIA 2 CTS**	F	-12 VDC
13	ACIA 2 RXD**	K	ACIA 1 DCD**
19	MODEM 2 AUDIO OUT	L	ACIA 1 RTS**
20	MODEM 2 AUDIO OUT	M	ACIA 1 TXD**
21	MODEM 2 AUDIO IN	N	ACIA 1 CTS**
22	MODEM 2 AUDIO IN	P	ACIA 1 RXD**
		X	MODEM 1 AUDIO OUT
		Y	MODEM 1 AUDIO OUT

MC2

PIN	FUNCTION	PIN	FUNCTION
2	MODEM 3 AUDIO IN	A	DC GROUND
3	MODEM 3 AUDIO IN	B	DC GROUND
9	ACIA 4 DCD**	C	+12 VDC
10	ACIA 4 RTS**	D	+12 VDC
11	ACIA 4 TXD**	E	-12 VDC
12	ACIA 4 CTS**	F	-12 VDC
13	ACIA 4 RXD**	K	ACIA 3 DCD**
19	MODEM 4 AUDIO OUT	L	ACIA 3 RTS**
20	MODEM 4 AUDIO OUT	M	ACIA 3 TXD**
21	MODEM 4 AUDIO IN	N	ACIA 3 CTS**
22	MODEM 4 AUDIO IN	P	ACIA 3 RXD**
		X	MODEM 3 AUDIO OUT
		Y	MODEM 3 AUDIO OUT

BACKPLANE COMMUNICATIONS CONNECTIONS*

T1 (ACIA1/MODEM 1)

PIN	FUNCTION
1	AUDIO IN
2	AUDIO IN
3	DCD**
4	RTS**
5	TXD**
6	CTS**
7	RXD**
8	AUDIO OUT
9	AUDIO OUT
10	DC GND

C2S

PIN	FUNCTION	SOURCE
A	MODEM 1 AUDIO IN	MC1-2
B	MODEM 1 AUDIO IN	MC1-3
C	MODEM 1 AUDIO OUT	MC1-X
D	+5 VDC	
E	MODEM 1 AUDIO OUT	MC1-Y
F	-5 VDC	
H	ACIA 1 DCD**	MC1-K
J	ACIA 1 RTS**	MC1-L
K	ACIA 1 TXD**	MC1-M
L	ACIA 1 RXD**	MC1-P
M	ACIA 1 CTS**	MC1-N
N	DC GND	
P	+12 VDC	
R	-12 VDC	

C20S

PIN	FUNCTION	SOURCE
A	MODEM 2 AUDIO IN	MC1-21
B	MODEM 2 AUDIO IN	MC1-22
C	MODEM 2 AUDIO OUT	MC1-19
D	+5 VDC	
E	MODEM 2 AUDIO OUT	MC1-20
F	-5 VDC	
H	ACIA 2 DCD**	MC1-9
J	ACIA 2 RTS**	MC1-10
K	ACIA 2 TXD**	MC1-11
L	ACIA 2 RXD**	MC1-13
M	ACIA 2 CTS**	MC1-12
N	DC GND	
P	+12 VDC	
R	-12 VDC	

C30S

PIN	FUNCTION	SOURCE
A	MODEM 3 AUDIO IN	MC2-2
B	MODEM 3 AUDIO IN	MC2-3
C	MODEM 3 AUDIO OUT	MC2-X
D	+5 VDC	
E	MODEM 3 AUDIO OUT	MC2-Y
F	-5 VDC	
H	ACIA 3 DCD**	MC2-K
J	ACIA 3 RTS**	MC2-L
K	ACIA 3 TXD**	MC2-M
L	ACIA 3 RXD**	MC2-P
M	ACIA 3 CTS**	MC2-N
N	DC GND	
P	+12 VDC	
R	-12 VDC	

C40S

PIN	FUNCTION	SOURCE
A	MODEM 4 AUDIO IN	MC2-21
B	MODEM 4 AUDIO IN	MC2-22
C	MODEM 4 AUDIO OUT	MC2-19
D	+5 VDC	
E	MODEM 4 AUDIO OUT	MC2-20
F	-5 VDC	
H	ACIA 4 DCD**	MC2-9
J	ACIA 4 RTS**	MC2-10
K	ACIA 4 TXD**	MC2-11
L	ACIA 4 RXD**	MC2-13
M	ACIA 4 CTS**	MC2-12
N	DC GND	
P	+12 VDC	
R	-12 VDC	

DEFINITIONS:
TXD: TRANSMIT DATA LINE
RXD: RECEIVE DATA LINE

ACIA 1 - C2S/MODEM #1
ACIA 2 - C20S/MODEM #2
ACIA 3 - C30S/MODEM #3
ACIA 4 - C40S/M170/M170E/MODEM #4

* PINS NOT ASSIGNED SHALL NOT BE USED BY THE CONTRACTOR FOR OTHER PURPOSES.

** RELATIVE TO THE ACIA

MC1, MC2, AND BACKPLANE COMMUNICATION CONNECTIONS

TSCES

ADDENDUM 8 | SECTION 2-5-7

NOVEMBER 19,1993

CHAPTER 3

SPECIFICATIONS FOR MODEL 200 SWITCH PACK AND MODEL 204 FLASHER UNIT MODULES

TABLE of CONTENTS

3.1 SECTION 1 - GENERAL REQUIREMENTS

3.1.1 The module chassis providing rigid unit support (for connector mounting, PCB support, module alignment and insertion/removal) and Triac heat sinking 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.

3.1.2. Module control circuitry and switches shall be readily accessible by the use of a screwdriver or wrench. Only one type of screw head end (slotted or Phillips) shall be used throughout.

3.1.3. Each module shall be so constructed that persons inserting or removing the module will not be exposed to any parts having live voltage. A handle shall be attached to the front of each module to facilitate the module insertion or removal from its mating connector.

3.1.4 The module shall be so constructed that its lower surface will be no more than 2.10 inches below the centreline of the connector and that no part will extend more than 0.90 inch to the left or 1.10 inches to the right of the centreline of the connector pin array.

3.1.5 Continuous edge guides shall be provided on the module.

3.1.6 The front panel of the module shall be provided with one indicator per switch. The indicators shall be vertically centred on the front panel with top and bottom indicators no more than one inch from the panel vertical centre.

3.1.7 Each switch shall have the capability of switching any current from 0.05 to 10 amperes (AC) of tungsten lamp load or 10 amperes (AC) at a power factor of 0.85.

3.1.8 Each switch shall turn ON within $\pm$5 degrees of the zero voltage point of the AC sinusoidal line, and shall turn OFF within $\pm$5 degrees of the zero current point of the alternating current sinusoidal line. After power restoration, the zero voltage turn ON may be within $\pm$10 degrees of the zero voltage point only during the first half cycle of line voltage during which an input signal is applied. Turn ON and OFF shall be within 8.33 ms following application or removal of the logic signal, respectively.

3.1.9 Each switch shall be designed for a minimum of 300 million operations while switching a tungsten filament load of 1,000 watts at 70o C.

3.1.10 Each switch shall have isolation between input DC control and AC to lights output circuit of at least 2,000 VDC and 10,000 megohms DC.

3.1.11 Each switch shall have a one cycle surge rating of 175 amperes RMS and a one second surge rating of 40 amperes RMS.

3.1.12 Each switch shall be capable of withstanding a peak inverse voltage of 500 volts at 70 degrees C and no more than 20 mA leakage.

3.1.13 The connector plug contact tails shall be solder hook or eye styles only. PCB (soldered to the PCB) and quick connect connections styles are not allowed.

3.2 SECTION 2 - MODEL 200 REQUIREMENTS

3.2.1 The Model 200 Solid State Switch Pack shall be a modular plug-in device containing 3 solid state switches to be used for opening and closing connections between the applied power and an external load.

3.2.2 A LOW state input (negative true logic) from the controller unit (saturated NPN transistor, 0 to 6 VDC) shall cause the switch to be energized. A HIGH state input (cut-off NPN transistor, 16 VDC or greater) shall cause the switch to de-energize. The state transition (conducting to nonconducting or vice versa) shall occur between 6 and 16 VDC.

3.2.3 The incoming logic signal shall not sink more than 20 mA nor be subjected to more than 30 VDC.

3.2.4 The module shall not draw more than 60 mA at +16 VDC or greater from the cabinet power supply with all switches ON.

3.2.5 Each switch shall have an OFF state dv/dt rating of 100 volts per us or greater.

3.2.6 The indicators shall be labeled or colour coded from top to bottom "Red", "Yellow" and "Green". Each indicator shall indicate a controller unit output circuit.

3.2.7 The input circuit of each switch shall have reverse polarity protection.

3.2.8 The resistance between the AC+ input terminal and the AC+ output terminal of each switch shall be 15,000 ohms, minimum, when the switch is in the open position. The output current from the switch through the load when the load switch is in the OFF state shall not exceed 20 mA peak.

3.2.9 Each switch shall be isolated so that line transients or switch failure will not adversely affect the controller unit.

3.2.10 The Plug Connector shall be a BEAU P-5412-LAB or equal.

3.3 SECTION 3 - MODEL 204 REQUIREMENTS

3.3.1 The Model 204 Flasher Unit shall be a modular plug-in device containing a flasher control circuit and 2 solid state switches. The module's function is to alternately open and close connections between the applied power and an external lamp load during flashing operation.

3.3.2 The module shall generate its own internal DC power for logic and control from the AC Line.

3.3.3 The module shall commence flashing operation when AC power is applied to the module.

3.3.4 The circuit shall provide 50 to 60 flashes per minute with a 50% duty cycle.

3.3.5 A surge arrestor shall be provided between AC+ (pin 11) and Flasher Out (pins 7 & 8). The surge arrestor 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 Volts
Energy rating, maximum	50 Joules
Power dissipation, average	0.85 Watt
Standby current for pulses less than 6 us:	2000 Amperes
Standby current: less than	1 ma

3.3.6 Each switch shall have an OFF state dv/dt rating of 200 volts per us or greater.

3.3.7 The indicators shall indicate the output state of the switches.

3.3.8 The Plug Connector shall be a BEAU P-5406-LAB or equal.

3.3.9 Each circuit shall be designed to operate in an open circuit (without load) condition for 10 years or greater.

CHAPTER 4

SPECIFICATIONS FOR MODEL 208 AND 210 MONITOR UNITS

TABLE OF CONTENTS

4.1 SECTION 1 - GENERAL REQUIREMENTS

4.1.1 The Monitor Unit shall render reliable detection and cause a relay output contact condition (FAILED state) when sensing the following:

4.1.1.1 MODEL 208 MONITOR UNIT
1. The +24 VDC Power Supply Voltage below specified threshold
2. A WDT Timeout Condition

4.1.1.2 MODEL 210 MONITOR UNIT
1. The +24 VDC Power Supply Voltage below specified threshold
2. A WDT Timeout Condition
3. Conflicting Field Output Circuits ON together

4.1.2 FAILED State Output Circuits

4.1.2.1 An electro-mechanical relay shall be provided to switch an output circuit during a FAILED state. The relay coil shall be energized in a NON FAILED state.

4.1.2.2 The relay contacts shall be rated for a minimum of 3 amperes at 120 VAC and 100,000 operations. Contact opening/closing time shall be 30 ms or less.

4.1.2.3 Monitor Unit Reset

4.1.2.3.1 A momentary SPST CONTROL switch labeled "RESET" shall be provided on the unit front panel to reset the monitor unit circuitry to a NON FAILED state. The switch shall be so positioned on the front panel that the switch can be operated while gripping the front panel handle.

4.1.2.3.2 A reset issuance (Unit Reset) shall be a onetime input to prevent the monitor from constant reset.

4.1.2.4 All monitor logic and driver power shall be generated from an internal unit power supply except for WDT and +24 VDC cabinet voltage sense circuits. The WDT sense circuit power may be derived from either power supply. Circuits on the monitor that are "powered" by the +24 VDC cabinet power supply shall be optically isolated from those deriving their power from the monitor unit internal supply. The monitor shall not draw more than 500 mA from the +24 VDC cabinet power supply. Failure to provide reliable operating voltage levels shall cause a FAILED state.

4.2 SECTION 2 - POWER SUPPLY MONITOR REQUIREMENTS

4.2.1 The monitor unit shall sense an external +24 VDC power supply output voltage.

4.2.2 Voltages sensed at +18 VDC or below for a duration of 500 ms or longer shall cause a FAILED state.

4.2.3 Voltages sensed at +22 VDC or above shall NOT cause a FAILED state.

4.2.4 Voltages sensed below +22 VDC for a duration of 200 ms or less shall NOT cause a FAILED state.

4.2.5 All timing and voltage conditions other than those specified above may or may not cause

a FAILED state.

4.2.6 A FAILED state caused by sensing the power supply shall illuminate a front panel indicator light labeled "VDC FAILED". The indicator light shall remain ON until Unit Reset.

4.2.7 Only Unit Reset shall reset the power supply sense circuitry from a FAILED state.

4.3 SECTION 3 - WATCHDOG TIMER MONITOR REQUIREMENTS

4.3.1 WDT Circuitry shall be provided to monitor a controller unit output line state routed to the monitor unit at its assigned pin. The WDT Circuitry shall sense any line state change and the time between the last change. No state change for 1.5 (± 0.1) seconds shall cause a FAILED state. The timer shall reset at each state change in a NON FAILED state.

4.3.2 Only the Unit Reset or a WDT inactive due to the voltage sense shall reset the WDT from a FAILED state.

4.3.3 A FAILED state caused by the WDT shall illuminate a front panel indicator light labelled "WDT ERROR". The indicator shall remain ON until Unit Reset issuance.

4.3.4 The WDT Circuitry shall sense the incoming VAC Line and when the voltage falls below 98 (± 2) VAC for 50 (± 17) ms shall inhibit the WDT Function. When the WDT Circuitry senses the incoming VAC Line rise above 103 (± 2) VAC for 50 (± 2) ms the WDT shall become active. A hysteresis between the Voltage Inhibit and the Voltage Active Settings shall be a minimum of 3 volts.

4.4 SECTION 4 - MODEL 208 REQUIREMENTS

4.4.1 Provision to drive an external NE2H Neon light through a 56 KOhm, 1/2 watt series resistor (resident on unit) from the unit shall be supplied.

4.4.2 The PDA #3 WDT Reset Input shall not be sensed by the unit. It exists only for downward compatibility reset of past WDT plug-in boards.

4.4.3 The output relay contact for FAILED state shall be "OPEN".

4.5 SECTION 5 - MODEL 210 REQUIREMENTS

4.5.1 Conflicting Field Output Circuits

4.5.1.1 The monitor unit shall monitor up to 32 field output circuits using a 16 conflicting channel (green and yellow outputs logically OR'd internally together) comparison setup. The specified associated cabinet output file assignment or operator selected output switches will determine channel assignment.

4.5.1.2 All monitored field output voltages shall be measured as true RMS responsive (up to 3 KHz) to both positive and negative alternations of the sine wave and the full cycle. The calculated value shall be averaged over a minimum of 2 cycles. If digital means are used in calculating RMS, a minimum of 2 samples shall be taken per alternation.

4.5.1.3 **Sensed conflicting field output voltages 25 VAC or greater for a duration of 250 ms or longer shall cause a FAILED state. (This provision varies from CALTRANS (500 mS) to properly sense flashing field output circuits which flash at a rate greater than 1 Hz.)**

4.5.1.4 **Sensed conflicting field output voltages between 15 and 25 VAC and for durations between 200 ms and 250 ms may or may not cause a FAILED state. (This provision varies from CALTRANS (200 ms and 500 ms) to properly sense flashing field output circuits which flash at a rate greater than 1 Hz.)**

The above two Conflict Monitor provisions (4.5.1.3 and 4.5.1.4) are modified for Winnipeg application to permit the Monitor to properly sense flashing field output circuits which flash at a rate greater than 1 Hz, so as to be compatible with "Winnipeg Standard" Model 170E flash rate of 100 flashes per minute (300 ms ON + 300 ms OFF).

4.5.1.5 Sensed conflicting field output voltages 15 VAC or less OR any voltage having a duration of 200 ms or less shall NOT cause a FAILED state.

4.5.1.6 The conflict monitoring circuitry shall be capable of detecting both a positive and negative half-wave failure under the foregoing conditions.

4.5.1.7 A FAILED state caused by sensing voltage conflicts shall be reset only by the Unit Reset.

4.5.1.8 Sixteen indicators shall be provided on the unit front panel to indicate if the channel output is sensed ON. The indicators shall remain ON in a latched state during a FAILED state unless unlatched by a Unit Reset or a unit loss of power during said FAILED state.

