Ministry
Of
Transportation
Ontario

Ontario Traffic Signal

Control Equipment

Specifications

Highway Standards Branch
Traffic Office
Electrical Engineering Section

To all users of this publication:

The information contained herein has been carefully compiled and is believed to be accurate at the date of publication. Freedom from error, however, cannot be guaranteed.

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CONTINUING RECORD OF REVISIONS MADE
TO THE
ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS MANUAL

This sheet should be retained permanently in this page sequence in the Manual..
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CHAPTER 1

General Specifications

For

Traffic Signal Control Equipment

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1 GENERAL REQUIREMENTS

1.1 SCOPE

1.1.1 This Chapter defines the general requirements and approval procedures for all traffic control equipment supplied under the Traffic Signal Control Equipment Specifications.

1.1.2 Suppliers shall examine this specification thoroughly and fully understand all conditions that do or can affect the performance of the equipment furnished under the contract. It is the responsibility of the supplier to identify potential problem areas and ambiguities prior to the submission of his quotation. Following the award of the contract, Suppliers will be bound to accept all requirements stated in the specification. Any queries or communications regarding this specification should be submitted in writing (letter or fax) to the following offices no later than ten (10) days prior to a tender closing date:

Technical questions:

Ministry of Transportation of Ontario
Electrical Engineering Office
Room 224, Central Building
1201 Wilson Avenue
Downsview, Ontario M3M lJ8

Phone: (416) 235-3804
Fax: (416) 235-4904

Tendering questions:

Ministry of Transportation of Ontario
Corporate Materials Management Planning
1201 Wilson Avenue
Downsview, Ontario M3M lJ8

Phone: (416) 235-3241
Fax: (416) 235-4846

1.1.3 The Ministry reserves the right to inspect the facility and the processes of a Manufacturer and his representative at any time before the award of the contract in order to evaluate the Manufacturer's ability to supply a quality product and reliable warranty service.

1.2 PRE-QUALIFICATION REQUIREMENTS

1.2.1 The Ministry requires that Suppliers of all traffic control equipment to be pre-qualified prior to participating in the tendering process. If the Ministry changes the specifications, all pre-qualified suppliers will be notified and may be requested to submit a new sample.

1.2.2 The Supplier shall submit, for each type of equipment to be pre-qualified, a sample for Ministry approval. The Ministry will require the Supplier to submit detailed information on any of his designs. The approval shall be based on the requirements and tests specified in this chapter and the specifications applicable to the particular equipment being qualified.

1.2.3 5 sets each of the following items shall be submitted with the sample:

1.2.3.1 Complete schematic diagrams and parts lists, cross referenced with Supplier's name.

1.2.3.2 Divide the whole circuit into functional logical blocks in order to give a detailed circuit description. Provide details of how each functional block operates along with how the blocks relate to each other, with reference to the complete schematic diagrams. Provide a block diagram of the circuit to accompany the above circuit descriptions.

1.2.3.3 Quality Control procedures and test results for the sample unit.

1.2.3.4 Drawings, shall be submitted on the format of minimum 11" x 17", showing detailed external and internal physical dimensions to scale, of the sample unit.

1.2.3.5 Manufacturer's data sheets and engineering technical data shall be supplied for all electronic/electrical components and mechanical parts used in the sample (example; resistors, capacitors, switches, semiconductors, slide-guides, etc.). Where applicable, the information to be supplied shall include: operating temperature range, operating characteristics, electrical ratings, pin or connector configuration of the component used and all physical dimensions. All of the above information shall be bound in an indexed booklet. The Supplier shall provide additional information on any components and processes used in the manufacturing of its equipment if requested by the Ministry.

1.2.3.6 The Supplier shall provide information and test procedures for troubleshooting. These procedures shall include descriptions for the test points if located on the sample and details outlining wave forms expected at each test point along with detailed troubleshooting procedures.

1.2.3.7 The Ministry will test and inspect the sample in any fashion in order to ensure that it meets the requirements of the specifications. The Ministry shall not assume any liability for damage incurred to the sample during testing and inspection.

1.2.4 The Ministry, after the completion of the testing, will:

1.2.4.1 Issue written notification to the Supplier stating either that:

1.2.4.1.1 The sample evaluated is acceptable, and authorize that the Supplier is qualified to supply the equipment,

or,

1.2.4.1.2 That the submitted sample is not acceptable, and provide the Supplier with a list of areas of non-compliance with these specifications and/or a list of areas of poor workmanship and human engineering based on the Ministry's interpretation of poor workmanship. The Ministry's interpretation of poor workmanship and human engineering may not be necessarily reflected completely within the specifications. The Supplier may resubmit the sample along with the information outlined in 1.2.3, or supply another sample of the same type for evaluation. The Supplier shall rectify the problems before resubmission. If the resubmitted sample still fails to meet the Ministry specifications, the sample will be rejected and returned to the supplier and the Ministry will not accept the same sample for further testing. If the supplier wishes to proceed further with the product pre-qualification, a new sample must be submitted. The Supplier shall assume all costs of production, shipping, exchange, duty, tariffs, taxes and similar incidental costs associated with the submission.

1.2.5 The approved sample shall be retained by the Ministry. The Supplier shall not change material type or sources, production methods or design of the approved sample without written advised to the Ministry. The modified sample or new sample will be subjected to pre-qualification process.

1.3 PURCHASE ORDER REQUIREMENTS

1.3.1 These requirements are applicable to all traffic control equipment.

1.3.2 Upon placement of a Ministry purchase order, the Supplier will be bound to accept all requirements stated in the specifications. The Supplier may be requested to submit, for each type of equipment to be supplied under the contract, a production unit for Ministry approval if specifies in the tender and the Purchase Order. The Ministry may require the Supplier to submit detailed information on any of his designs. The approval shall be based on the requirements of this chapter and the specifications applicable to the particular equipment being supplied.

1.3.3 1 set each of the following items shall be submitted with the production unit:

1.3.3.1 Complete schematic diagrams and parts lists, cross referenced with Manufacturer's name.

1.3.3.2 Divide the whole circuit into functional logical blocks in order to give a detailed circuit description. Provide details of how each functional block operates along with how the blocks relate to each other, with reference to the complete schematic diagrams. Provide a block diagram of the circuit to accompany the above circuit descriptions.

1.3.3.3 Quality Control procedures and test results for the production unit.

1.3.3.4 Drawings, shall be submitted on the format of minimum 11" x 17", showing detailed external and internal physical dimensions to scale, of the production unit.

1.3.3.5 Manufacturer's data sheets and engineering technical data shall be supplied for all electronic/electrical components and mechanical parts used in the sample (example; resistors, capacitors, switches, semiconductors, slide-guides, etc.)