4.5.2 Conflict Programming Card

4.5.2.1 A plug-in PCB Programming Card shall be provided in the monitor unit. The card shall plug into the unit through a slot in the unit front panel. The card shall contain 120 diodes (#1N4148 or equal). Each diode shall match 1 through 16 channels of possible conflict. The programming card shall be logically labeled and laid out for easy identification of the diodes by channel. With diodes in place all output channels being monitored shall be in conflict. When the diode (anode to numerical pins and cathode to alphabetical pins) has been removed the channels shall be defined as non-conflict.

4.5.2.2 A pad for 16 yellow inhibit jumpers shall be provided. Placement of the associated channel jumper between the channel yellow pin and the yellow inhibit common shall disable sensing the said channel yellow.

4.5.2.3 The programming card shall intermate with a PCB 28/56S Connector. The card shall be provided with card ejectors. The monitor unit shall provide a mechanically sound card and connector support including continuous card guides. When the programming card is resident in the unit, the card's front end shall be flush with the unit's front panel.

4.5.2.4 Pins 16 and T shall be connected together on the programming card. Removal of the card shall be sensed as a conflicting FAILED state.

4.5.3 A front panel indicator labeled "CONFLICT" shall be provided. The indicator shall illuminate when there is a FAILED state caused by conflicting channels and go off only by Unit Reset issuance.

4.5.4 The output relay contact for FAILED state shall be "CLOSED".

4.5.5 A second output circuit (STOPTIME controller input) shall be provided to sink a NPN

Open Collector Transistor upon FAILED state. The transistor shall be rated to sink a minimum of 50 mA at up to 30 VDC. A blocking diode shall be provided on the transistor output to prevent it from sourcing power into the controller unit.

4.5.6 An internal SPST LOGIC toggle switch shall be provided on the Model 210 Monitor Unit to activate the WDT function. When the switch is ON the WDT circuitry shall be active. The switch shall be mounted on the module PCB in a readily accessible location.

4.5.7 The Front Panel RESET switch shall be tied to the External Test Reset Input Line (Pin Z). The External Line shall be optically isolated from internal circuitry.

CHAPTER 5

SPECIFICATIONS FOR DETECTOR SENSOR UNITS, ELEMENTS AND ISOLATORS

MODEL 222 TWO-CHANNEL LOOP DETECTOR SENSOR UNIT

MODEL 224 FOUR-CHANNEL LOOP DETECTOR SENSOR UNIT

MODEL 231 MAGNETIC DETECTOR SENSING ELEMENT

MODEL 232 TWO-CHANNEL MAGNETIC DETECTOR SENSOR UNIT

MODEL 242 TWO-CHANNEL DC ISOLATOR

MODEL 252 TWO-CHANNEL AC ISOLATOR

TABLE of CONTENTS

5.1 SECTION 1 - GENERAL REQUIREMENTS

5.1.1 The sensor unit and isolator channels shall be operationally independent from each other.

5.1.2 Each sensor unit or AC isolator channel shall draw no more than 100 mA from the +24 VDC cabinet power supply and shall be insensitive to 700 millivolts RMS ripple on the incoming +24 VDC line.

5.1.3 The sensor unit or isolator front panel shall be provided with a hand pull to facilitate insertion and removal from the input file.

5.1.4 All control switches, gain dials and channel indicators shall be mounted on the front panel. Each sensor unit or isolator channel shall have an indicator to provide visual indication of detection or incoming signal.

5.1.5 Each sensor unit or isolated channel output shall be an opto-isolated N Open Collector capable of sinking 50 mA at 30 VDC. The output shall be compatible with the controller unit inputs.

5.1.6 A valid channel input shall cause a channel ground true output to the controller unit of a minimum 100 ms in duration. An onboard jumper shall be provided to bypass the above minimum timing requirement.

5.1.7 The sensor unit or sensing element shall operate and interface successfully with an associate CALTRANS Standard Sensing Unit or Element.

5.1.8 The output transistor shall switch from the OFF state to the ON state in a period equal to or less than 20 us. The transistor shall switch from the ON state to the OFF state in a period equal to or less than 20 us.

5.1.9 The numbered and lettered sides of the PCB connector shall be commonly assigned.

5.2 SECTION 2 - MODEL 222 & 224 LOOP DETECTOR SENSOR UNIT REQUIREMENTS

5.2.1 The sensor unit channel shall produce an output signal when a vehicle passes over or remains over wire loops embedded in the roadway. The method of detection shall be based upon a design that renders the output signal when a metallic mass (vehicle) enters the detection zone causing a change of 0.02% minimum decrease in inductance of the circuit measured at the input terminals of the sensor unit. The detector zone shall include all configurations listed in paragraph 5.2.9.

5.2.2 An open loop shall cause the sensor unit channel to output a signal.

5.2.3 Each sensor unit channel shall be capable of detecting all types of Manitoba licensed motor vehicles when connected to the loop configuration/leadin requirements of 5.2.9.

5.2.4 The sensor unit shall comply with all performance requirements when connected to an inductance (loop plus lead-in) from 50 to 700 micro henries with a Q-parameter as low as 5 at the sensor unit operating frequency.

5.2.5 Loop inputs to each channel shall be transformer isolated.

5.2.6 Each individual channel shall have a minimum of 3 switch selectable operating frequencies.

5.2.7 The sensor unit channel tuning circuits shall be automatic and shall be so designed that drift, caused by environmental changes, or changes in applied power shall not cause an actuation.

5.2.8 Mode Selection Requirements

5.2.8.1 Each sensor unit channel shall have Pulse and Presence selectable modes.

5.2.8.1.1 Pulse Mode

5.2.8.1.1.1 In the pulse mode, each new vehicle presence within the detection zone shall initiate a sensor unit channel output pulse of 125 (±25) ms in duration.

5.2.8.1.1.2 Should a vehicle remain in a portion of the detection zone for a period in excess of 2 seconds, the sensor unit channel shall automatically "tune out" the presence of said vehicle. The sensor unit channel shall then be capable of detecting another vehicle entering the same detection zone. The recovery time between the first vehicle pulse and channel capability to detect another vehicle shall be 3 seconds maximum.

5.2.8.1.2 Presence Mode

5.2.8.1.2.1 In the presence mode, the sensor unit channel shall recover to normal sensitivity within 1 second after termination of vehicle presence in the detection zone regardless of the duration of the presence.

5.2.8.1.2.2 The channel sensitivity settings shall be provided that detect the presence of a vehicle in the detection zone for a specified time period and inductance change(s). The conditions are as follows:

	Minimum time duration in minutes	Detector Input inductance change
5.2.8.1.2.2.1 Setting 1	3	0.02% or more
	10	0.06% or more
5.2.8.1.2.2.2 Setting 2 (OCC)	4	1.00% or more

5.2.9 Sensitivity

5.2.9.1 Each sensor unit channel shall be equipped with a front panel selectable sensitivity setting(s) in presence and pulse modes to accomplish the following under operational and environmental requirements of this specification:

5.2.9.1.1 Each sensor unit channel shall respond to an inductance change of 0.02% while connected to the following California Standard Plan ES-5A & B Loop Configurations. (California Department of Transportation Standard Plans)

5.2.9.1.1.1 Single Type A, B or Q Loop with a 250 foot lead-in cable.

5.2.9.1.1.2 Single Type A, B or Q Loop with a 1000 foot lead-in cable.

5.2.9.1.1.3 Four Type A, B or Q Loops connected in series/parallel with a 250 foot lead-

in cable.

5.2.9.1.1.4 Four Type A, B or Q Loops connected in series with a 1000 foot lead-in cable.

5.2.9.1.1.5 One 50 foot Type C Loop with 250 foot lead-in cable.

5.2.9.2 Each sensor unit channel shall respond while in Setting 2 (OCC) to a nominal change in inductance between 0.15% to 0.4% while connected to the above loop configurations. This setting shall not respond to an inductance change of less than 0.1%.

5.2.9.3 The sensor unit channel shall not detect vehicles, moving or stopped, at distances of 3 feet or more from any loop perimeter, in all configurations listed in paragraph 5.2.9.

5.2.9.4 All sensitivity settings shall not differ $\pm$40% from the nominal value chosen.

5.2.9.5 There shall be a minimum of 7 selectable sensitivity settings including specified sensitivity settings.

5.2.10 Response time of the sensor unit channel for the OCC setting shall be less than 20 ms. That is, for any decreased inductive change which exceeds its sensitivity threshold, the channel shall output a ground true logic level within 20 ms. When such change is removed, the output shall become an open circuit within 20 ms.

5.2.11 The sensor unit channels shall begin normal operation within 2 seconds after the application of power or after a reset signal of 15 us.

5.2.12 Lightning protection shall be installed within the sensor unit.

5.2.12.1 The protection shall enable the sensor unit to withstand the discharge of a 10 microfarad capacitor charged to $\pm$1000 volts directly across the sensor unit input pins with no loop load present.

5.2.12.2 The protection shall enable the sensor unit to withstand the discharge of a 10 microfarad capacitor charged to $\pm$2000 volts directly across either the sensor unit input inductance pins or from either side of the sensor unit input inductance pins to equipment ground. The sensor unit input pins shall have a dummy resistive load attached equal to 5.0 ohms.

5.2.13. Tracking rate - The sensor unit shall be capable of compensating or tracking for an environmental change up to 0.001% change in inductance per second.

5.2.14 Tracking Range

5.2.14.1 The sensor unit 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.

5.2.14.2 The sensor unit shall be capable of normal operation as the input resistance is changed $\pm$ 0.5% from the quiescent tuning point regardless of internal circuit drift.

5.2.15 Temperature Change - The operation of the sensor unit shall not be affected by changes in the inductance and/or capacitance of the loop caused by environmental changes with the rate of temperature change not exceeding 1 degrees 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 unit.

5.2.16 A switch or switch position shall be provided on the front panel to disable each channel output.

5.3 SECTION 3 - MODEL 231 MAGNETIC SENSING ELEMENT REQUIREMENTS

5.3.1 Each sensing element shall be designed for ease of installation, repositioning, and removal. It shall be no larger than 2.25 inches in diameter and shall have no sharp edges along its length. The overall length shall not exceed 21 inches.

5.3.2 Each sensing element including lead-in shall have a DC resistance of less than 3500 ohms.

5.3.3 The sensing element shall be constructed of nonferrous material and shall be moisture proof. The element shall contain no moving parts or active components. The element shall have a minimum of 50 feet lead-in cable. Leakage resistance shall be a minimum of 10 megohms when tested with 400 VDC between lead wire, including lead wire entrance, and the fluid of a salt water bath after the device has been entirely immersed in the bath for a period of 24 hours at 20 degrees ($\pm$3 degrees) C. The salt water bath concentrate shall be one fourth ounce of salt per gallon of water.

5.4 SECTION 4 - MODEL 232 TWO-CHANNEL MAGNETIC DETECTOR SENSOR UNIT REQUIREMENTS

5.4.1 The Model 232 Two-Channel Magnetic Detector Sensor Unit contains 2 channels of detection. When resident in an energized cabinet Input File and each channel connected to its associated Model 231 Magnetic Detector Sensing Element(s), the channel shall produce an output signal to the controller unit when a voltage is induced in the sensing element by a vehicle passing over the sensing element.

5.4.2 Each channel shall detect all Manitoba licensed vehicles passing within 6 feet of the Model 231 Sensing Element with a 1000 foot lead-in cable at all speeds between 3 and 80 miles per hour.

5.4.3 A single control knob for adjusting the sensitivity of each channel shall be readily adjustable without use of tools and shall be mounted on the front panel.

5.4.4 A momentary switch or switch position shall be provided to place a call on each channel on an individual basis.

5.5 SECTION 5 - MODEL 242 TWO-CHANNEL DC ISOLATOR REQUIREMENTS

5.5.1 The Model 242 Two-Channel DC Isolator shall contain 2 isolation channels which provide isolation between electrical contacts external to the module and the controller unit input. The method of isolation shall be based upon a design which shall provide reliable operation.

5.5.2 Each isolation channel shall have 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.

5.5.3 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 watts of AC power. No current shall be drawn from the cabinet power supply.

5.5.4 A channel contact closure input of 5 ms or less shall not cause an out (ground true) to the controller. An input of 25 ms or greater shall cause an output to the controller. An input of duration between 5 and 25 ms may or may not cause an output to the controller. The channel circuitry shall be able to react to a new input closure within 25 ms of an input opening.

5.5.5 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.

5.5.6 The minimum isolation shall be 1000 megohms and 2,500 VDC measured between the input and output of the same channel.

5.5.7 Lightning protection shall be installed inside the Isolator.

5.5.7.1 The protection shall enable the isolator to withstand the discharge of a 10 microfarad capacitor charged to ± 1000 volts directly across the input pins with no load present.

5.5.7.2 The protection shall enable the isolator to withstand the discharge of a 10 microfarad capacitor charged to ± 2000 volts directly across either the input pins or from either side of the input pins to equipment ground. The input pins shall have a dummy resistive load attached equal to 5.0 ohms.

5.6 SECTION 6 - MODEL 252 TWO-CHANNEL AC ISOLATOR REQUIREMENTS

5.6.1 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. The method of isolation shall be based upon a design which provides reliable operation.

5.6.2 A channel input voltage (Von) of 80 (± 5) VAC applied for a minimum duration of 100 ms shall cause an output (ground true) to the controller.

5.6.3 A channel input voltage of Von minus 10 VAC applied for a minimum duration of 100 ms shall cause an output (False) to the controller.

5.6.4 Each channel input circuit shall have a input impedance of between 6000 to 15000 Ohms at 60 Hz.

5.6.5 Circuitry switching to invert inputs to read ground false logic (by jumpers) shall be provided.

5.6.6 The transistor shall be capable of sinking 50 mA at 30 VDC.

5.6.7 The minimum isolation shall be 1000 megohms between the input and output terminals at 500 VAC applied voltage.

5.6.8 Each channel input shall withstand, without damage, the discharge of a 10 microfarad capacitor charged to ± 1000 volts, when connected directly to the open input pins. Each channel shall withstand, without damage, the discharge of a 10 microfarad capacitor charged to +/- 2000 volts, when connected between either input pin and equipment ground.

CHAPTER 6

SPECIFICATIONS FOR CABINET MODELS 332, 334 & 336

TABLE OF CONTENTS

6.1 SECTION 1 - GENERAL REQUIREMENTS AND CABINET MODEL COMPOSITION

6.1.1 Unless otherwise specified the model shall be furnished, ready for operation with the following composition.

6.1.1.1 Model 332A Cabinet (Panel Termination) shall consist of:

Housing 1 A or B	Output File	#1
Mounting Cage 1	C1 Harness	#1
Power Distribution Assembly #1*	Service Panel	#1
Input Files I & J	Input Panel	#1
Power Supply Assembly *		

6.1.1.2 Model 332B Cabinet (Pan Duct) shall consist of:

Housing 1 A or B	Output File	#1
Mounting Cage 1	C1 Harness	#1
Power Distribution Assembly #1*	Service Panel	#1
Input Files I & J	Input Panel	#2
Power Supply Assembly *		

6.1.1.3 Model 334 Cabinet (Ramp Meter) shall consist of:

Housing 1 A or B	PDA Assembly	#3
Mounting Cage 1	C1 Harness	#2
Input File I	Service Panel	#1
Input Panel #3		

6.1.1.4 Model 336A Cabinet (2 to 8 Phase) shall consist of:

Housing 2	Output File	#1
Mounting Cage 2	C1 Harness	#3
Power Distribution Assembly #2	Service Panel	#2
Input File I	Input Panel	#4

6.1.1.5 Model 336B Cabinet (2 to 4 Phase) shall consist of:

Housing 2	Output File	#2**
Mounting Cage 2	C1 Harness	#3
Power Distribution Assembly #2	Service Panel	#2
Input File I	Input Panel	#4
Monitor Unit Assembly		

*The Contractor has the option to supply the Power Distribution Assembly #2 in lieu of the Power Supply and Power Distribution #1 Assemblies.

**A C1 Harness #3/Output File #2 Adaptor shall be provided.

6.1.1.6 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.

6.1.2 Cabinet Shipping Requirements - The cabinet shall be delivered mounted on a plywood shipping pallet. The pellet 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.

6.1.3 Cabinet Adaptors - When specified, adaptors shall be provided. The adaptors shall be fabricated of the same material and finish as the cabinet housing.

6.1.4 All bolts, nuts, washers, screws (size 8 or larger), hinges and hinge pins shall be stainless steel unless otherwise specified.

6.1.5 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.

6.1.6 All conductors, terminals and parts which could be hazardous tomaintenance personnel shall be protected with suitable insulating material.

6.2 SECTION 2 - HOUSING REQUIREMENTS

6.2.1 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 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 The enclosure doors, lifting eyes, gasket channels, police panel and all supports welded to the enclosure and doors shall be fabricated of 0.125 inch minimum thickness aluminum sheet. Bolted on supports shall be either the same material and thickness as the enclosure or 0.105 inch minimum thickness steel. The side panels and filter shell shall be fabricated of 0.080 inch minimum thickness aluminum sheet.

6.2.2.3 All exterior seams for enclosure 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. 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) process or gas tungston arc (TIG) process.

6.2.2.4 Aluminum surfaces shall conform to the following:

6.2.2.4.1 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 71 degrees C for 5 minutes (Oakite 61A, Diversey 909 or equivalent in mix of 6 to 8 ounces per gallon of distilled water). Rinse in cold water. Etch in a sodium solution at 66 degrees C for 5 minutes (0.5 ounce sodium fluoride plus 5 ounces of sodium hydroxide mix per gallon of distilled water). Rinse in cold water. Desmut in a 50% by volume nitric acid solution at 20 degrees C for 2 minutes. Rinse in cold water.

6.2.2.4.2 The anodic coating shall conform to MIL-A-8625C (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 27 milligrams 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 99 degrees C.

6.2.2.5 The enclosure door frames 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) inch.

6.2.2.6 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 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 inch aluminum or 0.105 inch steel.

6.2.2.8 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 a weight load of 1000 pounds.

6.2.2.9 All exterior bolt heads shall be tamperproof type.

6.2.3 Door Latches and Locks

6.2.3.1 The latching handles shall have provision for padlocking in the closed position. Each handle shall be 0.75 inch minimum diameter stainless steel with a minimum 0.5 inch shank. The padlocking attachment shall be placed at 4.0 inches from the handle shank centre to clear the lock and key. An additional 4.0 inches minimum gripping length shall be provided.

6.2.3.2 The latching mechanism shall be a three-point draw roller type. The pushrods shall be turned edgewise at the outer supports and have a cross section of 0.25 inch thick by 0.75 inch wide, minimum.

6.2.3.3 When the door is closed and latched, the door shall be locked. The locks and handles shall be on the left side of the front door and right 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 The locks shall be Corbin 2 type, or equal. One key shall be supplied with each lock. The keys shall be removable in the locked position only.

6.2.3.5 The locks shall have rectangular, spring loaded bolts. The bolts shall have a 0.281 inch throw and shall be 0.75 inch wide by 0.375 inch thick (tolerance is ± 0.035 inch).

6.2.3.6 The centre 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 centre of the door.

6.2.3.7 Rollers shall have a minimum diameter of 0.875 inch with nylon wheels and steel ball bearings.

6.2.4 The housing ventilation including intake, exhaust, filtration, fan assembly and environmental control are as follows:

6.2.4.1 The front door shall be provided with louvered vents. The louvered vent depth shall be a maximum of 0.25 inches. 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 shall be bent over a minimum of 0.25 inches 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.

6.2.4.2 The intake (including filter with shell) and exhaust areas shall pass a minimum of 60 cubic feet of air per minute for housing #1 and 26 cubic feet of air per minute for housing #2.

6.2.4.3 The housing shall be equipped with an 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.

6.2.4.4 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 off. The fan circuit shall be protected at 125% of the fan motor ampacity. The manual adjustment shall be graded in 10 degrees C increment scale. Technical documentation of the fan performance characteristics shall be supplied with the first "Evaluation" model.

6.2.4.5 The filter shall be 16 inches wide by 12 inches high by 0.875 inch thick. The filter shall be an ECO-AIR Products E35S or equal.

6.2.5 Hinges and Door Catches

6.2.5.1 Two-bolt per leave hinges shall be provided to bolt the enclosure to the door. Housing 1 shall have 4 hinges and Housing 2 three hinges. Each hinge shall be 3.5 inches 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 shall be provided with catches to hold the door open at both 90 and 180 ($\pm$ 10) degrees. The catch minimum diameter shall be either 0.375 inch for plated steel or aluminum rods or 0.25 inch 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 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 1.5 inches.

6.2.6.2 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 The police panel shall contain 2 DPST toggle POWER switches.

6.2.6.3.1 Model 334 - One switch shall be labeled "ON-OFF LIGHTS" and the other "POLICE CONTROL ON-OFF".

6.2.6.3.2 Models 332 and 336 - One switch shall be labeled "ON-OFF" and the other "FLASH/AUTOMATIC".

6.2.6.4 The front and back of the panel shall be enclosed with a rigid metal covering so that no parts having line voltage are exposed.

6.2.6.5 The panel assembly shall have a drain to prevent water collecting within the assembly. The drain shall be channeled to the outside.

6.3 SECTION 3 - CABINET CAGE REQUIREMENTS

6.3.1 A standard EIA 19-inch rack cage shall be installed inside the housing for mounting of the controller unit and cabinet assemblies.

6.3.2 The EIA rack portion of the cage shall consist of 2 pairs of continuous, adjustable equipment mounting angles. The angle nominal thickness shall be either 0.1345 inch plated steel or 0.105 stainless steel. The angles shall be tapped with 10-32 threads with EIA universal spacing. The angle shall comply with Standard EIA RS-310-B and shall be supported at the top and bottom by either welded or bolted support angles to form a cage.

6.3.3 Clearance between rails for mounting assemblies shall be 17.75 inches.

6.3.4 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 inches. The angles shall be mounted 17.5 inches from the top of the mounting area for Models 332 and 334 and 7.25 inches for the Model 336 Cabinet. The angles shall be vertically adjustable.

6.3.5 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 The cage shall be centered within the cabinet.

6.4 SECTION 4 - CABINET ASSEMBLIES

6.4.1 General

6.4.1.1 The following equipment shall be completely removable from the cabinet without removing any other equipment and using only a slotted or Phillips screw driver:

Power Supply Assembly
Power Distribution Assembly

Input File
Output File
Monitor Unit Assembly

6.4.1.2 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 All equipment in the cabinet, when required, shall be clearly and permanently labelled. 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 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 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 relay sockets to overcome the residual magnetism.

6.4.1.6 Assembly or file depth dimension shall include terminal blocks.

6.4.1.7 All assemblies and files shall allow air circulation through its top and bottom unless specifically called out otherwise.

6.4.1.8 Socket types (or equal) 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 Supply Module	BEAU S-5406-XX (or equal)
208 Monitor Unit	PCB 22/44S
210 Monitor Unit	PCB 28/56S

6.4.1.9 Connector sockets for Flasher Unit, Power Supply, and Switch Pack modules shall be mounted with their front face 7.5 inches deep from assembly or file front panel. (Note Output File exception).

6.4.1.10 Guides (top and bottom) shall be provided for Switch Pack Modules, Flasher Units, Monitor Unit, Watchdog Timer Module, Detector and Isolator Modules and Power Supply Module (bottom only). The guides shall begin 1.0 ($\pm$ 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 Assemblies and Files shall be fabricated of 0.060 inch 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 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 of ferro-resonant design having no active components and conform to the following requirements.

6.4.2.1.1 Line Regulation - 2% from 90 to 135 VAC at 60 Hz, plus an additional 1.6% for each additional 1.0% frequency change.

6.4.2.1.2 Load Regulation - 5% from 1 ampere to 5 amperes with a maximum temperature rise of 30 degrees C above ambient.

6.4.2.1.3 Design Voltage - +24 (± 0.5) VDC at full load, 30 degrees C, 115 VAC incoming after a 30 minute warm up period.

6.4.2.1.4 Full Load Current - 5 amperes, minimum.

6.4.2.1.5 Ripple Noise - 2 volts peak-to-peak and 500 millivolts RMS at full load.

6.4.2.1.6 Line Voltage - 90 to 135 VAC.

6.4.2.1.7 Efficiency - 70% minimum.

6.4.2.1.8 Minimum Voltage - +22.8 VDC.

6.4.2.1.9 Circuit capacitors shall be rated for 40 volts, minimum.

6.4.2.2 The assembly shall have a maximum depth of 5.5 inches.

6.4.2.3 The front panel shall include AC and DC fuses, power ON light and test points for monitoring the output voltages.

6.4.2.4 The assembly including terminals shall be protected to prevent accidental contact with energized parts.

6.4.2.5 The power supply cage and transformer shall be securely braced to prevent damage in transit.

6.4.3 Power Distribution Assembly

6.4.3.1 The following equipment shall be provided with the Power Distribution Assemblies:

6.4.3.1.1 PDA #1

1 - Duplex NEMA 5-15R Controller Receptacle
2 - Duplex NEMA 5-15R Equipment Receptacles, (one with GFI)
1 - Pole 50 Amperes minimum, 120 VAC Main Circuit Breaker
1 - Pole 15 Amperes, 120 VAC Equipment Circuit Breaker
1 - 6 Pole Ganged, 15 Amperes, 120 VAC Signal Bus Circuit Breaker
1 - 2 Pole Ganged, 20 Amperes, 120 VAC Flash Bus Circuit Breaker
1 - Mercury Contactor - rated minimum 60 Amperes, 120 VAC
2 - Model 204 Flasher Units and Sockets
1 - AUTO/FLASH Control Switch
1 - FLASH Indicator Light
1 - Model 430 Heavy Duty Relay (Transfer Relay) and Socket
2 - 10 Position Terminal Blocks (TBK) T1 and T2

6.4.3.1.2 PDA #2

1 - Duplex NEMA 5-15R Controller Receptacle
2 - Duplex NEMA 5-15R Equipment Receptacles, (one with GFI)
1 - 1 Pole 50 Amperes minimum, 120 VAC Main Circuit Breaker
1 - 1 Pole 15 Amperes, 120 VAC Equipment Circuit Breaker
1 - 6 Pole Ganged, 15 Amperes, 120 VAC Signal Bus Circuit Breaker*
1 - 2 Pole Ganged, 20 Amperes, 120 VAC Flash Bus Circuit Breaker

1 - Mercury Contactor - rated minimum 60 Amperes, 120 VAC
2 - Model 204 Flasher Units and Sockets
1 - Model 206 Power Supply Module and Socket
1 - Model 430 Heavy Duty Relay and Socket (Transfer Relay)*
1 - AUTO/FLASH Control Switch
1 - FLASH ON Indicator Light
3 - 10 Position Terminal Blocks (TBK) T1, T2 and T4
1 - 4 Position Terminal Block (TBK) T3
OR * Circuit Breaker Option

6.4.3.1.3 PDA #3

1 - Duplex NEMA 5-15R Controller Receptacle
2 - Duplex NEMA 5-15R Equipment Receptacles, (one with GFI)
1 - 1 Pole 30 Amperes, 120 VAC Main Circuit Breaker
3 - 1 Pole 15 Amperes, 120 VAC Circuit Breakers, (Equipment and Field)
1 - Model 206 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 Terminal Blocks (TBK) T1, T2 and T4
1 - 4 Position Terminal Block (TBK) T3

6.4.3.2 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. 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 The "AUTO/FLASH" switch, when placed in "FLASH" position (down), shall energize the Mercury Contactor (MC) coil. 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 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 Option.

6.4.3.6 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.

6.4.3.7 Ganged Circuit Breakers shall be certified by the circuit breaker manufacturer that their circuit breakers shall gang trip.

6.4.3.8 The Monitor Unit ON/OFF-RESET Switch shall be a DPST Toggle Control switch mounted on the PDA #3 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 shall close bypassing the Monitor Unit.

6.4.3.9 Circuit Breaker Option

6.4.3.9.1 Six Single Pole 15 Ampere Circuit Breakers with Auxiliary Switch feature and Medium Trip Delay characteristics shall be provided.

6.4.3.9.2 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 the ON position. The auxiliary circuits shall be wired in parallel so that any tripped breaker shall energize the Mercury Contactor Coil, 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 Model 206 Power Supply Module

6.4.3.10.1 The module shall meet requirements specified in 6.4.2.1 and 6.4.2.3.

6.4.3.10.2 The module chassis shall be vented. Its top and sides shall be open except for unit supports.

6.4.3.10.3 When resident in the PDA assembly the module shall be held firmly in place by its stud screw, assembly connector support panel and a wingnut.

6.4.3.10.4 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 0.68 uF capacitor shall be placed across AC+ and AC- between the two power resistors and the MOV's.

6.4.3.11 Terminal screw size shall be 10-32 for Terminal Blocks (TBK) T1, T2 and T4 and 6-32 for Terminal Block (TBK) T3.

6.4.4 Input File

6.4.4.1 The file shall have a maximum depth of 8.5 inches and shall inter mate with and support 14 two-channel detector sensor or isolator units.

6.4.4.2 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 an 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 The input file shall be provided with marker strips to identify isolators and detectors in the file.

6.4.4.4 Terminal Block screw size for Input File Terminals shall be 8-32.

6.4.4.5 Output File

6.4.4.5.1 General Requirements

6.4.4.5.1.1 The Output File shall be provided with marker strips to identify switch packs when mounted in the file.

6.4.4.5.1.2 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.

6.4.4.5.1.3 Terminal Blocks (TBK) 01 and 03 terminal positions shall be labelled functionally. A permanent label reading "Channels 9 and 10 Separated" shall be placed on the right side Output File mounting flange.

6.4.4.5.1.4 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.

6.4.4.5.1.5 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.

6.4.4.5.1.6 The depth of the file shall not exceed 14.5 inches.

6.4.4.5.1.7 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.

6.4.4.5.1.8 Terminal Blocks (TBK) 01 and 03 terminal screw size shall be 8-32 and Terminal Blocks (TBK) 02 and 04 shall be 6-32.

6.4.4.5.2 Output File #1

6.4.4.5.2.1 The output file shall be capable of containing 12 Model 200 Switch Packs, 4 Flash Transfer Relays, and the Model 210 Monitor Unit. 4 Flash Transfer Relays and 1 Model 210 Monitor Unit shall be furnished with each output file.

6.4.4.5.2.2 The red and yellow output circuits of switch packs 1, 2, 3, 4, 5, 6, 7 and 8 shall be made available at individual Molex receptacle/plug connections for flash selectability. Eight "red" and 4 "yellow" Molex Plugs shall be provided.

6.4.4.5.2.3 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.

6.4.4.5.2.4 The monitor unit compartment including the housed Model 210 Monitor Unit exclusive of handle shall extend no farther than 1.25 inches in front of the 19 inch 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.

6.4.4.5.3 Output File #2 (Model 420)

6.4.4.5.3.1 The Output File #2 shall be capable of containing 6 Model 200 Switch Packs and 2 Flash Transfer Relays. 2 Flash Transfer Relays shall be provided with the file.

6.4.4.5.3.2 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 selectability.

6.4.4.6 Heavy Duty Relay (Model 430)

6.4.4.6.1 Heavy duty relays shall be the electromechanical type designed for continuous duty.

6.4.4.6.2 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.

6.4.4.6.3 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 ampere 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.

6.4.4.6.4 The relay coil shall have a power consumption of 10 volt-amperes maximum.

6.4.4.6.5 Each relay shall withstand a potential of 1500 VAC at 60 Hz between insulated parts and between current carrying and noncarrying parts. Each relay shall have a 1 cycle surge rating of 175 amperes RMS.

6.4.4.7 Side Panels

6.4.4.7.1 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".

6.4.4.8 Cabinet Harnesses

6.4.4.8.1 The C1 Harness shall be a minimum of 4 feet 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 City Approved Model 170 Controller Unit mounted in the cabinet.

6.4.4.8.2 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 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.

6.4.4.8.3 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.

6.4.4.8.4 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).

6.4.4.9 Monitor Unit Assembly (For Model 336B)

6.4.4.9.1 The monitor unit assembly shall be 1.75 inches high and a maximum of 17.0 inches wide. The assembly shall house the Model 210 Monitor Unit (horizontally). A Model 210 Monitor Unit shall be furnished with each assembly.

6.4.4.9.2 The assembly shall have a vertical opening of 1.5 inches on the front panel for Model 210 insertion/removal. PCB edge guides shall be provided for monitor unit support and to guide it into its mating connector socket.