Where applicable, the information to be supplied shall include: operating temperature range, operating characteristics, electrical ratings, pin or connector configuration of the component used and all physical dimensions. All of the above information shall be bound in an indexed booklet. The Supplier shall provide additional information on any components and processes used in the manufacturing of its equipment if requested by the Ministry.

1.3.3.6 The Supplier shall provide information and test procedures for troubleshooting. These procedures shall include descriptions for the test points if located on the sample and details outlining wave forms expected at each test point along with detailed troubleshooting procedures.

1.3.3.7 The Ministry will test and inspect the production unit in any fashion in order to ensure that it meets the requirements of the specifications. The Ministry shall not assume any liability for damage incurred because of non-compliance of the production unit during testing and inspection.

1.3.4 The Ministry, within a period of thirty (30) days following receipt of the production unit complete with the required information listed above, will:

1.3.4.1 Issue written notification to the Supplier stating either:

1.3.4.1.1 The production unit evaluated is acceptable, and authorize the Supplier to proceed with the supply of the equipment in accordance with the delivery schedule specified in the Purchase Order,

or,

1.3.4.1.2 That the submitted production unit is not acceptable, and provide the Supplier with a list of areas non-compliance with these specifications and/or a list of areas of poor workmanship and human engineering based on the Ministry's interpretation of poor workmanship. The Ministry's interpretation of poor workmanship and human engineering may not be necessarily reflected completely within the specifications. The Ministry shall allow the Supplier a maximum interval of twenty (20) days following the date of mailing of the letter advising of non-compliance to correct the

identified deficiencies and resubmit the production unit along with the information outlined in 1.3.3, or supply another production unit of the same type for evaluation. The Supplier shall assume all costs of production, shipping, exchange, duty, tariffs, taxes and similar incidental costs associated with the initial supply, and any further required shipment of all evaluation equipment if a production unit has failed due to poor workmanship, then it is not expected to fail under same conditions if the sample is resubmitted.

If the Supplier fails to correct the deficiencies within the permitted time or the resubmitted unit still fails to meet the Ministry specifications, the Ministry will reserve the right to cancel the Purchase Order at no cost to the Ministry.

1.3.5 The approved production unit shall be retained by the Ministry until the acceptance of the final shipment of equipment specified in the contract. The approved production unit shall be included as part of the final shipment.

1.3.6 All equipment furnished under contract shall be exact duplicates of the approved production unit. It is expressly understood that approval by the Ministry of the Supplier's submitted information as outlined in 1.3.3 and the production unit shall not relieve the Supplier of any of his responsibility under the Purchase Order for the successful completion of the work in conformity with the requirements of the Purchase Order specified. Such approval shall not waive any of the requirements of the specification or relieve the Supplier of any obligation thereunder, and defective work, materials and equipment may be rejected notwithstanding such approval.

1.3.7 Failure to submit a production unit with the required information, for approval on the submittal date as specified on the Ministry Purchase Order may result in cancellation of the order at no cost to the Ministry. Suppliers who undertake the production of the equipment without being approved do so at their own risk.

1.4 WARRANTY

1.4.1 The Supplier is responsible for the conformance of the equipment supplied to the requirements of the Ministry's drawings and specifications. The Supplier agrees to indemnify and hold the Ministry harmless from all claim, liability, loss, damage and expenses incurred or sustained by the Ministry by reason of any breach of such warranties.

1.4.2 The guarantee period of each item of equipment shall begin upon acceptance of the item by the Ministry and shall extend for a period of twenty-four (24) months. The date of acceptance will be provided in writing by the Ministry.

1.5 REPAIR UNDER WARRANTY

1.5.1 Should any of the equipment prove defective due to failure to comply to the purchase order's specifications or due to otherwise defective workmanship or materials within the specified warranty period, the Supplier agrees, upon demand by the Ministry, to replace or repair said defective equipment without cost to the Ministry to include all shipping and handling costs.

1.5.2 The Supplier shall perform such work and return the equipment to the Ministry within fifteen (15) days after receipt of demand from the Ministry. The Supplier will provide without cost to the Ministry a tested, equivalent item of equipment for temporary use by the Ministry if the defective equipment is not restored to full operation within ten days after the Supplier received from the Ministry a demand for repair or replacement of defective equipment. The Ministry may, with agreement from the Supplier, make minor repairs to the equipment without affecting the warranty status of the equipment.

1.5.3 A printed circuit board may be factory repaired not more than two times during the warranty period. A third failure shall result in replacement of the printed circuit board with a new one. Any printed circuit board whose components or printed conductor become damaged during factory repair shall also be replaced by a new board. The warranty period on the new board or repaired board shall be a minimum of six (6) months from approval date of Ministry retesting or shall be equivalent to the remainder of the warranty of the original board, whichever is longer.

1.5.4 Components may be factory repaired not more than two times during the warranty period. A third failure shall result in replacement of the component with a new one. The warranty period on the new component or repaired component shall be a minimum of six (6) months from approval date of Ministry retesting or shall be equivalent to the remainder of the warranty of the original component, whichever is longer.

1.5.5 All factory repairs shall be described in detail on a form to be furnished by the Ministry. The completed form shall be returned together with the repaired unit.

1.5.6 Failure to comply with warranty requirements shall be sufficient grounds to prohibit the Supplier from bidding on future Ministry Contracts and cancellation of Supplier's pre-qualified where applicable.

1.6 PRE-DELIVERY REPAIR

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

1.6.2 Any defects or deficiencies found by the inspection system involving mechanical structure or wiring shall be fed back through the manufacturing process or special repair process for correction

1.6.3 Defects in printed circuit boards or electronic circuit components shall be specially treated as follows:

a) a printed circuit board may be flow soldered a second time if copper runs and joints are not satisfactorily coated on the first run.
b) under no circumstances shall a printed circuit board be flow soldered more than twice.
c) hand soldering may be used for printed circuit repair.
d) A printed circuit board may be factory repaired not more than two times during the warranty period. A third failure shall result in replacement of the printed circuit board whose components or printed conductor become damaged during factory repair shall also be replaced by a new board. The warranty period on the new board shall be a minimum of six (6) months from date of receipt or shall be equivalent to the remainder of the warranty of the original board, whichever is longer.
e) All factory repairs shall be described in detail on a form to be furnished by the Ministry. The completed form shall be returned together with the repaired unit.

1.7 REJECTION

1.7.1 The Ministry may reject any item of a shipment which is not in compliance with these specifications and/or based on the Ministry's interpretation of workmanship, which is not necessarily reflected in the specifications or which is in breach of warranty, expressed or implied, or which is otherwise defective.