6.4.4.9.3 A 10 position terminal block (M1) shall be provided on the backplane of the assembly. Position assignment, left to right, shall be as follows:

Position 1 - +24 VDC
Position 2 - DC Ground
Position 3 - External Reset
Position 4 - Watchdog Timer (WDT) Input
Position 5 - STOPTIME Output
Position 6 - Door Switch (Unit Resident)
Position 7 - Mercury Contactor Coil (To PDA)
Position 8 - AC+
Position 9 - AC-
Position 10- Equipment Ground

6.4.4.9.4 A 37 pin circular plastic connector, matching C4P requirements, shall be provided and mounted rigidly on the back of the assembly. Pin assignments shall be as follows:

PIN	CHANNEL /FUNCTION	PIN	CHANNEL /FUNCTION	PIN	CHANNEL /FUNCTION
1	1 GREEN	12	6 YELLOW	23	12 GREEN
2	1 YELLOW	13	7 GREEN	24	12 YELLOW

3	2 GREEN	14	7 YELLOW	25	13 GREEN
4	2 YELLOW	15	8 GREEN	26	13 YELLOW
5	3 GREEN	16	8 YELLOW	27	14 GREEN
6	3 YELLOW	17	9 GREEN	28	14 YELLOW
7	4 GREEN	18	9 YELLOW	29	15 GREEN
8	4 YELLOW	19	10 GREEN	30	15 YELLOW
9	5 GREEN	20	10 YELLOW	31	16 GREEN
10	5 YELLOW	21	11 GREEN	32	16 YELLOW
11	6 GREEN	22	11 YELLOW	33	AC-

NOTE: PINS 34 to 37 NOT ASSIGNED.

6.5 SECTION 5 - CABINET WIRING

6.5.1 Cabinet Wiring Diagram

6.5.1.1 Four sets of nonfading (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 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 diagrams shall be placed in a heavy duty side opening clear plastic pouch and attached to the front cabinet door. The pouch shall be of such design and material that it provides adequate storage and access to the wiring diagram and manual.

6.5.1.2 Two cabinet manuals shall be provided in the pouch together with the cabinet wiring diagram sets. The pouch shall be of a size and strength to easily hold the documents and keys without tearing.

6.5.2 Conductors

6.5.2.1 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 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 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 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 All conductors shall conform to the following colour-code requirements:

6.5.2.5.1 The grounded conductors of AC circuits shall be identified by a continuous

white or grey colour.

6.5.2.5.2 The equipment grounding conductors shall be identified by a solid green colour or by a continuous green colour with 1 or more yellow stripes.

6.5.2.5.3 The DC logic ground conductors shall be identified by a solid white colour with a red stripe.

6.5.2.5.4 The ungrounded AC+ conductors shall be identified by a solid black colour or black with coloured stripe.

6.5.2.5.5 The ungrounded logic conductors shall be identified by any colour not specified above.

6.5.2.6 All 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.

6.5.2.6.1 Wiring containing AC shall be routed and bundled separately or shielded separately from all logic voltage control circuits.

6.5.2.6.2 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.

6.5.2.7 Within the cabinet, the DC logic ground 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 protector disconnected.

6.5.2.8 The AC- copper terminal bus shall not be grounded to the cabinet nor connected to logic ground. Nylon screws with a minimum diameter of 0.25 inch shall be used for securing the bus to the service panel.

6.5.2.9 The cabinet power supply DC Ground shall be connected to the DC logic ground bus using a No. 14, or larger, stranded copper wire.

6.5.2.10 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 The terminal blocks shall be barrier type rated at 20 amperes, 600 volts RMS minimum. The terminal screws shall be 0.3125 inch 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.

6.5.3.2 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 amperes at 600 volts peak, minimum. The block shall be either a double row, 3 position screw/insert with shorting bar (screws, inserts and shorting bars shall be nickel plated brass) or a Marathon #1423552 (or equal). If the Marathon block is used, the surge protectors shall

be terminated under a screw head (not common with AC+, AC- or Equipment Ground). The AC+, AC- and Equipment Ground conductors connecting to the service terminals and appropriate busses shall not be spade lugged.

6.6 SECTION 6 - POWER LINE SURGE PROTECTORS

6.6.1 Two 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.

6.6.2 One type of surge protector shall be the Three-Electrode Gas Tube type and shall have the following ratings:

6.6.2.1 IMPULSE BREAKDOWN: Less than 1,000 volts in less than 0.1 us at 10 kilovolts/us.

6.6.2.2 STANDBY CURRENT: Less than 1 ma.

6.6.2.3 STRIKING VOLTAGE: Greater than 212 VDC.

6.6.2.4 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.

6.6.3 The other type of surge protector shall be Metal Oxide Varistor (MOV). One shall be installed between AC+ and equipment ground and the other between AC- and equipment ground. The MOV shall have the following ratings:

6.6.3.1 RECURRENT PEAK VOLTAGE: 212 Volts.

6.6.3.2 ENERGY RATING MINIMUM: 50 Joules.

6.6.3.3 POWER DISSIPATION: Average 0.85 Watt.

6.6.3.4 PEAK CURRENT FOR PULSES: 2,000 Amperes for less than 6 us.

6.6.3.4 STANDBY CURRENT: Less than 1 ma.

CHAPTER 7
SPECIFICATIONS FOR MODEL 400 MODEM MODULE

TABLE of CONTENTS

7.1 **SECTION 1 MODEL 400 MODEM MODULE**

7.1.1 The MODEM shall provide two-wire half duplex and four-wire full duplex communications. It shall be switch selectable between half duplex and full duplex. In half duplex, pins X and Y shall be used for Audio IN/OUT.

7.1.2 The MODEM shall be compatible with Bell Standard 202S and comply with the following requirements:

7.1.2.1 Data Rate: 300 to 1200 baud modulation.

7.1.2.2 Modulation: Phase coherent frequency shift keying (FSK).

7.1.2.3 Data Format: Asynchronous, serial by bit.

7.1.2.4 Line and Signal Requirements: Type 3002 voice-grade, unconditioned.

7.1.2.5 ACIA and MODEM Interface: EIA RS-232-C standards.

7.1.2.6 Tone Carrier Frequencies (Transmit & Receive): 1200 Hz (MARK) and 2200Hz (SPACE) with $\pm$1% tolerance. The operating band shall be (half power, - 3dB) between 1000 and 2400 Hz.

7.1.2.7 Transmitting Output Signal Level: 0, -2, -4, -6 and -8 dB (at 1700 Hz) continuous or switch selectable.

7.1.2.8 Receiver Input Sensitivity: 0 to -40 dB.

7.1.2.9 Receiver Bandpass Filter: Shall meet the error rate requirement specified in Paragraph 7.1.2.15 and shall provide 20 dB/Octave, minimum active attenuation for all frequencies outside the operating band.

7.1.2.10 Clear-to-Send (CTS) Delay: 12 ($\pm$2) ms.

7.2.1.11 Receive Line Signal Detect Time: 8 ($\pm$2) ms mark frequency.

7.2.1.12 Receive Line Squelch: 6.5 ($\pm$1) ms, 0 ms (OUT).

7.2.1.13 Soft Carrier (900 Hz) Turn Off Time: 10 ($\pm$2) ms.

7.2.1.14 MODEM Recovery Timer: Capable of receiving data within 22 ms after completion of transmission.

7.2.1.15 Error Rate: Shall not exceed 1 bit in 100,000 bits, with a signal-to-noise ratio of 16 dB measured with flat-weight over a 300 to 3000 Hz band.

7.2.1.16 Transmit Noise: Less than -50 dB across 600 ohm resistive load within the frequency spectrum of 300 to 3000 Hz at maximum output.

7.1.3 The MODEM power requirements are as follows:

Input Voltages	Maximum Current Consumption
+12 VDC	75 milliamperes
-12 VDC	75 miliamperes

7.1.4 Indicators shall be provided on the front of the MODEM to indicate Carrier Detect, Transmit Data, and Receive Data.

CHAPTER 8
SPECIFICATIONS FOR MODEL 402 SUPPORT ASSEMBLY

TABLE of CONTENTS

8.1 SECTION 1 - MODEL 402 SUPPORT ASSEMBLY

8.1.1 The Model 402 Support Assembly shall be constructed to mount in a standard EIA 19 inch rack.

8.1.2 The top of the Model 402 shall be covered. The sides and bottom shall be slotted for ventilation.

8.1.3 The front panel shall provide 2 openings for the insertion and removal of Model 400 Modem Modules. The openings shall allow for the proper use of PCB card ejectors. PCB edge guides shall be provided for each opening.

8.1.4 Connector SAC1 shall be a TYPE 25P connector with solder cup connectors on contact plug assembly. The connector shall be mounted on the assembly rear panel.

8.1.5 Connector SAC2 shall be a TYPE T connector.

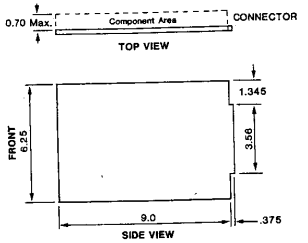
8.1.6 Connectors SAC4 and SAC5 shall be PCB 22/44S connectors. The connectors shall intermate with Model 400 Modules. SAC4 Connector shall be wired for Model 400 Module only. SAC5 Connector is wired for either Model 400 or a future I/O Module.

8.1.7 Connector D25S shall be a TYPE 25S connector. The connector shall have a shield and mounting hardware to mate with the TYPE 25P connector on the Model 414 Module. The D25S connector shall have a 4 foot cable to interconnect it to the Model 402's other connectors. The cable shall also be provided with strain relief at entry to the Model 402's rear panel. The cable shall be Belden 9515 (or equal).

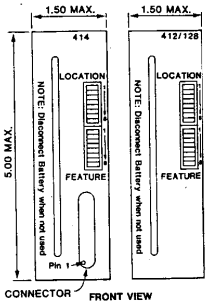
APPENDIX A

TABLE OF CONTENTS

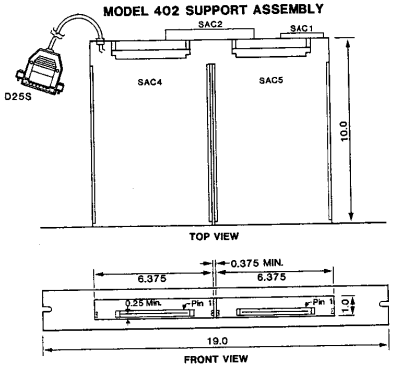
MODEL 400 MODULES

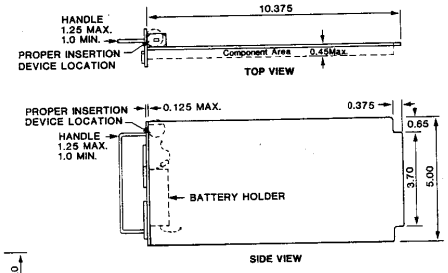


MODEL 412/128 AND MODEL 414 PROGRAM MODULES

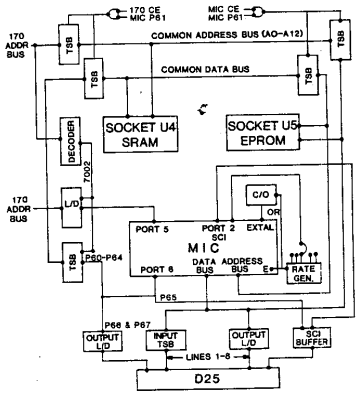


MODEL 402 SUPPORT ASSEMBLY





MODEL 414 PROGRAM MODULE BLOCK DIAGRAM



MODEL 412/128 AND MODEL 414 PROGRAM MODULE CONNECTOR ASSIGNMENTS

CIRCUIT SIDE FUNCTION	PCB CONNECTOR NUMBER		COMPONENT SIDE FUNCTION
A0	1	2	A1
A2	3	4	A3
A4	5	6	A5
A6	7	8	A7
A8	9	10	A9
A10	11	12	A11
A12	13	14	A13
A14	15	16	A15
D0	17	18	D1
D2	19	20	D3
D4	21	22	D5
D6	23	24	D7
VMA /Q2(E)	25	26	NA
Read/Write	27	28	NA
NA	29	30	NA
NA	31	32	NA
NA	33	34	Equipment Ground
NA	35	36	NA
NA	37	38	NA
NA	39	40	NA
NA	41	42	NA
NA	43	44	NA
NA	45	46	NA
NA	47	48	NA
NA	49	50	NA
NA	51	52	NA
NA	53	54	NA
NA	55	56	NA
NA	57	58	NA
+12 VDC	59	60	+12 VDC
-12 VDC	61 Key	62	-12 VDC
-5 VDC	63	64	-5 VDC
+5 VDC	65	66	+5 VDC
+5 VDC	67	68	+5 VDC
GND	69	70	GND
GND	71	72	GND

REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

MODEL 402 AND 414 CONNECTOR ASSIGNMENTS

SAC1 CONTACT	SAC1 TO	SAC1 FUNCTION	SAC2 TO	SAC2 MODEL 400 FUNCTION	SAC3 TO	SAC3 MODEL 400 FUNCTION	D25 TO	D25 MODEL 414 FUNCTION
1	EQUIP GND		SAC5-2	AUDIO INPUT 2	EQUIP GND		SAC3-1	EQUIP GND
2	SAC5-1	INPUT A-1	SAC5-3	AUDIO INPUT 2	SAC4-M	DATA INPUT	SAC3-2	SCI TXDI
3	SAC5-11	OUTPUT A-1	SAC5-X	AUDIO OUTPUT 2	SAC4-P	DATA OUTPUT	SAC3-3	SCI RXDI
4	SAC5-9	INPUT A-2	SAC5-Y	AUDIO OUTPUT 2	SAC4-L	REQUEST TO SEND	SAC3-4	P65 RTSI
5	SAC5-12	OUTPUT A-2	NA		SAC4-N	CLEAR TO SEND	SAC3-5	SCI CTSI
6	SAC5-13	OUTPUT A-3	NA		SAC4-R	OUTPUT B-1	SAC3-6	IN MD1/RXD2
7	SAC5-A&B	DC GROUND	SAC4-2	AUDIO INPUT 1	SAC4&5-A&B	DC GROUND	SAC3-7	DC GROUND
8	SAC5-14	OUTPUT A-4	SAC4-3	AUDIO INPUT 1	SAC4-K	CARRIER DETECT	SAC3-8	SCI DCDI
9	SAC5-15	OUTPUT A-5	SAC4-X	AUDIO OUTPUT 1	SAC5-N	OUTPUT B-2	SAC3-9	IN MD0/RTS2
10	SAC5-16	OUTPUT A-6	SAC4-Y	AUDIO OUTPUT 1	SAC5-K	OUTPUT B-3	SAC3-10	IN MD3/DCD2
11	NA				SAC4&5-C&D	12 VDC	SAC3-11	12 VDC
12	SAC5-17	OUTPUT A-7			SAC5-V	OUTPUT B-4	SAC3-12	IN MD4
13	SAC5-18	OUTPUT A-8			SAC5-W	OUTPUT B-5	SAC3-13	IN MD5
14	NA				SAC5-M	INPUT B-1	SAC3-14	OUT MD0/TXD2
15	NA				SAC5-J	OUTPUT B-6	SAC3-15	IN MD6
16	NA				SAC5-21	NA	SAC3-16	P66 CONTROL
17	NA				SAC4-22	NA	SAC3-17	P67 CONTROL
18	NA				SAC4&5-E&F	-12 VDC	SAC3-18	-12VDC
19	NA				SAC5-L	INPUT B-2	SAC3-19	OUT MD2/RTS2
20	NA				SAC5-H	INPUT B-3	SAC3-20	OUT MD3
21	NA				SAC5-J	INPUT B-4	SAC3-21	OUT MD4
22	SAC5-5	INPUT A-3			SAC5-R	INPUT B-5	SAC3-22	OUT MD5
23	SAC5-6	INPUT A-4			SAC5-S	INPUT B-7	SAC3-23	OUT MD6
24	SAC5-7	INPUT A-5			SAC5-T	INPUT B-7	SAC3-24	OUT MD7
25	SAC5-8	INPUT A-6			SAC5-U	INPUT B-8	SAC3-25	OUT MD8

MODEL 400 MODULE CONNECTOR ASSIGNMENT

COMPONENT SIDE CONTACT	COMPONENT SIDE MODEL 400 FUNCTION	CIRCUIT SIDE CONTACT	CIRCUIT SIDE MODEL 400 FUNCTION
1	NA	A	DC GROUND
2	AUDIO INPUT	B	DC GROUND
3	AUDIO INPUT	C	12 VDC
4	NA	D	12 VDC
5	NA	E	-12 VDC
6	NA	F	-12 VDC
7	NA	H	NA
8	NA	J	NA
9	NA	K	CARRIER DETECT
10	NA	L	REQUEST TO SEND
11	NA	M	DATA INPUT
12	NA	N	CLEAR TO SEND
13	NA	P	DATA OUTPUT
14	NA	R	NA
15	NA	S	NA
16	NA	T	NA
17	NA	U	NA
18	NA	V	NA
19	NA	W	NA
20	NA	X	AUDIO OUTPUT
21	NA	Y	AUDIO OUTPUT
22	NA	Z	NA

NOTES:

1. ALL DIMENSIONS SHOWN ARE IN INCHES.
2. PROGRAM MODULES' HEIGHT AND WIDTH DIMENSIONS ARE MAXIMUM.
3. THE BLOCK DIAGRAM FOR MODEL 414 IS INTENDED TO BE DESCRIPTIVE OF OPERATION.
4. SHEET DEFINITIONS:

CE = CHIP ENABLE
C/O = CRYSTAL OSCILLATOR
CTS = CLEAR TO SEND
DCD = DATA CARRIER DETECT
L/D = LATCH/DRIVER DEVICE
MD = MIC DATA BUS LINES 0 TO 7
P66 = MIC PORT 6, BIT 6
RTS = REQUEST TO SEND
RXD = RECEIVE DATA
SAC = SUPPORT ASSEMBLY CONNECTOR
SCI = SERIAL COMMUNICATION INTERFACE
TSB = TRISTATE BUFFER
TXD = TRANSMIT DATA

DIST | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET NO | TOTAL SHEETS

CHIEF, OFFICE OF ELECTRICAL SYSTEMS
REGISTERED ELECTRICAL ENGINEER
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — R.L. Donner — No. 7405 — Exp. 9-30-90 — ELECTRICAL — STATE OF CALIFORNIA

DATE | REVISED BY | DATE REVISED
CALCULATED/ DESIGNED BY
CHECKED BY
PROJECT ENGINEER

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

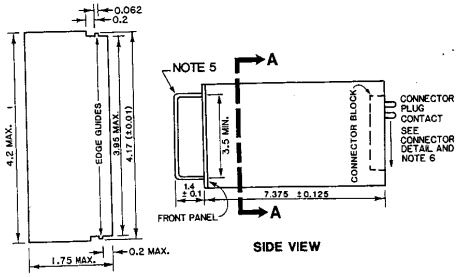
FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3

MODELS 400, 402, 412/128 AND 414 TSCES-3

CU | EA

FORM DC-OE-82-PF (REV. 1/85)

MODEL 200 AND 204 PHYSICAL DETAILS



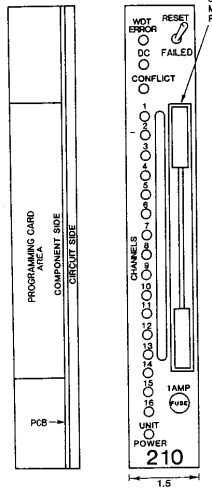
SIDE VIEW

CROSS SECTION A-A

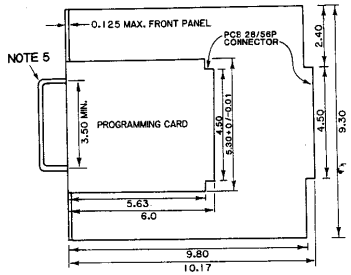
MODEL 200 AND 204 CONNECTOR DETAIL

PIN	MODEL 200 FUNCTION	PIN	MODEL 204 FUNCTION
1	AC+	7	Load Circuit #1
2	Equip. Ground	8	Load Circuit #2
3	Red Output	9	Equip Ground
4	Not Assigned	10	AC−
5	Yellow Output	11	AC+
6	Red Output	12	Not Assigned
7	Green Output		
8	Yellow Input		
9	+ 24VDC		
10	Green Input		
11	Not Assigned		
12	Not Assigned		

MODEL 210 MONITOR UNIT



BACK VIEW FRONT VIEW



SIDE VIEW

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 Yellow	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 +24 VDC	Z	External Reset +24 VDC
23		AA	
24	(Pins 24 and 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	NA
28	Yellow Inhibit Common	FF	NA

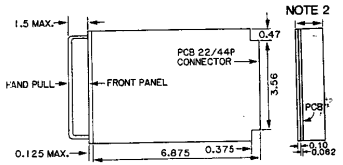
REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

CHIEF, OFFICE OF ELECTRICAL SYSTEMS
REGISTERED ELECTRICAL ENGINEER
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
R.L. Donner
No. 7455
Exp. 9-30-90
ELECTRICAL
STATE OF CALIFORNIA

DETAIL FOR MODELS 222, 224, 232, 242 AND 252



SIDE VIEW END VIEW

MODELS 222, 224, & 232 CONNECTOR ASSIGNMENTS

PIN	FUNCTION
A	DC Ground
B	+24 VDC
* C	Detector Reset
D	#1 Input
E	#1 Input
F	#1 Output (C)
H	#1 Output (E)
J	#2 Input
K	#2 Input
L	Equipment Ground
M	AC−
N	AC+
P	#3 Input
R	#3 Input
S	#3 output (C)
T	#3 Output (E)
U	#4 Input
V	#4 Input
W	#4 Output (C)
X	#4 Output (E)
Y	#4 Output (C)
Z	#4 Output (E)

MODELS 242 & 252 CONNECTOR ASSIGNMENTS

PIN	FUNCTION
* A	DC Ground
* B	+24 VDC
C	NA
D	#1 Input
E	#1 Input Common
F	#1 Output (C)
H	#1 Output (E)
J	#2 Input
K	#2 Input Common
L	Equipment Ground
M	AC−
N	AC+
P	NA
R	NA
S	NA
T	NA
U	NA
V	NA
W	#2 Output (C)
X	#2 Output (E)
Y	NA
Z	NA

NOTES:

1. ALL DIMENSIONS SHOWN ARE IN INCHES.
2. MODELS 222, 232, 242, AND 252 SHALL HAVE A WIDTH OF 1.12. MODEL 224 SHALL HAVE A WIDTH OF 2.0 ±0.25.
3. MODEL 210 TOLERANCE DIMENSIONS ARE ±0.02 INCH EXCEPT AS NOTED.
4. SHEET DEFINITIONS:
   − = SLOTTED FOR KEYING
   (C)= COLLECTOR
   (E)= EMITTER
   * = NA FOR THESE CONNECTIONS ON MODEL 232 & MODEL 242
5. 'U' SHAPE ROD HANDLE SHALL BE FABRICATED OF 0.2 TO 0.25 DIAMETER STOCK TO FORM A HANDLE.
6. THE MODEL 200 CONNECTOR SHALL BE BEAU P-5412-LAB (OR EQUAL). THE MODEL 204 CONNECTOR SHALL BE BEAU P-5406-LAB (OR EQUAL).

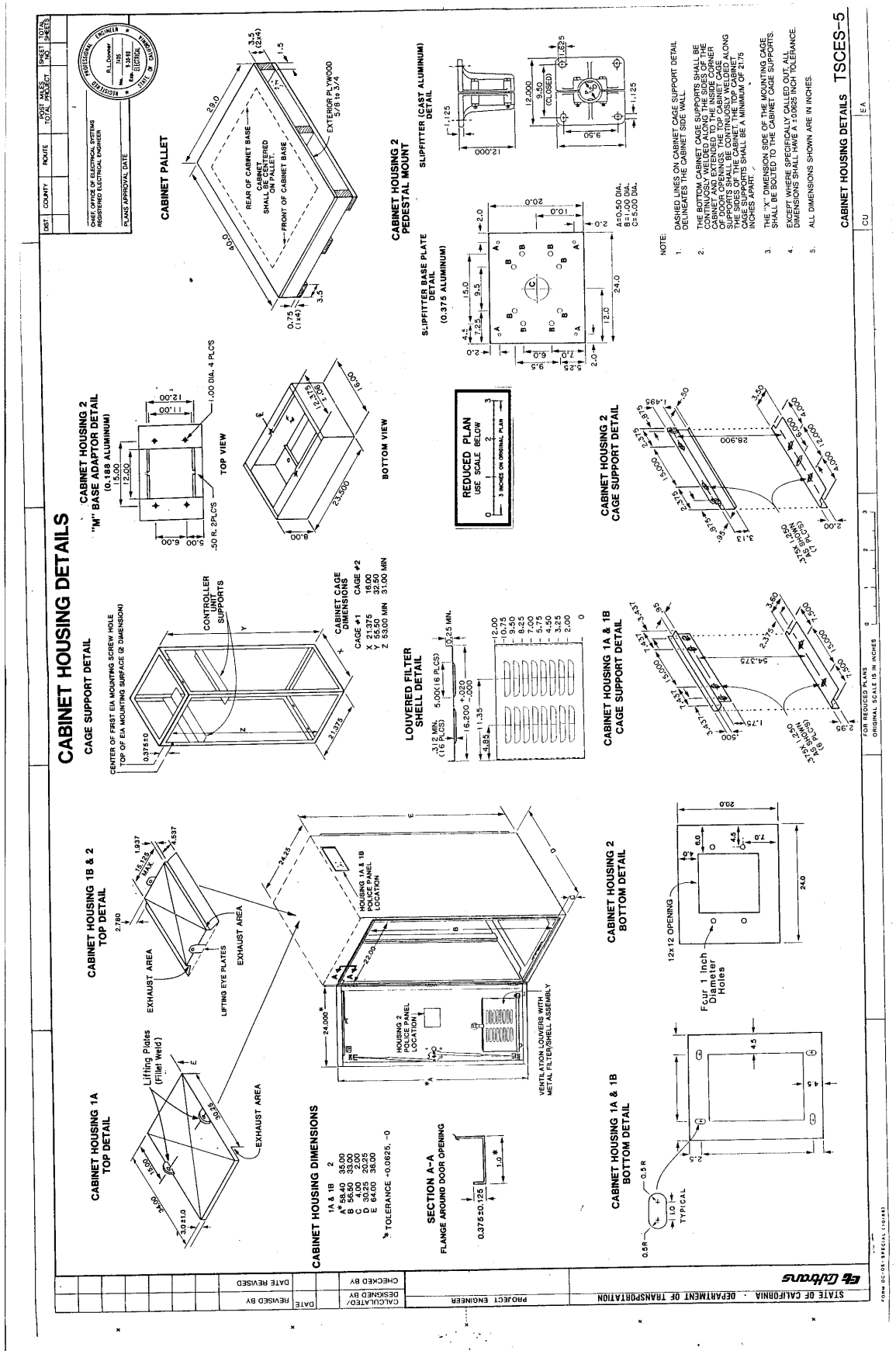
MODELS 200, 204, 210, 222, 224, 232, 242, AND 252. TSCES-4

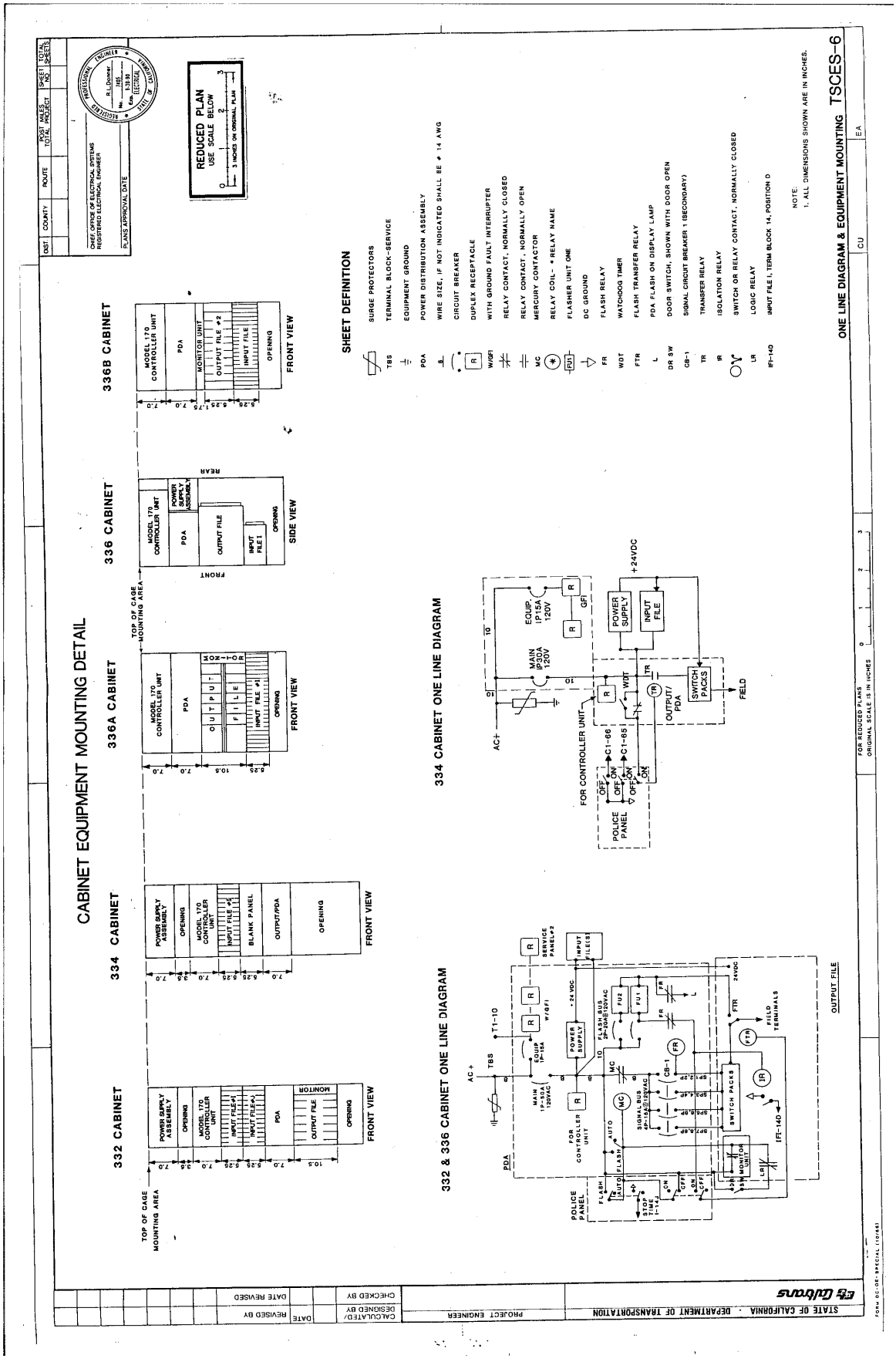
STATE OF CALIFORNIA · DEPARTMENT OF TRANSPORTATION
Caltrans
PROJECT ENGINEER
CALCULATED/ DESIGNED BY
CHECKED BY
DRAWN BY
DATE REVISED BY
DATE REVISED