1.7.2 Rejected items will be returned to the Supplier by common carrier at the Supplier's expense and risk unless Supplier notifies the Ministry that the Supplier will pick up the rejected items within ten (10) days of the rejection notification.

1.7.3 All equipment supplied shall be tested for compliance with specifications by the Ministry. The Ministry may reject a shipment of equipment on the basis of poor quality control or noncompliance with specifications. A shipment of equipment with more than 20% failure rate when tested by the Ministry may cause the whole shipment to be rejected. Any further shipment of equipment with more than 20% failure when tested by the Ministry may cause cancellation of the complete purchase order and cancellation of the Supplier's pre-qualification were applicable. The Supplier shall assume all costs of shipping, exchange, duty, tariffs, taxes and similar incidental costs incurred by the rejection.

1.8 OPERATION AND MAINTENANCE MANUALS

1.8.1 Draft of the Operation and Maintenance manuals must be approved by the Ministry. Five copies of the draft shall be submitted thirty (30) days prior to the first delivery. The Ministry may take up to fifteen (15) days to review the draft submitted.

1.8.2 Quantity and Delivery

1.8.2.1 One Operation and Maintenance manual for components shall be supplied for each item furnished up to a maximum of 40 copies unless otherwise specified. The full quantity of manuals shall be delivered, at the same time as the first shipment of equipment, to the Electrical Engineering Office.

1.8.2.2 Manuals for cabinets shall be furnished in the following manner:

1.8.2.2.0.1 One Maintenance manual shall be shipped inside each cabinet.

1.8.2.2.0.2 A total of fifteen (15) Operation and Maintenance manuals shall be shipped separately, at the same time as the first shipment of equipment, to the Electrical Engineering Office.

1.8.3 Content for Operation and Maintenance Manual and Maintenance Manual

1.8.3.1 The Operation and Maintenance Manual supplied with components and cabinets shall be precise and shall include the following:

a) General Description
b) General Characteristics
c) Installation
d) Adjustments
e) Theory of Operation
   1. Systems description (include block diagram)
   2. Detailed Circuit Description
f) Maintenance
   1. Preventative Maintenance
   2. Field Trouble Analysis
   3. Bench Trouble Analysis
   4. Trouble Shooting Analysis Chart
   5. Wave Forms
   6. Voltage Measurements
   7. Voltage Measurement Chart
   8. Alignment
g) Parts List
   1. Circuit and board designation
   2. Part type, class and power ratings
   3. Component Manufacturer and the Manufacturer's part number
   4. Name and address of one Canadian or U.S. distributor for replacement parts.
h) Electrical Interconnection Drawing
i) Schematic and Logic diagram
j) Assembly drawings and a pictorial diagram showing physical locations and identification of each component
k) Storage precautions (under warehouse conditions for up to l year)

1.8.3.2 The Maintenance Manual supplied inside cabinets shall be precise and shall include the following:

a) Adjustments
b) Maintenance
   1. Field Trouble Analysis
   2. Trouble Shooting Analysis Chart
c) Electrical Interconnection Drawing
d) Schematic and Logic diagram
e) Assembly drawings and a pictorial diagram showing physical locations and identification of each component

1.9 DELIVERY

1.9.1 Each delivered item shall be individually packaged in its own shipping container and shall be complete, ready for testing.

1.9.2 Each shipping container shall identify in the top left corner the following information as applicable:

a) Either production or prototype
b) Equipment Description
c) Contract Number
d) Manufacturer
e) Serial Number
f) Date of Shipment
g) Packing List

2 COMPONENTS

2.1 GENERAL REQUIREMENTS

2.1.1 No component shall be of such design, fabrication, nomenclature, or other identification as to preclude the purchase of said component from a wholesale electronics distributor or from the component manufacturer, except as noted.

2.1.1.1 When monolithic integrated circuits are of such special design that they preclude the purchase of identical components from any wholesale electronics distributor or component manufacturer, one exact duplicate monolithic integrated circuit shall be furnished with each twenty, or fraction thereof, monolithic integrated circuits used.

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

2.1.2 All components shall be capable of withstanding the extreme environmental conditions as specified without degrading their design life.

2.1.3 The design life of all components, under twenty-four (24) hours a day operating condition in their circuit application, shall not be less than ten (10) years.

2.1.4 All components shall be down rated by 20 percent with regard to applied voltage and power dissipation so that material shortening of life or shift in values is minimized.

2.1.5 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.

2.1.6 The circuit reference symbol for each component part shall be clearly marked.

2.1.7 Encapsulation of two or more discrete components into circuit modules is prohibited, except for transient suppression circuits, resistor networks, diode arrays, optical isolators and transistor arrays.

2.2 PC BOARD SOCKETS

2.2.1 Electronic components shall not be socket or jack mounted, except that large scale integrated (LSI) circuits having 16 or more leads shall be socket or jack mounted.

2.2.1.1 Where the use of sockets is permitted, all sockets shall be guaranteed for a minimum of 50 insertions and removals without any degradation in functional performance.

2.2.2 Pin 1 (one) location of all LSI sockets shall be properly marked on the board adjacent to the socket.

2.2.3 All sockets used on the Prom Module Card shall be the Augat Low Profile Machined Contact Sockets or equivalent.

2.3 CAPACITORS

2.3.1 The D.C. and A.C. voltage ratings as well as the dissipation factor of a capacitor shall meet the worst case design parameters of the circuitry.

2.3.2 The effect of change in capacitance due to environmental changes shall not cause circuit malfunctions.

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

2.3.4 Capacitor encasements shall be resistant to cracking, peeling and discolouration due to humidity and changes in temperature.

2.3.5 All capacitors shall be insulated and shall be marked with their capacitance value, working voltage and, when applicable, shall indicate polarity on the outer foil.

2.3.6 Electrolytic capacitors shall not be used for capacitance values of less than 1.0 microfarad.

2.4 POTENTIOMETERS

2.4.1 Potentiometers with ratings from one to two watts shall be the commercial equivalent of Military Type RV4.

2.4.2 Potentiometers (excluding trimmer type potentiometers) of less than one watt rating shall not be used.

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

2.5 RESISTORS

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

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

2.5.2 Resistors shall be 10 percent or less tolerance.

2.5.3 The value of the resistors shall not vary by more than 5 percent between -37°C and +74°C.

2.5.4 No resistors of a rating exceeding two watts shall be used unless special ventilation or heat sinking is provided. When used they shall be insulated from the printed circuit board.