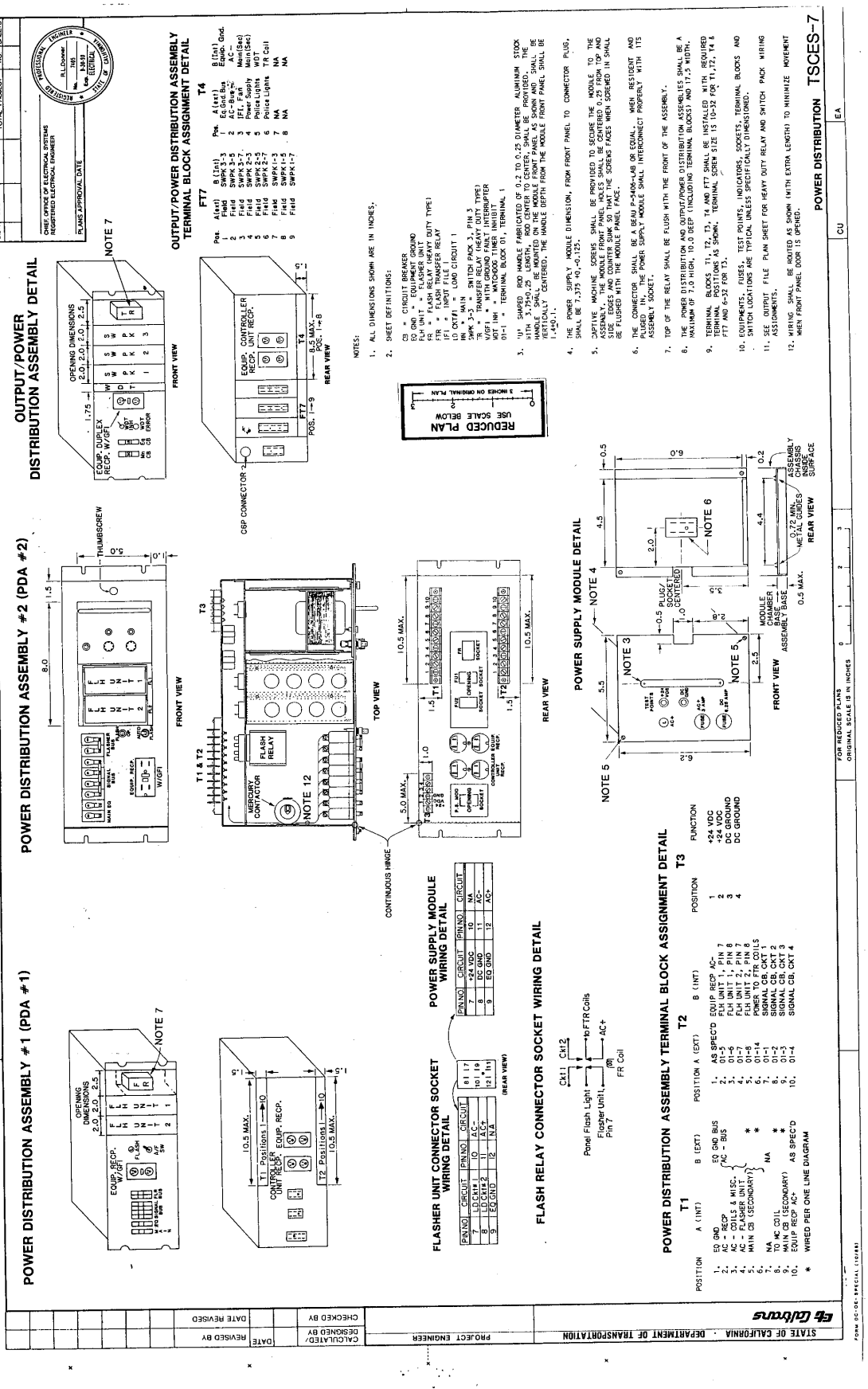
FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3

CU EA

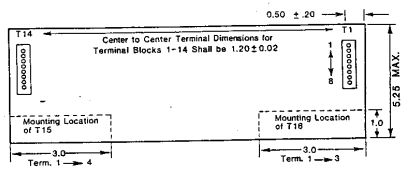
FORM OE-2E SPECIAL (10/88)


CABINET HOUSING DETAILS
CABINET HOUSING DETAILS TSCES-5
STATE OF CALIFORNIA · DEPARTMENT OF TRANSPORTATION
CABINET PALLET
CABINET HOUSING 2 PEDESTAL MOUNT
SLIPFITTER (CAST ALUMINUM) DETAIL
SLIPFITTER BASE PLATE DETAIL (0.375 ALUMINUM)
CABINET HOUSING 2 "M" BASE ADAPTOR DETAIL (0.188 ALUMINUM)
TOP VIEW
BOTTOM VIEW
REDUCED PLAN USE SCALE BELOW
CABINET HOUSING 2 CAGE SUPPORT DETAIL
CABINET HOUSING 2 CAGE SUPPORT DETAIL
CABINET HOUSING 2 CAGE SUPPORT DETAIL
LOUVERED FILTER SHELL DETAIL
CABINET HOUSING 1A & 1B CAGE SUPPORT DETAIL
CABINET HOUSING 1B & 2 TOP DETAIL
CABINET HOUSING 1A TOP DETAIL
CABINET HOUSING DIMENSIONS
SECTION A-A FLANGE AROUND DOOR OPENING
CABINET HOUSING 1A & 1B BOTTOM DETAIL
CABINET HOUSING 2 BOTTOM DETAIL
NOTE:
1. DASHED LINES ON CABINET CAGE SUPPORT DETAIL DELINEATES THE CABINET SIDE WALL.
2. THE BOTTOM CABINET CAGE SUPPORTS SHALL BE CONTINUOUSLY WELDED ALONG THE SIDES OF THE CABINET AND EXTENDED TO THE INSIDE CORNER OF CORNER POSTS. THE TOP CABINET CAGE SUPPORTS SHALL BE CONTINUOUSLY WELDED ALONG THE SIDES OF THE CABINET. THE CAGE SUPPORTS SHALL BE A MINIMUM OF 21.75 INCHES APART.
3. THE "X" DIMENSION SIDE OF THE MOUNTING CAGE SHALL BE BOLTED TO THE CABINET CAGE SUPPORTS.
4. EXCEPT WHERE SPECIFICALLY CALLED OUT, ALL DIMENSIONS SHALL HAVE A ±.0625 INCH TOLERANCE.
5. ALL DIMENSIONS SHOWN ARE IN INCHES.
FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES
DATE REVISED BY CHECKED BY
CALCULATED/ DESIGNED BY
PROJECT ENGINEER
FORM BC-05 SPECIAL (10/88)


CABINET EQUIPMENT MOUNTING DETAIL
332 CABINET
334 CABINET
336A CABINET
336B CABINET
336 CABINET
FRONT VIEW
SIDE VIEW
REAR
TOP OF CAGE MOUNTING AREA
332 & 336 CABINET ONE LINE DIAGRAM
334 CABINET ONE LINE DIAGRAM
SHEET DEFINITION
SURGE PROTECTORS
TERMINAL BLOCK-SERVICE
EQUIPMENT GROUND
POWER DISTRIBUTION ASSEMBLY
WIRE SIZE, IF NOT INDICATED SHALL BE # 14 AWG
CIRCUIT BREAKER
DUPLEX RECEPTACLE
WITH GROUND FAULT INTERRUPTER
RELAY CONTACT, NORMALLY CLOSED
RELAY CONTACT, NORMALLY OPEN
MERCURY CONTACTOR
RELAY COIL - * RELAY NAME
FLASHER UNIT ONE
DC GROUND
FLASH RELAY
WATCHDOG TIMER
FLASH TRANSFER RELAY
PDA FLASH ON DISPLAY LAMP
DOOR SWITCH, SHOWN WITH DOOR OPEN
SIGNAL CIRCUIT BREAKER 1 (SECONDARY)
TRANSFER RELAY
ISOLATION RELAY
SWITCH OR RELAY CONTACT, NORMALLY CLOSED
LOGIC RELAY
INPUT FILE 1, TERM BLOCK 14, POSITION D
REDUCED PLAN
USE SCALE BELOW
ONE LINE DIAGRAM & EQUIPMENT MOUNTING TSCES-6
NOTE:
1. ALL DIMENSIONS SHOWN ARE IN INCHES.
STATE OF CALIFORNIA · DEPARTMENT OF TRANSPORTATION
Caltrans

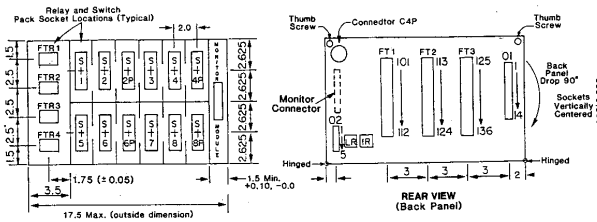

OUTPUT/POWER DISTRIBUTION ASSEMBLY
POWER DISTRIBUTION ASSEMBLY #1 (PDA #1)
POWER DISTRIBUTION ASSEMBLY #2 (PDA #2)
OUTPUT/POWER DISTRIBUTION ASSEMBLY TERMINAL BLOCK ASSIGNMENT DETAIL
FLASH RELAY CONNECTOR SOCKET WIRING DETAIL
POWER DISTRIBUTION ASSEMBLY TERMINAL BLOCK ASSIGNMENT DETAIL
POWER SUPPLY MODULE DETAIL
FLASHER UNIT CONNECTOR SOCKET WIRING DETAIL
POWER SUPPLY MODULE WIRING DETAIL
REDUCED PLAN USE SCALE BELOW
NOTES:
1. ALL DIMENSIONS SHOWN ARE IN INCHES.
2. SHEET DEFINITIONS:
3. 'U' SHAPED ROD HANDLE FABRICATED OF 0.2 TO 0.25 DIAMETER ALUMINUM STOCK
4. THE POWER SUPPLY MODULE DIMENSION, FROM FRONT PANEL TO CONNECTOR PLUG,
5. CAPTIVE MACHINE SCREWS SHALL BE PROVIDED TO SECURE THE MODULE TO THE
6. THE CONNECTOR SHALL BE A BEAU P-5406-L4S OR EQUAL, WHEN RESIDENT AND
7. TOP OF THE RELAY SHALL BE FLUSH WITH THE FRONT OF THE ASSEMBLY.
8. THE POWER DISTRIBUTION AND OUTPUT/POWER DISTRIBUTION ASSEMBLIES SHALL BE A
9. TERMINAL BLOCKS T1, T2, T3, T4 AND FT7 SHALL BE INSTALLED WITH REQUIRED
10. EQUIPMENTS, FUSES, TEST POINTS, INDICATORS, SOCKETS, TERMINAL BLOCKS AND
11. SEE OUTPUT FILE PLAN SHEET FOR HEAVY DUTY RELAY AND SWITCH PACK WIRING
12. WIRING SHALL BE ROUTED AS SHOWN (WITH EXTRA LENGTH) TO MINIMIZE MOVEMENT
POWER DISTRIBUTION TSCES-7
DEPARTMENT OF TRANSPORTATION · STATE OF CALIFORNIA
PROJECT ENGINEER
CHECKED BY
DATE REVISED
REVISED BY
CALCULATED/ DESIGNED BY
DATE
FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES
CHIEF, OFFICE OF ELECTRICAL SYSTEMS REGISTERED ELECTRICAL ENGINEER
PLANS APPROVAL DATE
R.L.Donner
1145
ELECTRICAL
DIST
COUNTY
ROUTE
POST MILES TOTAL PROJECT
SHEET NO.
SHEETS TOTAL
CU
EA

INPUT FILE DETAIL



REAR VIEW

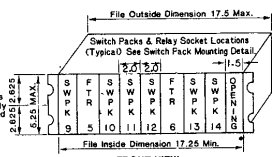
OUTPUT FILE #1 DETAIL



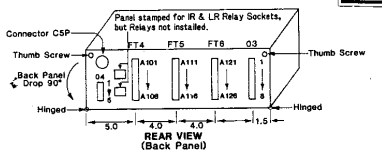
FRONT VIEW

REAR VIEW (Back Panel)

OUTPUT FILE #2 DETAIL



FRONT VIEW



REAR VIEW (Back Panel)

INPUT FILE TERMINAL ASSIGNMENT DETAIL

T1-14 Term.	Pin – Function	T15 Term.	Function	T16 Term.	Function
1	SP – Spare	1	+24 VDC	1	AC+
2	F – Channel 1 Output	2	DC Ground	2	AC–
3	W – Channel 2 Output	3	Det Reset	3	Equip. Ground
4	D – Channel 1 Input	4	C1 Harness DC Ground		
5	E – Channel 1 Input				
6	J – Channel 2 Input				
7	K – Channel 2 Input				
8	L – Equip. Ground				

OUTPUT FILE #1 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	MC COIL (TO PDA)
13	DOOR SW (FROM POL PAN)
14	FTR COILS (TO)

02 TERM.	FUNCTION
1	+24 VDC
2	DC GROUND
3	IFI-14J, STOPTIME (FROM MU)
4	IFI-14D, FLASH SENSE (FROM IR)
5	EXTERNAL RESET (TO MU)

FT1 TERM.	FUNCTION	FT2 TERM.	FUNCTION	FT3 TERM.	FUNCTION
101	SWPK 4-RED	113	SWPK2P-RED	125	SWPK 1-RED
102	SWPK 4-YEL	114	SWPK2P-YEL	126	SWPK 1-YEL
103	SWPK 4-GRN	115	SWPK2P-GRN	127	SWPK 1-GRN
104	SWPK4P-RED	116	SWPK 3-RED	128	SWPK 2-RED
105	SWPK4P-YEL	117	SWPK 3-YEL	129	SWPK 2-YEL
106	SWPK4P-GRN	118	SWPK 3-GRN	130	SWPK 2-GRN
107	SWPK 8-RED	119	SWPK6P-RED	131	SWPK 5-RED
108	SWPK 8-YEL	120	SWPK6P-YEL	132	SWPK 5-YEL
109	SWPK 8-GRN	121	SWPK6P-GRN	133	SWPK 5-GRN
110	SWPK8P-RED	122	SWPK 7-RED	134	SWPK 6-RED
111	SWPK8P-YEL	123	SWPK 7-YEL	135	SWPK 6-YEL
112	SWPK8P-GRN	124	SWPK 7-GRN	136	SWPK 6-GRN

OUTPUT FILE #2 TERMINAL ASSIGNMENT DETAIL

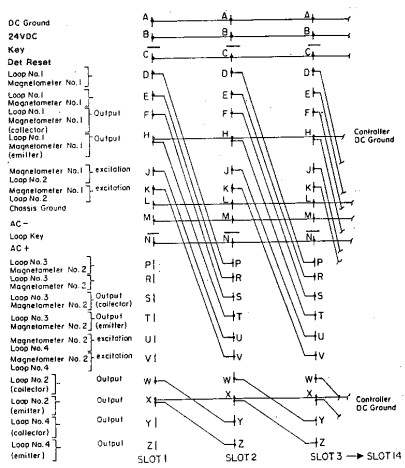
03 TERM.	FUNCTION
1	PDA FU1 CKT1/FTR5
2	PDA FU2 CKT2/FTR6
3	FTR COILS (TO)
4	AC–
5	PDA CKT2/SWPKS 1,2,3-1
6	PDA CKT4/SWPKS 4,5,8-1
7	EQUIP. GROUND
8	AC+ (FROM PDA)

04 TERM. FUNCTION

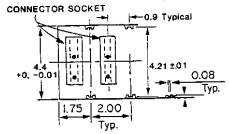
AT PRESENT A 5 POSITION TERMINAL (MINIMUM) TERMINAL BLOCK SHALL BE PROVIDED. BUT NOT WIRED TO CABINET. SEE 02 FUNCTIONS FOR FUTURE ASSIGNMENTS.

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

INPUT FILE WIRING DIAGRAM

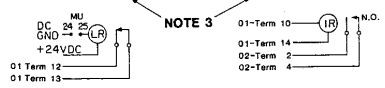


SWITCH PACK MOUNTING DETAIL

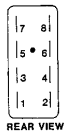


LOGIC RELAY (LR) DETAIL — ISOLATION RELAY (1R) DETAIL

NOTE 3



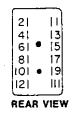
HEAVY DUTY FLASH RELAY SOCKET DETAIL



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

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

MODEL 210 MONITOR UNIT PIN ASSIGNMENT

CONNECTOR PIN NO.	MONITOR FUNCTION	TERMINATION
1	SWPK 2 GRN	
2	SWPK 2P GRN	
3	SWPK 6 YELO	
4	SWPK 4 GRN	
5	SWPK 4P GRN	
6	SWPK 8 YELO	
7	SWPK 5 GRN	
8	T & B	
9	SWPK 1 YELO	
10	SWPK 7 GRN	
11	T & B	
12	SWPK 3 YELO	
13	T&B	
14	NA	
15	T & B	
16	T&B	
17	NA	
18	T & B	
19	NA	
20	EQ GND	01-TERM 9
21	AC–	01-TERM 10
22	WATCHDOG TIMER	C4-37
23	+24VDC	02-TERM 1
24	BD. OUT CKT	LOGIC RELAY COIL
25	BD. OUT CKT	DC GROUND
26	NA	
27	NA	
28	OUTPUT-SW SIDE 1 AC+	

CONNECTOR PIN NO.	MONITOR FUNCTION	TERMINATION
A	SWPK 2 YELO	
B	SWPK 6 GRN	
C	SWPK 6P GRN	
D	SWPK 4 YELO	
E	SWPK 8 GRN	
F	SWPK 8P GRN	
H	SWPK 5 YELO	
J	SWPK 1 GRN	
K	T & B	
L	SWPK 7 YELO	
M	SWPK 3 GRN	
N	T & B	
P	NA	
R	T&B	
S	T & B	
T	NA	
U	T&B	
V	T & B	
W	NA	
X	NA	
Y	DC GROUND	02-TERM 2
Z	EXTERNAL RESET	02-TERM 5
AA	T & B	
BB	STOP TIME	02-TERM 3
CC	NA	
DD	NA	
EE	OUTPUT SW-SIDE2	01-TERM 12
FF	AC+	01-TERM 11

NOTES:

1. ALL DIMENSIONS SHOWN ARE IN INCHES.
2. TOP OF RELAYS SHALL BE FLUSH WITH FACE OF FILE.
3. THE ISOLATION RELAY SHALL BE POTTER & BRUMFIELD R10-E1-X2-115 (OR EQUAL). THE LOGIC RELAY (LR) SHALL BE A P-BKU-93 (OR EQUAL).
4. SEE CONNECTORS C4 & C5 WIRING LISTS FOR CONNECTOR/FILE INTERFACE.
5. SHEET DEFINITIONS:

   CKT = CIRCUIT
   FU = FLASHER UNIT
   FTR = FLASH TRANSFER RELAY
   IFI-14D = INPUT FILE "I", TB 14, TERMINAL D
   MC = MERCURY CONTACT (PDA)
   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 = SWITCH PACK
   T&B = CONDUCTORS CONNECTED TO PIN, TWO FEET IN LENGTH WITH RING LUG ON UNCONNECTED END, TIED AND BUNDLED SEPARATELY

   2P-1=Phase 2 Ped. Pin 1

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

CHIEF, OFFICE OF ELECTRICAL SYSTEMS
REGISTERED ELECTRICAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — R.L.Donner — No. 7405 — Exp. 9-30-10 — ELECTRICAL — STATE OF CALIFORNIA

REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

DATE | REVISED BY | DATE REVISED
CALCULATED/ DESIGNED BY | CHECKED BY
PROJECT ENGINEER

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3

CU | EA

INPUT & OUTPUT FILES TSCES-8

FORM DC-OE-SPECIAL (10/88)

SIDE PANEL DETAILS REAR DOOR VIEW

REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

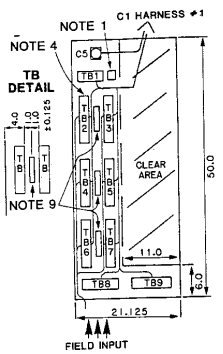
DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

CHIEF OFFICE OF ELECTRICAL SYSTEMS
REGISTERED ELECTRICAL ENGINEER

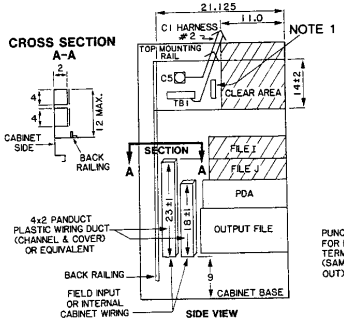
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — R.L.Donner — No. 7405 — Exp. 1-30-90 — ELECTRICAL — STATE OF CALIFORNIA

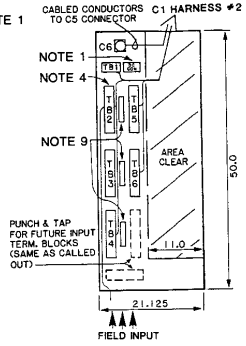
INPUT PANEL #1



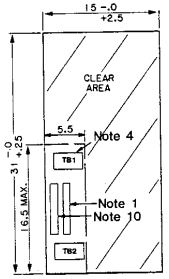
INPUT PANEL #2 (with Panduct Detail)



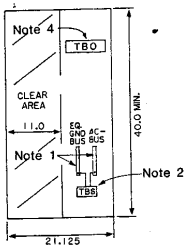
INPUT PANEL #3



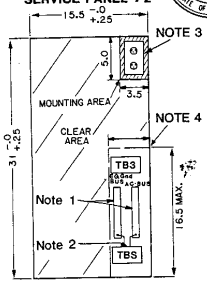
INPUT PANEL #4



SERVICE PANEL #1



SERVICE PANEL #2



SERVICE PANELS 1 & 2 TERMINAL BLOCK ASSIGNMENT DETAIL

TERM	A	B
TBS-1	AC+	To Main C.B. in PDA
TBS-2	NA	EQ GND BUS AND Surge Protector
TBS-3	AC-	BUS
TB0-1 to 12	NA	NA
TB3-1 to 6	NA	NA

NOTES:

1. 10 TERMINAL MINIMUM COPPER BUS.
2. THREE ELECTRODE GAS TUBE SURGE PROTECTOR AND TWO MOV'S SHALL BE INSTALLED ON TBS.
3. A DUPLEX OUTLET WITH COVER PLATE MOUNTED IN SHALLOW HANDY BOX SHALL BE FURNISHED AND INSTALLED IN THE MOUNTING AREA SHOWN. THE MAXIMUM PROJECTION OF OUTLET FROM SURFACE OF SERVICE PANEL SHALL NOT EXCEED 1.25 INCHES. THE UPPER RECEPTACLE SHALL LABELED "CONTROLLER UNIT" AND WIRED TO PDA TERMINALS T1-6 (AC+1, T1-2 (AC-) AND T1-1 (EQ GND). THE LOWER RECEPTACLE SHALL BE LABELED "EQUIPMENT" AND WIRED TO THE PDA TERMINALS T1-10 (AC+), T2-1 (AC-) AND T1-1 (EQ GND). (IF PDA #2 IS USED, THE DUPLEX OUTLET IS NOT REQUIRED.)
4. ALL TERMINAL BLOCKS BELOW THIS POINT SHALL BE MOUNTED BELOW THE CONTROLLER UNIT SUPPORT ANGLES.
5. THE TERMINAL BLOCKS SHALL HAVE TERMINAL POSITIONS NECESSARY TO MATCH POSITION ASSIGNMENTS. TERMINAL POSITION SCREWS SHALL BE 8-32 EXCEPT FOR TBS, TB0 & TB3 WHICH SHALL BE 10-32.
6. ALL DIMENSIONS ARE IN INCHES.
7. SHEET DEFINITIONS
   11 COM = DC COMMON
   CB = CIRCUIT BREAKER
   COMM = COMMUNICATION PREEMPTION A
   DET 1 = DETECTOR #1
   EVA = EMERGENCY VEHICLE
   IFI = INPUT FILE I
   IFJ = INPUT FILE J
   1-10 = INPUT FILE I SLOT 1 CONNECTOR, PIN D
   OF = OUTPUT FILE
   O/POA = OUTPUT/POWER DISTRIBUTION ASSEMBLY
   M = MONITOR MODULE
   NA = NOT ASSIGNED
   RR = RAILROAD PREEMPTION 1
8. SIDE PANEL SURFACES SHALL BE PAINTED WITH A BAKED WHITE ENAMEL FINISH.
9. INSTALL A 8 TERMINAL EQUIPMENT GROUND COPPER BUS FOR INPUT LEAD-IN CADLE SHIELD GROUNDING.

INPUT PANEL #1 TERMINAL BLOCK ASSIGNMENT DETAIL

POS	A	B
TB1-1	+24VDC	OF,IFI,IFJ,M
2	M Reset	NA
3	NA	NA
4	NA	NA
5	NA	NA
6	NA	NA

POS	A	B
TB4-1	Det 7	I-4D
2		I-4E
3	Det 8	I-4J
4		I-4K
5	Det 9	I-5D
6		I-5E
7	Det10	I-5J
8		I-5K
9	Det11	I-6D
10		I-6E
11	Det12	I-6J
12		I-6K

POS	B	A
TB7-1		J-7D
2	Det33	J-7E
3		J-7J
4	Det34	J-7K
5		J-8D
6	Det35	J-8E
7		J-8J
8	Det36	J-8K
9		J-9D
10	Det37	J-9E
11		J-9J
12	Det38	J-9K

TB2-1		A
2	Det 1	I-1D
3		I-1E
4	Det 2	I-1J
5		I-1K
6	Det 3	I-2D
7		I-2E
8	Det 4	I-2J
9		I-2K
10	Det 5	I-3D
11		I-3E
12	Det 6	I-3J
		I-3K

TB5-1	B	A
2	Det25	J-4D
3		J-4E
4	Det26	J-4J
5		J-4K
6	Det29	J-5D
7		J-5E
8	Det30	J-5J
9		J-5K
10	Det31	J-6D
11		J-6E
12	Det32	J-6J
		J-6K

TB8-1	A
MANUAL	I-11D
2 SPARE	I-11J
3 11 COM	I-11K
4 PED Ø2	I-12D
5 PED Ø4	I-12J
6 12 COM	I-12K
7 PED Ø6	I-13D
8 PED Ø8	I-13J
9 13 COM	I-13K
10 FLH SENSE	I-14D
11 STOP TIME	I-14J
12 14 COM	I-14K

TB3-1	B	A
2	Det 19	J-1D
3		J-1E
4	Det 20	J-1J
5		J-1K
6	Det 21	J-2D
7		J-2E
8	Det 22	J-2J
9		J-2K
10	Det 23	J-3D
11		J-3E
12	Det 24	J-3J
		J-3K

TB6-1	A	B
2	Det13	I-7D
3		I-7E
4	Det14	I-7J
5		I-7K
6	Det15	I-8D
7		I-8E
8	Det16	I-8J
9		I-8K
10	Det17	I-9D
11		I-9E
12	Det18	I-9J
		I-9K

TB9-1	SPARE 2	J-11D
2	SPARE 3	J-11J
3	11 COM	J-11K
4	EVA	J-12D
5	EVC	J-12J
6	12 COM	J-12K
7	EVB	J-13D
8	EVD	J-13J
9	13 COM	J-13K
10	RR1	J-14D
11	RR2	J-14J
12	14 COM	J-14K

INPUT PANEL #3 TERMINAL BLOCK ASSIGNMENT DETAIL

POSITION	A	B
TB1 - 1	+24VDC	IF,C4,C6
2	+24VDC	O/POA
3	NA	NA
4	NA	NA
5	NA	NA
6	NA	NA

POSITION	A	B
TB3 - 1	DET 7	I-4D
2		I-4E
3	DET 8	I-4J
4		I-4K
5	DET 9	I-5D
6		I-5E
7	DET 10	I-5J
8		I-5K
9	DET 11	I-6D
10		I-6E
11	DET 12	I-6J
12		I-6K

POSITION	A	B
TB5 - 1	DET 19	I-10D
2		I-10E
3	DET 20	I-10J
4		I-10K
5	DET 21	I-11D
6		I-11E
7	DET 22	I-11J
8		I-11K
9	DET 23	I-12D
10		I-12E
11	DET 24	I-12J
12		I-12K

TB2 - 1	DET 1	I-1D
2		I-1E
3	DET 2	I-1J
4		I-1K
5	DET 3	I-2D
6		I-2E
7	DET 4	I-2J
8		I-2K
9	DET 5	I-3D
10		I-3E
11	DET 6	I-3J
12		I-3K

TB4 - 1	DET 13	I-7D
2		I-7E
3	DET 14	I-7J
4		I-7K
5	DET 15	I-8D
6		I-8E
7	DET 16	I-8J
8		I-8K
9	DET 17	I-9D
10		I-9E
11	DET 18	I-9J
12		I-9K

TB6 - 1	DET 25	I-13D
2		I-13E
3	DET 26	I-13J
4		I-13K
5	DET 27	I-14D
6		I-14E
7	DET 28	I-14J
8		I-14K
9	NA	I-NA
10	NA	I-NA
11	NA	I-NA
12	NA	I-NA

INPUT PANEL #4 TERMINAL BLOCK ASSIGNMENT

TERM	A	B
TB1-1	+24VDC	OF,IFI,M
-2	M RESET	NA
-3	RESERVED	RESERVED (COMM IN)
-4	RESERVED	RESERVED (COMM IN)
-5	RESERVED	RESERVED (COMM OUT)
-6	RESERVED	RESERVED (COMM OUT)
TB2-1 to 6	NA	NA

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans
PROJECT ENGINEER
DATE | REVISED BY | DATE REVISED
CALCULATED/DESIGNED BY
CHECKED BY

SIDE PANELS TSCES-9

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3

CU | EA

FORM DC-OE-SPECIAL (10/86)

C1 HARNESS #1 WIRING LIST

PIN	SOURCE	DESTINATION	FUNCTION	PIN	SOURCE	DESTINATION	FUNCTION	PIN	SOURCE	DESTINATION	FUNCTION	PIN	SOURCE	DESTINATION	FUNCTION
1	DC GND	DC GND BUS	-	27	04-1	C4-25	SWPK 6P-RED	53	12-7	1FI-11W	SPARE #1	79	16-5	1FJ-7W	8 CE
2	01-1	C4-1	SWPK 4P-RED	28	04-2	C4-26	SWPK 6P-GRN	54	12-8	1FJ-11F	SPARE #2	80	16-6	1FI-11F	ADVANCE
3	01-2	C4-2	SWPK 4P-GRN	29	04-3	C4-27	SWPK 6-RED	55	13-1	1FJ-1F&W	5 CE	81	16-7	1FI-14F	FLASH SENSE
4	01-3	C4-3	SWPK 4-RED	30	04-4	C4-28	SWPK 6-YEL	56	13-2	1FI-1F&W	1 CE	82	16-8	1FI-14W	STOP TIME
5	01-4	C4-4	SWPK 4-YEL	31	04-5	C4-29	SWPK 6-GRN	57	13-3	1FJ-5F&W	7 CE	83	06-1	C5-1	SWPK 14-RED
6	01-5	C4-5	SWPK 4-GRN	32	04-6	C4-30	SWPK 5-RED	58	13-4	1FI-5F&W	3 CE	84	06-2	C5-2	SWPK 14-GRN
7	01-6	C4-6	SWPK 3-RED	33	04-7	C4-31	SWPK 5-YEL	59	13-5	1FJ-9F	5 CE	85	06-3	C5-3	SWPK 13-RED
8	01-7	C4-7	SWPK 3-YEL	34	04-8	C4-32	SWPK 5-GRN	60	13-6	1FI-9F	1 CE	86	06-4	C5-4	SWPK 13-YEL
9	01-8	C4-8	SWPK 3-GRN	35	05-1	C4-33	SWPK 2P-YEL	61	13-7	1FJ-9W	7 CE	87	06-5	C5-5	SWPK 13-GRN
10	02-1	C4-9	SWPK 2P-RED	36	05-2	C4-34	SWPK 6P-YEL	62	13-8	1FI-9W	3 CE	88	06-6	C5-6	SWPK 12-RED
11	02-2	C4-10	SWPK 2P-GRN	37	05-3	C4-35	SWPK 4P-YEL	63	14-5	1FI-3F	2 CE	89	06-7	C5-7	SWPK 12-YEL
12	02-3	C4-11	SWPK 2-RED	38	05-4	C4-36	SWPK 8P-YEL	64	14-6	1FJ-3F	6 CE	90	06-8	C5-8	SWPK 12-GRN
13	02-4	C4-12	SWPK 2-YEL	39	11-1	1FI-2F	2 CE	65	14-7	1FI-7F	4 CE	91	07-1	C5-9	SWPK 11-RED
14	DC GND	1FI-15-4	INPUT DC GND	40	11-2	1FJ-2F	6 CE	66	14-8	1FJ-7F	8 CE	92	DC GND	DC GND BUS	-
15	02-5	C4-13	SWPK 2-GRN	41	11-3	1FI-6F	4 CE	67	15-1	1FI-12F	2 PED	93	07-2	C5-10	SWPK 11-GRN
16	02-6	C4-14	SWPK 1-RED	42	11-4	1FJ-6F	8 CE	68	15-2	1FI-13F	6 PED	94	07-3	C5-11	SWPK 10-RED
17	02-7	C4-15	SWPK 1-YEL	43	11-5	1FI-2W	2 CE	69	15-3	1FI-12W	4 PED	95	07-4	C5-12	SWPK 10-YEL
18	02-8	C4-16	SWPK 1-GRN	44	11-6	1FJ-2W	6 CE	70	15-4	1FI-13W	8 PED	96	07-5	C5-13	SWPK 10-GRN
19	03-1	C4-17	SWPK 8P-RED	45	11-7	1FI-6W	4 CE	71	15-5	1FJ-12F	EVA PREEMPT	97	07-6	C5-14	SWPK 9-RED
20	03-2	C4-18	SWPK 8P-GRN	46	11-8	1FJ-6W	8 CE	72	15-6	1FJ-13F	EVB PREEMPT	98	07-7	C5-15	SWPK 9-YEL
21	03-3	C4-19	SWPK 8-RED	47	12-1	1FI-4F&W	2 CALL	73	15-7	1FJ-12W	EVC PREEMPT	99	07-8	C5-16	SWPK 9-GRN
22	03-4	C4-20	SWPK 8-YEL	48	12-2	1FJ-4F&W	6 CALL	74	15-8	1FJ-13W	EVD PREEMPT	100	05-5	C5-17	SWPK 14-YEL
23	03-5	C4-21	SWPK 8-GRN	49	12-3	1FI-8F&W	4 CALL	75	16-1	1FI-11W	SPARE #3	101	05-6	C5-18	SWPK 11-YEL
24	03-6	C4-22	SWPK 7-RED	50	12-4	1FJ-8F&W	8 CALL	76	16-2	1FI-3W	2 CE	102	05-7	1FI&J-15-3	DETECTOR RESET
25	03-7	C4-23	SWPK 7-YEL	51	12-5	1FJ-14F	RR1 PREEMPT	77	16-3	1FJ-3W	6 CE	103	05-8	C4-37	WDT-MJ
26	03-8	C4-24	SWPK 7-GRN	52	12-6	1FJ-14W	RR2 PREEMPT	78	16-4	1FI-7W	4 CE	104	DC GND	1FJ-15-4	INPUT DC GND