2.6 SEMICONDUCTOR DEVICES

2.6.1 Semiconductor devices shall not be stressed to more than 80 percent of any of their design ratings.

2.6.2 Semiconductor devices used shall be the best quality and grade available for the application.

2.6.3 The integrated circuit manufacturers fan out rating shall not be exceeded.

2.6.4 All solid state devices, except LED's shall be of the silicon type, except as noted herein.

2.6.5 All transistors, integrated circuit, and diodes shall be a standard type listed by EIA and clearly identifiable to this standard, except as noted.

2.6.6 When permitted in writing by the Engineer, germanium diodes may be used only when a low forward voltage drop is required in logic circuit applications.

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

2.7 SWITCHES

2.7.1 50,000 operations per positions rocker dip switches, sealed Grayhill or equivalent.

2.8 TRANSFORMERS AND INDUCTORS

2.8.1 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.

2.8.2 All transformers and inductors shall have their windings insulated and shall be protected to exclude moisture. All wire leads shall be numbered, marked, or colour coded, and clearly indicated in their associated schematic diagrams.

2.8.3 All transformer and inductor leads shall be colour coded with an approved EIA colour code or numbered in a manner to facilitate proper installation.

2.9 CIRCUIT BREAKERS

2.9.1 Circuit breakers shall be approved and listed by UL or CSA. The trip and frame sizes shall be plainly marked, and the ampere rating shall be visible from the front of the breaker. All circuit breakers 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 -37°C to 74°C. Minimum interrupting capacity shall be 5,000 amperes, RMS.

2.9.2 Circuit breakers shall be the trip-free type.

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

2.10 INDICATORS AND CHARACTER DISPLAYS

2.10.1 All indicators and character displays shall have a ±45° cone of visibility with its axis perpendicular to the front panel. All indicators and character displays shall be readily visible at a radius of up to 4 feet within the cone of visibility when the indicator is subjected to 9,000 footcandles of white light with the light source at 45° to the front panel. If characters are not self-luminous, illumination shall be provided for viewing in low levels of ambient light.

2.10.2 All indicators and character displays with a rated life below 100,000 hours shall be replaceable from the front of the equipment.

2.10.3 The encapsulation of the LED's shall be the same colour as the light emitted by the LED and shall have a minimum intensity of 100 mcd (millicandell), and a viewing angle not less than 90°. Other LED's, as approved in writing by the Ministry may also be used.

2.11 CONNECTOR

2.11.1 All connectors shall be keyed to prevent accidental insertion of the wrong connector or printed circuit card.

2.11.2 Printed circuit card edge connectors shall have bifurcated gold plated contacts.

2.11.2.1 The printed circuit 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 Resistance:	0.006 ohms
Contact Material:	Copper alloy plated with 0.000005 inches of nickel and 0.00015 inches of gold

2.11.3 Connector plug and sockets of C1, C2, C4 and C5 shall use the AMP #601105-1 or #91002-1 contact insertion tool, and the AMP #305183 contact extraction tool.

2.11.4 Pin and socket contacts for Connectors C1, C2, C4 and C5 shall be beryllium copper construction subplated with 0.00005 inch nickel and plated with 0.00003 inch gold. Pin diameter shall be 0.062 inch.

2.12 ELECTRICAL ISOLATION

2.12.1 Electrical insulating paper may only be used when permitted in writing by the Engineer. Where possible electrical isolation shall be carried out by the use of stand off's or similar devices.

3 MECHANICAL

3.1 ASSEMBLIES

3.1.1 All assemblies (including Controller Unit) shall be easily replaceable. All assemblies shall incorporate plug-in capability for their associated devices or printed circuit boards.

3.1.2 All assemblies shall be mechanically secured to retain the assemblies and their associated devices in the proper position under condition of shock and vibration.

3.1.3 All PC Board Connectors mounted on a Mother Board shall be mechanically secured to the chassis or frame on the unit.

3.1.4 Assemblies shall be provided with two non-metallic guides for each plug-in printed circuit board or associated device (except relay). The guides shall extend to within 3/4 inch from the face of either the socket or connector.

3.1.5 The guides shall be securely mounted and shall not depart from the mounting positions due to shock, vibration or environment changes.

3.2 INTERCHANGEABILITY

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

Assemblies	Associated Devices
Output File	Model 200 Switch Pack Model 210, 212 Monitor Unit Model 430 Heavy Duty Relay
Input File	Model 222, 224 Detectors, Model 242, 244 and 252 Isolators
Power Distribution Assembly	Model 204 Flasher Unit Model 430 Heavy Duty Relay
Auxiliary Output File Model 420	Model 200 Switch Pack Model 430 Heavy duty Relay

3.2.2 The Model 170 Controller Unit shall be compatible with and intermate with the Model 400 MODEM, Model 411 Series PROM Modules, and 332 Series and 401 Series Cabinets.

3.3 MODULAR OR PRINTED CIRCUIT DESIGN

3.3.1 Modules or printed circuit assemblies shall incorporate plug-in techniques, and be easily replaceable. Guides shall be provided for each module or printed circuit assembly. The construction of the Modules and printed circuit assemblies shall be able to withstand the condition of shock and vibration as specified.

3.3.2 Printed circuit boards - components, traces, brackets or obstructions shall be kept to a minimum of 1/8 inch of the board edge (guide edges).

3.4 MODEL NUMBERS

3.4.1 The manufacturer's name or logo, model number, serial number, and circuit issue or revision number shall appear and be readily visible on all modules supplied. Placement of this information for modules such as the Traffic PROM module, MODEM, Systems Memory Module and Monitor Unit shall be on the printed circuit board.

3.4.2 The designated model number shall be displayed on the front panel in bold type, at least 1/4 inch in height.

The model numbers are as follows:

DESCRIPTION	MODEL NO.
CONTROLLER UNIT	170
CONTROLLER UNIT	170F
SWITCHPACK	200
FLASHER UNIT	204
MONITOR UNIT	212
2 CHANNEL LOOP DETECTOR UNIT	222
4 CHANNEL LOOP DETECTOR UNIT	224
2 CHANNEL DC ISOLATOR	242
4 CHANNEL DC ISOLATOR	244
2 CHANNEL AC ISOLATOR	252
CABINET	332
CABINET	401C
CABINET	401D

DESCRIPTION	MODEL NO.
CABINET	401S
CABINET	401R
MODEM UNIT	400
PROM MODULE UNIT, 332 Series	411
PROM MODULE UNIT, 401 Series	411F
AUXILIARY OUTPUT FILE	420
HEAVY DUTY RELAY	430
THERMOSTAT, ANALOGUE	500A
THERMOSTAT, DIGITAL	500D

3.4.3 All serial numbers shall be at least 1/4 inch in height and shall be either silkscreen, etched or engraved.

3.4.4 Serial numbers are required on 24 Volt DC Power Supply and Thermostat panels.

3.5 SCREWS AND FASTENERS

3.5.1 Only Robertson head or combination of Robertson and slot head screws shall be used with all terminal blocks and for mounting assemblies on the rack. Slotted thumb screws may also be used for assembly mounting.

3.5.2 All screw type fasteners shall utilize locking devices or locking compounds.

3.5.3 All screws shall be tightened to ensure secure mechanical and electrical connection before delivery.

3.5.4 All screws, nuts, washers and roll pins used in the assembly of traffic control equipment shall be made of stainless steel. This requirement does not apply to electronic/electrical components, load switches, detectors, isolators and flashers.

3.6 TOLERANCES

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

Sheet Metal	± 0.0525 inch
Printed Circuit Boards	+ 0, - 0.010 inch
Edge Guides	± 0.015 inch

3.7 PLATING

3.7.1 All plating shall be either cadmium or zinc. All cadmium plating shall meet the requirements of MIL QQ-P-416C, Type 2, Class 1.

All zinc plating within the cabinet shall meet the requirements of ASTM B 633-78, Finish type 2, with a thickness classification of SC3 (severe), min 13 micrometers.

All zinc plating applied to parts mounted on the outside of the cabinet shall meet the requirements of ASTM B 633-78, Finish type 2, with a thickness classification of SC4 (very severe), min 25 micrometers.

3.7.2 Plating on Aluminum

3.7.2.1 All aluminum components within the cabinet shall be either anodized or protected by means of Chemical conversion coatings as per MIL-C-5541C, Class 1A standards.

3.7.2.2 Anodized Aluminum

3.7.2.2.1 The surfaces of each aluminum component shall be finished to conform to the requirements of Military Specification MIL-A-08625C ("Anodic Coatings for Aluminum and Aluminum Alloys") for a Type II, Class I coating, except that the anodic coating shall have a minimum thickness of 0.007-inch and a minimum coating weight of 27 milligrams per square inch. Prior to applying the anodic coating, the components shall be cleaned and etched as follows:

3.7.2.2.1.1 Clean by immersion in inhibited alkaline cleaner such as Oakite 61A or Diversey 909, or equivalent, 6 to 8 oz. per gallon, 160°F for 5 minutes.

3.7.2.2.1.2 Rinse in cold water

3.7.2.2.1.3 Etch in a solution of sodium fluoride, 1.5 oz. plus sodium hydroxide 4-6 oz. per gallon at 140-150°F for 5 minutes.

3.7.2.2.1.4 Rinse in cold water.

3.7.2.2.1.5 Desmut in a 50% by volume nitric acid solution at room temperature for 2 minutes.

3.7.2.2.1.6 Rinse in cold water.

3.7.2.2.1.7 The anodic coating shall be sealed in a 5 percent aqueous solution of sodium dichromat (pH 5.0 to 6.5) for 15 minutes at 208°F to 212°F.

3.7.3 Unless otherwise specified, all metal components shall be either painted or plated. This requirement does not apply to screws, brass locks, keys, stainless steel, electrical/electronic components, printed circuit boards.

3.8 STANDOFFS

3.8.1 Where the application demands the use of standoff's within the cabinet, type Glastic 2165-1A or equivalent shall be used.

4 ENGINEERING

4.1 HUMAN ENGINEERING

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

4.1.1.1 No more than two 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.

4.1.1.2 Knobs shall be of large enough diameter (at least 1/2 inch edge to edge) to ensure ease of adjustment without disturbance of adjacent knobs.

4.1.1.3 All fuses shall be easily accessible on the front panel unless otherwise specified and shall be replaceable without the use of any tools.

4.1.1.4 Printed circuit boards and modules shall slide smoothly in their guides while being inserted into or removed from the frame and shall fit snugly into the plug-in printed circuit connectors and sockets.

4.1.1.4.1 Printed circuit boards and modules shall require a force of no less than 5 pounds or greater than 50 pounds for insertion into or removal from the connectors and sockets.

4.1.1.5 Test points shall be provided for monitoring all power supply voltages. All test points shall be readily accessible when equipment is opened in service position and the voltage level to be verified shall be clearly labelled beside the test point.

4.1.1.6 The equipment shall be designed so that it can be easily installed and maintained. Fault location, accessibility and serviceability features which will lead to simplified maintenance shall be a prime consideration. Modules or components which are found to be not accessible under simulated field maintenance conditions shall be reason for non-acceptance.

4.1.1.7 The routing of wires and the positioning of components for each assembly or device shall be designed in such a way that the removal or insertion of the assembly or device to the controller shall not cause any damage to any wiring component or connection external or internal to the assembly or device.

4.2 DESIGN ENGINEERING

4.2.1 All equipment furnished under these specifications shall be of solid state design. The use of vacuum or gaseous tubes or electromechanical device within the equipment is not acceptable unless otherwise indicated by a written approval by the Ministry.

4.2.2 The following practices shall be employed in the design of solid state equipment and circuitry.

4.2.2.1 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.

4.2.2.2 For reasons of personal safety, personnel shall be protected from all dangerous voltages, mechanical/fire hazards.

4.2.2.2.1 All inconspicuous electrical, mechanical and fire hazards shall be clearly identified by a warning label in the vicinity of the hazard.

4.2.2.2.2 When the front face and/or handle of a module are fabricated from metal, they shall be connected to chassis ground.

4.2.2.3 Constancy of Intervals

All equipment shall be designed so that the length of any timed period shall be within the maximum allowable timing deviations as the applied line voltage varies between 95 volts and 135 volts, and ambient temperature within the cabinet housing the equipment varies between minus 37°C, and plus 74°C, and the humidity varies between 5% and 95%. This performance shall include cold and hot starts, and shall be obtained without the use of any heating or cooling elements.

4.3 GENERATED NOISE

No item, component or subassembly shall emit a noise level exceeding the specification outlined by the DOC regulations on operation of electronic equipment.

5 PRINTED CIRCUIT BOARDS

5.1 DESIGN, FABRICATION AND MOUNTING

5.1.1 All contacts on printed circuit boards shall be gold plated.

5.1.2 Printed circuit board design shall be such that components may be removed and replaced without damage to boards, traces or tracks.

5.1.3 Fabrication of printed circuit boards shall be in compliance with Military Specification: MIL-P-12949, except as follows:

5.1.3.1 Only NEMA G-10 glass cloth base epoxy resin copper clad laminates 1/16 inch minimum thickness or equivalent shall be used. Inter component wiring shall be by laminated copper clad track having a minimum weight of 2 ounces per square foot with adequate cross-section for current to be carried. All copper track shall be plated or soldered to provide complete coverage of all exposed copper track. Jumper wires will not be permitted, except from plated-through padded holes to an external component or for designed function selection with the jumper insulated and as short as possible.