C1 HARNESS #2 WIRING LIST

PIN	SOURCE	DESTINATION	FUNCTION	PIN	SOURCE	DESTINATION	FUNCTION	PIN	SOURCE	DESTINATION	FUNCTION	PIN	SOURCE	DESTINATION	FUNCTION
1	DC GND	DC GND BUS	-	27	04-1	NA	-	53	12-7	1FI-11F	RATE CODE 2	79	16-5	1FI-10F	-
2	01-1	C6-1	SWPK 1-RED	28	04-2	NA	-	54	12-8	1FI-11W	RATE CODE 1	80	16-6	1FI- 9W	-
3	01-2	C6-2	SWPK 1-GRN	29	04-3	NA	-	55	13-1	1FI- 4F	-	81	16-7	1FI- 9F	-
4	01-3	C6-3	SWPK 2-RED	30	04-4	NA	-	56	13-2	1FI- 4W	-	82	16-8	1FI-10W	-
5	01-4	C6-4	SWPK 2-YEL	31	04-5	NA	-	57	13-3	1FI- 6F	MAIN 3	83	06-1	C5- 1	SWPK 14-RED
6	01-5	C6-5	SWPK 2-GRN	32	04-6	NA	-	58	13-4	1FI- 6W	MAIN 4	84	06-2	C5- 2	SWPK 14-GRN
7	01-6	C6-6	SWPK 3-RED	33	04-7	NA	-	59	13-5	1FI- 7F	MAIN 5	85	06-3	C5- 3	SWPK 13-RED
8	01-7	C6-7	SWPK 3-YEL	34	04-8	NA	-	60	13-6	1FI- 7W	MAIN 6	86	06-4	C5- 4	SWPK 13-YEL
9	01-8	C6-8	SWPK 3-GRN	35	05-1	NA	-	61	13-7	1FI- 8F	-	87	06-5	C5- 5	SWPK 13-GRN
10	02-1	NA	-	36	05-2	NA	-	62	13-8	1FI- 8W	-	88	06-6	C5- 6	SWPK 12-RED
11	02-2	NA	-	37	05-3	C6-9	SWPK 1-YEL	63	14-5	1FI- 1SP	-	89	06-7	C5- 7	SWPK 12-YEL
12	02-3	NA	-	38	05-4	NA	-	64	14-6	1FI- 2SP	-	90	06-8	C5- 8	SWPK 12-GRN
13	02-4	NA	-	39	11-1	1FI- 1W	PASSAGE 1	65	14-7	POL CONT'L SW	-	91	07-1	C5- 9	SWPK 11-RED
14	DC GND	1FI-15-4	INPUT DC GND	40	11-2	1FI-12W	PASSAGE 2	66	14-8	POL LIGHTS SW	-	92	DC GND	DC GND BUS	-
15	02-5	NA	-	41	11-3	1FI-12F	DEMAND 2	67	15-1	1FI- 3SP	-	93	07-2	C5-10	SWPK 11-GRN
16	02-6	NA	-	42	11-4	1FI-13W	OFF RAMP 2	68	15-2	1FI- 4SP	-	94	07-3	C5-11	SWPK 10-RED
17	02-7	NA	-	43	11-5	1FI-13F	QUE 2	69	15-3	1FI- 5SP	-	95	07-4	C5-12	SWPK 10-YEL
18	02-8	NA	-	44	11-6	1FI-14W	PASSAGE 3	70	15-4	1FI- 6SP	-	96	07-5	C5-13	SWPK 10-GRN
19	03-1	NA	-	45	11-7	1FI-14F	DEMAND 3	71	15-5	1FI- 7SP	-	97	07-6	C5-14	SWPK 9-RED
20	03-2	NA	-	46	11-8	1FI- 1F	DEMAND 1	72	15-6	1FI- 8SP	-	98	07-7	C5-15	SWPK 9-YEL
21	03-3	NA	-	47	12-1	1FI- 2W	OFF RAMP 1	73	15-7	1FI- 9SP	-	99	07-8	C5-16	SWPK 9-GRN
22	03-4	NA	-	48	12-2	1FI- 3W	-	74	15-8	1FI-10SP	-	100	05-5	C5-17	SWPK 14-YEL
23	03-5	NA	-	49	12-3	1FI- 3F	-	75	16-1	1FI-11SP	-	101	05-6	C5-18	SWPK 11-YEL
24	03-6	NA	-	50	12-4	1FI- 2F	QUE 1	76	16-2	1FI-12SP	-	102	05-7	1FI-15-3	DETECTOR RESET
25	03-7	NA	-	51	12-5	1FI- 5F	MAIN 1	77	16-3	1FI-13SP	-	103	05-8	C5-10	WDT
26	03-8	NA	-	52	12-6	1FI- 5W	MAIN 2	78	16-4	1FI-14SP	-	104	DC GND	DC GND BUS	-

C1 HARNESS #3 WIRING LIST

PIN	SOURCE	DESTINATION	FUNCTION	PIN	SOURCE	DESTINATION	FUNCTION	PIN	SOURCE	DESTINATION	FUNCTION	PIN	SOURCE	DESTINATION	FUNCTION
1	DC GND	DC GND BUS	-	27	04-1	C4-25	SWPK 6P-RED	53	12-7	TB1-4	SPARE #1	79	16-5	1FI-13SP	8 CE
2	01-1	C4-1	SWPK 4P-RED	28	04-2	C4-26	SWPK 6P-GRN	54	12-8	TB1-5	SPARE #2	80	16-6	1FI-14SP	ADVANCE
3	01-2	C4-2	SWPK 4P-GRN	29	04-3	C4-27	SWPK 6-RED	55	13-1	1FI-5F	5 CE	81	16-7	1FI-14F	FLASH SENSE
4	01-3	C4-3	SWPK 4-RED	30	04-4	C4-28	SWPK 6-YEL	56	13-2	1FI-1F	1 CE	82	16-8	1FI-14W	STOP TIME
5	01-4	C4-4	SWPK 4-YEL	31	04-5	C4-29	SWPK 6-GRN	57	13-3	1FI-7F	7 CE	83	06-1	NA	-
6	01-5	C4-5	SWPK 4-GRN	32	04-6	C4-30	SWPK 5-RED	58	13-4	1FI-3F	3 CE	84	06-2	NA	-
7	01-6	C4-6	SWPK 3-RED	33	04-7	C4-31	SWPK 5-YEL	59	13-5	1FI-1SP	-	85	06-3	NA	-
8	01-7	C4-7	SWPK 3-YEL	34	04-8	C4-32	SWPK 5-GRN	60	13-6	1FI-2SP	-	86	06-4	NA	-
9	01-8	C4-8	SWPK 3-GRN	35	05-1	C4-33	SWPK 2P-YEL	61	13-7	1FI-3SP	-	87	06-5	NA	-
10	02-1	C4-9	SWPK 2P-RED	36	05-2	C4-34	SWPK 6P-YEL	62	13-8	1FI-4SP	-	88	06-6	NA	-
11	02-2	C4-10	SWPK 2P-GRN	37	05-3	C4-35	SWPK 4P-YEL	63	14-5	1FI-5SP	-	89	06-7	NA	-
12	02-3	C4-11	SWPK 2-RED	38	05-4	C4-36	SWPK 8P-YEL	64	14-6	1FI-6SP	-	90	06-8	NA	-
13	02-4	C4-12	SWPK 2-YEL	39	11-1	1FI-2F	2 CE	65	14-7	1FI-7SP	-	91	07-1	NA	-
14	DC GND	1FI-15-4	INPUT DC GND	40	11-2	1FI-6F	6 CE	66	14-8	1FI-8SP	-	92	DC GND	DC GND BUS	-
15	02-5	C4-13	SWPK 2-GRN	41	11-3	1FI-4F	4 CE	67	15-1	1FI-12F	2 PED	93	07-2	NA	-
16	02-6	C4-14	SWPK 1-RED	42	11-4	1FI-8F	8 CE	68	15-2	1FI-13F	6 PED	94	07-3	NA	-
17	02-7	C4-15	SWPK 1-YEL	43	11-5	1FI-2W	2 CE	69	15-3	1FI-12W	4 PED	95	07-4	NA	-
18	02-8	C4-16	SWPK 1-GRN	44	11-6	1FI-6W	6 CE	70	15-4	1FI-13W	8 PED	96	07-5	NA	-
19	03-1	C4-17	SWPK 8P-RED	45	11-7	1FI-4W	4 CE	71	15-5	1FI-10F	EVA PREEMPT	97	07-6	NA	-
20	03-2	C4-18	SWPK 8P-GRN	46	11-8	1FI-8W	8 CE	72	15-6	1FI-11F	EVB PREEMPT	98	07-7	NA	-
21	03-3	C4-19	SWPK 8-RED	47	12-1	1FI-1W	2 CALL	73	15-7	1FI-10W	EVC PREEMPT	99	07-8	NA	-
22	03-4	C4-20	SWPK 8-YEL	48	12-2	1FI-5W	6 CALL	74	15-8	1FI-11W	EVD PREEMPT	100	05-5	NA	-
23	03-5	C4-21	SWPK 8-GRN	49	12-3	1FI-3W	4 CALL	75	16-1	1FI- 9SP	SPARE #3	101	05-6	NA	-
24	03-6	C4-22	SWPK 7-RED	50	12-4	1FI-7W	8 CALL	76	16-2	1FI-10SP	2 CE	102	05-7	1FI-15-3	DETECTOR RESET
25	03-7	C4-23	SWPK 7-YEL	51	12-5	1FI-9F	RR1 PREEMPT	77	16-3	1FI-11SP	6 CE	103	05-8	C4-37	WDT-MJ
26	03-8	C4-24	SWPK 7-GRN	52	12-6	1FI-9W	RR2 PREEMPT	78	16-4	1FI-12SP	8 CE	104	DC GND	DC GND BUS	-

C4 HARNESS #1 AND #3 WIRING LIST

PIN	SOURCE	DESTINATION	PIN	SOURCE	DESTINATION
1	C1- 2	SWPK 4P-RED	19	C1-21	SWPK 8-RED
2	C1- 3	SWPK 4P-GRN	20	C1-22	SWPK 8-YEL
3	C1- 4	SWPK 4-RED	21	C1-23	SWPK 8-GRN
4	C1- 5	SWPK 4-YEL	22	C1-24	SWPK 7-RED
5	C1- 6	SWPK 4-GRN	23	C1-25	SWPK 7-YEL
6	C1- 7	SWPK 3-RED	24	C1-26	SWPK 7-GRN
7	C1- 8	SWPK 3-YEL	25	C1-27	SWPK 6P-RED
8	C1- 9	SWPK 3-GRN	26	C1-28	SWPK 6P-GRN
9	C1-10	SWPK 2P-RED	27	C1-29	SWPK 6-RED
10	C1-11	SWPK 2P-GRN	28	C1-30	SWPK 6-YEL
11	C1-12	SWPK 2-RED	29	C1-31	SWPK 6-GRN
12	C1-13	SWPK 2-YEL	30	C1-32	SWPK 5-RED
13	C1-15	SWPK 2-GRN	31	C1-33	SWPK 5-YEL
14	C1-16	SWPK 1-RED	32	C1-34	SWPK 5-GRN
15	C1-17	SWPK 1-YEL	33	C1-35	SWPK 2P-YEL
16	C1-18	SWPK 1-GRN	34	C1-36	SWPK 6P-YEL
17	C1-19	SWPK 8P-RED	35	C1-37	SWPK 4P-YEL
18	C1-20	SWPK 8P-GRN	36	C1-38	SWPK 8P-YEL
			37	C1-103	WDT-MJ

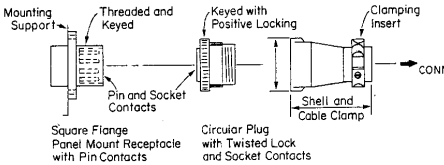
C5 HARNESS #1 AND #2 WIRING LIST

PIN	SOURCE	DESTINATION	PIN	SOURCE	DESTINATION
1	C1-83	SWPK 14-RED	13	C1-96	SWPK 10-GRN
2	C1-84	SWPK 14-GRN	14	C1-97	SWPK 9-RED
3	C1-85	SWPK 13-RED	15	C1-98	SWPK 9-YEL
4	C1-86	SWPK 13-YEL	16	C1-99	SWPK 9-GRN
5	C1-87	SWPK 13-GRN	17	C1-100	SWPK 14-YEL
6	C1-88	SWPK 12-RED	18	C1-101	SWPK 11-YEL
7	C1-89	SWPK 12-YEL	19	NA	NA
8	C1-90	SWPK 12-GRN	20	NA	NA
9	C1-91	SWPK 11-RED	21	NA	NA
10	C1-93	SWPK 11-GRN	22	NA	NA
11	C1-94	SWPK 10-RED	23	NA	NA
12	C1-95	SWPK 10-YEL	24	+24 VDC	PIN 9, ALL SOCKETS

C6 HARNESS #2 WIRING LIST

PIN	SOURCE	DESTINATION	PIN	SOURCE	DESTINATION
1	C1-2	SWPK 1-RED	13	NA	NA
2	C1-3	SWPK 1-GRN	14	NA	NA
3	C1-4	SWPK 2-RED	15	NA	NA
4	C1-5	SWPK 2-YEL	16	NA	NA
5	C1-6	SWPK 2-GRN	17	NA	NA
6	C1-7	SWPK 3-RED	18	NA	NA
7	C1-8	SWPK 3-YEL	19	NA	NA
8	C1-9	SWPK 3-GRN	20	NA	NA
9	C1-37	SWPK 1-YEL	21	NA	NA
10	C1-103	WDT	22	NA	NA
11	NA	NA	23	DC GND	WDT
12	NA	NA	24	+24 VDC	PIN 9, SWPK 1,2,3

CONNECTORS C4, C5, AND C6



NOTE:

1. SHEET DEFINITIONS:

C1-2 = CONNECTOR C1, PIN 2
EVA = EMERGENCY VEHICLE A
11-1 = INPUT PORT 5001, BIT 1
1FI-2F,SP = INPUT FILE 1, TERMINAL BLOCK 2, TERMINAL DESIGNATION F (CHANNEL 1 OUTPUT), SPARE
1FJ-6W = INPUT FILE 1, TERMINAL BLOCK 6, TERMINAL DESIGNATION W (CHANNEL 2 OUTPUT)
01-1 = OUTPUT PORT 5001, BIT 1
RR1 = RAILROAD 1
SWPK 2P-GRN = SWITCHPACK 2 PEDESTRIAN, GREEN
WDT-MJ = WATCHDOG TIMER, MONITOR UNIT
2 CE = PHASE 2 COUNT & EXTENSION

REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO	TOTAL SHEETS

CHIEF, OFFICE OF ELECTRICAL SYSTEMS
REGISTERED ELECTRICAL ENGINEER
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — R.L.Donner — No. 7405 — Exp. 6-30-96 — ELECTRICAL — STATE OF CALIFORNIA

DATE | REVISED BY | DATE REVISED
CALCULATED/ DESIGNED BY | CHECKED BY
PROJECT ENGINEER

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3

HARNESS WIRING LISTS TSCES-10

CU | EA