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

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

5.1.3.4 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".

5.1.3.5 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.

5.1.4 The fabrication of printed circuit boards and the mounting of parts and assemblies there on shall conform to Military Specification: MIL-STD-275, except as follows:

5.1.4.1 All semiconductor devices required to dissipate more than 250 milliwatts or any case temperature that is 10°C above ambient shall be mounted with spacers or transipads to prevent direct contact with the printed circuit board.

5.1.4.2 When completed, all residual flux shall be removed from the printed circuit board.

5.1.4.3 The resistance between any two isolated independent conductor paths shall be at least 100 megohms when a 500 volt D.C. potential is applied.

5.1.4.4 All boards shall be coated with a moisture resistant coating.

5.1.4.5 Where less than 0.25 inch lateral separation is provided between the printed circuit board and any metal surface, a 0.03125 inch thick Mylar (polyester) plastic cover shall be provided to protect the printed circuit board.

5.1.5 Each printed circuit board connector edge shall be chamfered at 30° from board side planes. The key slots shall also be chamfered so that the connector keys are not extracted upon removal of the 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.

5.2 SOLDERING

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

5.2.2 Automatic flow soldering shall conform to the following conditions:

a) Constant speed conveyor system.

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

c) Temperature shall be controlled to within ±8°C of the optimum temperature.

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

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

f) If exposure to the temperature bath is of such a time-temperature duration as to come within 80 percent of any component's maximum specified time-temperature exposure, that component shall be hand soldered to the printed circuit board after the flow process has been completed.

5.3 DEFINITIONS

5.3.1 Definitions for the purpose of this specification shall be taken from Military Specification: MIL-STD-429 as amended.

6 QUALITY CONTROL

6.1 QUALITY CONTROL CERTIFICATION

6.1.1 The Supplier shall submit his quality control procedures for approval together with the pre-production sample.

6.1.2 Every unit supplied by the Supplier shall pass the approved quality control procedure. A "pass" mark and the test completion date shall be stamped on the case or the printed circuit board of each unit.

6.1.3 The quality control procedure shall be prepared and signed by the manager who shall supervise and be responsible for the quality control process.

6.1.4 The quality control procedure shall include the following:

6.1.4.1 Acceptance testing of all supplied components.

6.1.4.2 Physical and functional testing of all modules.

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

6.1.4.4 Physical and functional testing of all items.

6.1.4.5 A minimum 24 hour operation of all controller units after the 100 hour. burn-in period.

6.1.4.6 A separate test area to be set aside by the Manufacturer where the Provincial Inspector will have free access to witness quality control inspection and testing being performed.

6.2 COMPONENTS

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

6.3 SUB-ASSEMBLY OR MODULE

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

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

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

6.4 UNITS

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

6.4.2 The unit shall be visually and physically (manually) inspected to assure proper placement, mounting, and compatibility of sub-assemblies.

7 TESTING REQUIREMENTS

7.1 GENERAL

7.1.1 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.

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

7.2 INSPECTION

7.2.1 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. Workmanship shall be of the highest industry standards as interpreted by the Ministry but which may not be fully expressed in these specifications.

7.3 ENVIRONMENTAL

7.3.1 All components shall properly operate within the following limits:

7.3.1.1 Ambient Temperature: -37°C to +74°C

7.3.1.2 Humidity: 5 percent to 95 percent

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

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

Ambient Temp. / Dry Bulb (°C)	Relative Humidity (%)	Ambient Temp. / Wet Bulb (°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
74.0	18	42.7

7.3.1.4 Shock Test: Per Military Specification: MIL-STD-810 Method 516.1

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

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

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

7.3.2.1 Low Temperature Test

7.3.2.1.1 With the item functioning at a line voltage of 95 VAC for all items except the conflict monitor (see monitor spec for power operation levels) VAC in its intended operation, the ambient temperature shall be lowered from 20°C to -37°C at a rate of not more than 18°C per hour. The item shall be cycled at -37°C for a period of 5 hours and then returned to 20°C at the same rate. The test shall be repeated with the line voltage of 135 VAC.

7.3.2.2 High Temperature Test

7.3.2.2.1 With the item functioning at a line voltage of 95 VAC in its intended operation, the ambient temperature shall be raised from 20°C to 74°C at a rate of not more than 18°C per hour. The item shall be cycled at 74°C for 5 hours and then returned to 20°C at the same rate. The test shall be repeated with the line voltage of 135 VAC.

7.4 ELECTRICAL

7.4.1 All components shall operate properly within the following limits:

a) Applied Line Voltage: 120 + 15 Volts AC or 120 - 25 Volts AC

b) Frequency: 60 ± 3.0 Hertz

7.4.2 All circuits, unless otherwise noted, shall commence operation at, or below, 95 VAC as the applied voltage is raised from 50 VAC to 95 VAC at a rate of 2 (±0.5) volts per second.

7.4.3 All equipment when housed within its associated cabinet, shall be unaffected by transient voltages normally experienced on commercial and industrial power lines. Equipment purchased separately from the cabinet will be tested for compliance with the equipment housed within a Ministry approved cabinet and the cabinet connected to commercial power lines.

7.4.3.1 The power line surge protection (including that of the cabinet 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 ten (10) seconds for a maximum of 50 occurrences per test. The unit under test will be operated at room temperature and at 117 (± 10%) volts.

7.4.3.2 The Programming System will not be required to meet these specifications.

7.4.3.3 The Model 400 MODEM will be housed in a Ministry approved Model 170 Controller Unit which in turn is housed in the cabinet during the test described above.

7.4.4 All equipment shall be unaffected by transient voltages normally experienced on commercial power lines. Equipment purchased separately from the cabinet (note exceptions under 7.4.4.1 and 7.4.4.2) will be tested for compliance as follows:

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

Equipment properly housed and connected within a Ministry approved cabinet. The cabinet power surge protectors deactivated or removed.

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

7.4.4.1 The Model 400 MODEM shall comply with the above requirements when housed in a Ministry approved Model 170 Controller Unit with the Ministry acceptance test program operating, and tested under the above conditions.

7.4.4.2 Within the wiring of any component, module or printed circuit board, electrical isolation shall be provided between DC logic ground, earth ground and the AC neutral grounded conductor. The DC logic ground and earth 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 50 VDC.

7.4.5 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 30 openings and closing per minute for a period of 2 minutes in durations.

7.5 COLD START

7.5.1 All equipment shall resume normal operation when 95 volts AC is applied to the input terminals of the cabinet, following a period of at least five (5) hours at -37°C and less than 10 percent humidity with power removed.

8 SOFTWARE REQUIREMENTS

8.1 GENERAL

8.1.1 If a microprocessor-based design is used, 2 manuals containing the source listing of the operating program and the documentation for the program. For each new version of the software, a new manual shall be re-submitted.

8.1.2 References shall be made to the following:

8.1.2.1 All variables imply memory locations, registers.

8.1.2.2 All references to peripherals imply registers, latches, flip-flops, peripheral interface adapters, ACIA's, analog to digital convertors etc.

8.1.2.3 All references to subroutines imply subroutines, interrupt service routines, traps, etc.

8.2 SOURCE LISTING

8.2.1 The source listing shall include the following:

8.2.1.1 The version number.

8.2.1.2 All equates and sets shall be complete with comments describing these functions.

8.2.1.3 All subroutines and the main program shall be clearly identified and isolated in the program listing by a header.

ie.
```
**********
*  Subroutine name: function
**********
```

8.2.1.4 All long branches should be documented.

8.3 DOCUMENTATION REQUIREMENTS

8.3.1 The documentation of the main program, which should include:

8.3.1.1 The version number.

8.3.1.2 A brief description of the main program.

8.3.1.3 A flow chart of the main program.

8.3.1.4 A detailed memory map.

8.3.1.5 A list of global variables used by the main program and their description.

8.3.1.6 A list of subroutines used in the program

8.3.1.7 The documentation of the subroutines/interrupt service routines/traps etc., should include:

8.3.1.8 A brief description of the subroutine.

8.3.1.9 A flow chart of the routine.

8.3.1.10 A list of imports and exports/entry parameters. Imports are defined as global variable/ registers/ memory locations used by the routine. Exports are defined as variables/ systems/ memory locations modified by the routine.

ie.- If a global variable "B" is used by a subroutine and not altered then it is an Import.

If a global variable "B" is used by a subroutine and its value is altered then it is both an Import and an Export

If the value of a global variable "B" is altered but not used then it is an Export.

8.3.1.11 A list of local variables and their description.

8.3.2 Where peripherals/registers/latches etc., are used. The documentation should include the address location of the peripherals and a detailed memory map shall be provided.

8.4 PLA/PAL/FPAL/FPLA REQUIREMENTS

8.4.1 Where PLA or other such devices are used, the following information shall be supplied:

8.4.1.1 Detailed programming information

8.4.1.2 Detailed memory map and decoding information

9 GLOSSARY

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

AC+	-	120 Volt AC, 60 Hertz Ungrounded Power Source
AC-	-	120 Volt AC, 60 Hertz Grounded Return to the Power Source
ACIA	-	Asychronous Communications Interface Adapter
ANSI	-	American National Standards Institute
ASTM	-	American Society for Testing and Materials
AWG	-	American Wire Gauge
Cabinet	-	An outdoor enclosure for housing the controller unit and associated equipment
CEC	-	Canadian Electrical Code
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.
Controller Unit	-	That portion of the controller assembly devoted to the implementation of traffic control software.
CR	-	Control Register
CSA	-	Canadian Standard Association

Day	-	Working Day means any Day a) except Saturdays, Sundays and statutory holidays; b) except any Day on which the Supplier is prevented from proceeding with the supplying of equipment, as determined by the Electrical Engineering Office by reason of: i) any breach of Contract or prevention by the Ministry or by any employee of the Ministry, ii) non-delivery of Ministry supplied materials, iii) any cause beyond the reasonable control of the Supplier which can be substantiated by the Supplier to the satisfaction of the Electrical Engineering Office.
DTA	-	Down Time Accumulator
DOC	-	Department of Communications, Federal
EIA	-	Electronic Industries Association
Engineer	-	The Director, Transportation Operations Branch, acting either directly or through properly authorized agents, such agents acting within the scope of the particular duties delegated to them.
EPROM	-	Erasable Programmable Read-Only Memory
Faze	-	A traffic movement in a given direction either vehicle or pedestrian.
Federal Standard	-	Standard of the Canadian or U.S. Federal Government
Laboratory	-	The established laboratory of the Ministry or other laboratories authorized by the Ministry to test materials involved in the contract.
Manufacturer	-	The original fabricator of the component or product being supplied.
Military Specification	-	Current issues and/or revisions of standards or specifications issued by the U.S. Department of Defense.

Ministry	-	Ministry of Transportation, Ontario
Motherboard	-	A Printed Circuit Connector Interface Board with no active or passive components.
MODEM	-	Modulate/Demodulate Unit
MOS	-	Metal Oxide Semiconductor
MPU	-	Microprocessor Unit
NA	-	Not assigned, cannot be used by the manufacturer or vendor.
NC	-	Not Connected
NEMA	-	National Electrical Manufacturer's Association
Phase	-	any combination of traffic movements (fazes) receiving the right of way simultaneously during an interval.
Power Failure	-	A power failure is said to have occurred when the incoming RMS line voltage falls below 93 ± 2 VAC for 50 milliseconds or longer. The determination of the 50 milliseconds interval shall be completed within 67 milliseconds of the time the voltage falls below 93 ± 2 VAC.
Power Restoration	-	Power is said to be restored when the incoming RMS line voltage equals or exceeds 95 ± 2 VAC for 50 milliseconds or longer. The determination of the 50 millisecond interval shall be completed within 67 milliseconds of the time the voltage first reaches 95 ± 2 VAC.
PROM	-	Programmable Read Only Memory
PROVINCE	-	The Province of Ontario
RAM	-	Random Access Memory
RDR	-	Receiver Data Register
Response Time	-	The time between the occurrence of an event to the sensing of that event and providing an action to it.
Second Sourced	-	Produced by more than one manufacturer.

Specifications	-	The direction, provisions and requirements contained in the latest issue of Traffic Signal Control Equipment Specifications as supplemented by the current Addendum.
SR	-	Status Register
Supplier	-	The person or persons, firm, partnership, corporation or combination thereof, who have entered into a contract with the MINISTRY as party or parties of the second part of his or their legal representative, or, the person or persons, firm, partnership, corporation or combination thereof, who have submitted a sample for pre-qualification to supply equipment.
TDR	-	Transmit Data Register
TTL	-	Transistor Transistor Logic
UL	-	Underwriter's Laboratories, Inc.
Watchdog Timer (WDT)	-	A monitoring circuit, external to the Controller Unit, which senses a Controller Unit Output Line.
Electrical Engineering Office	-	Ministry of Transportation of Ontario Electrical Engineering Office 1201 Wilson Avenue Room 224, Central Building Downsview, Ontario M3M lJ8 Telephone: 1-416-235-3804
Sample	-	A production prototype unit submitted by the Supplier to the Ministry for approval prior to the start of any production activity.

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CHAPTER 2

Specifications

For

Controller Unit

Model 170F

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Date	OTSCES No.	Rev	Title
June 1, 1992	0210.01	-	170 Controller - Outline
June 1, 1992	0210.02	-	170 Controller - Block Diagram
June 1, 1992	0210.03	-	170 Controller - Memory Map
June 1, 1992	0210.04	-	170 Controller - Output Port Data
June 1, 1992	0210.05	-	170 Controller - Input Port Data
June 1, 1992	0210.06	-	170 Controller - Communication Assignment

1 GENERAL REQUIREMENTS

1.1 SCOPE

1.1.1 This chapter defines the general specifications applicable to Controller Units, Models 170 and 170F.

1.1.2 These specifications shall supplement the General Specifications for Traffic Control Equipment and in case of conflict the specification of this Chapter will govern.

2 CONTROLLER REQUIREMENTS

2.1 MICROPROCESSOR UNIT

2.1.1 The controller unit shall properly execute existing Province owned object programs developed to operate with a Motorola 6800 Microprocessor Unit.

2.2 CONTROLLER UNIT CLOCK TIMING

2.2.1 The controller unit shall have clock timing whose frequency is Dip-Switch selectable between 2 MHZ and 1 MHZ operation. There shall be no intermediate switch setting at which the CPU becomes disconnected from the CPU clock timing circuit. The frequency of operation of the controller shall be marked adjacent to the appropriate switch setting. For example "2 MHZ" shall be marked adjacent to the switch setting which selects the 2 MHZ operation. The controller shall be shipped with the 1 MHZ operation selected. 1 MHZ clock frequency is one which lies within the range of 900 KHZ to 1 MHZ. 2 MHZ clock frequency is one which lies within the range of 1.8 MHZ to 2 MHZ. The 170 controller shall be designed such that it operates at 2 MHZ with EPROM's having an access speed of no less than 250 ns and RAM's having an access speed of no less than 200 ns. The Dip-Switch contacts shall be gold plated.

2.3 INPUT-OUTPUT INTERFACE

2.3.1 The input-output interface shall utilize a ground true logic. The transfer of data between interface and working registers within the MPU shall be in 8-bit work increments, minimum. The steering of data from inputs or outputs for a given address shall be controlled by the state of the MPU read/write command at the time the given address is valid.

2.3.2 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 50 volts DC and sinking up to 100 milliamperes. The output driver shall be a ULN-2003A high-voltage, high-current Darlington transistor array (Sprague or equivalent). A logic state one from the MPU shall be presented as a grounded collector (0 to 2 volts), and a logic state zero 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.

2.3.3 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 volts, and shall be turned OFF (false) when the input current is less than 100 microamperes or the input voltage exceeds 8.5 volts, each input bit shall pull up to 12 Volts DC, and shall not deliver in excess of 20 milliamperes to a short circuit to logic level common. A 100 kilo Ohm (minimum) series resistor shall be installed for all DC input lines. 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 "one" and an open on any input or the presence of a voltage greater than 8.5 volts shall be interpreted as a "zero" by the MPU when that input is read.

2.4 SYSTEM ADDRESS ORGANIZATION

2.4.1 The system addressing for the Controller Unit shall be as shown in Section 6.0.

2.5 DOWNTIME ACCUMULATOR (DTA)

2.5.1 A Downtime Accumulator shall be provided to accumulate time during power failures. Upon restoration of power, the DTA shall present two 8-bit data inputs indicating the number of minutes and seconds of power failure with an emergency of plus minus 1 second over the 255 minute range of the DTA. The DTA shall indicate all ones on the Minutes Register for power failures greater than 255 minutes.

2.5.2 The DTA shall reset both 8 bit registers to zero by writing to Address 5000, and shall read by reading from Address 5000 for Minutes and Address 500F for Seconds. The Seconds Register shall utilize Bits 1 through 6 to count 0 to 59 seconds.

2.5.3 The DTA shall start timing immediately at the power failure point and continue timing until the RES line goes High following power restoration.

2.6 RAM MEMORY

2.6.1 RAM Memory shall be a minimum of 20 k eight-bit words. The RAM chips shall be socket mounted.

2.6.2 Only the lowest address 2 k RAM memory shall be supplied with the controller unless otherwise specified. Sockets shall be provided for all address RAM memory. All sockets shall be clearly marked according to the address. The RAM shall have a read and write time suitable to perform either function in one MPU instruction cycle. The RAM shall be static and alterable by word. The RAM (Read/Write) Memory shall be Second Sourced. The RAM shall retain full memory for a minimum of 30 days in the controller unit with AC power off.

2.7 COMMUNICATION SYSTEM COMPONENTS

2.7.1 The components of the communication system required as part of the Model 170 Controller Unit include an asynchronous communications interface adapter (ACIA): space, power, mounting facilities, and a connector for installation of a Model 400 MODEM within the controller unit; and Connector 2 and Terminal Block Tl.

2.7.2 Connector C2S-D-25 shall be wired to appear as a D.T.E. to external devices as per EIA RS-232-C standard, see drawings.

NOTE: The signals DATA OUT, DATA IN, AUDIO IN, AUDIO OUT are referenced with respect to the model 400 modem; all other communication signals are referenced with respect to the serial chip on the 170 controller, see drawings.

2.7.3 The purpose of the communication system is to provide for bi-directional communications from a controller unit to another controller unit at a different location over standard 3002 voice grade telephone lines, or equivalent. The communication system shall be capable of both two wire, half-duplex operation and four wire, full-duplex operation.

2.7.4 The ACIA shall be capable of receiving and transmitting up to eight-bits of data from the MPU for serial data communications. The ACIA shall have four registers which may be addressed 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). The interface between the ACIA and the Model 400 shall comply with EIA-RS-232-C standards. The TRS and TX Data Lines to the MODEM shall have MARK and SPACE Voltages of -12 and +12 VDC respectively.

2.7.5 The MPU shall be able to read the converted serial to parallel data on the RDR by addressing Location 6001.

2.7.6 The MPU shall be able to store data in the TDR for parallel to serial conversion by addressing Location 6001.

2.7.7 The SR shall be read by the MPU by addressing Location 6000. The SR shall comply with the following bit requirements:

STATUS REGISTER (SR)

8	7	6	5	4	3	2	1
IRQ	PE	ROV	PE	CTS	DCD	TDRE	RDRF

Bit 1 Receiver Data Register Full (RDRF)

"1" - The Receiver Data Register is full
"0" - The Receiver Data Register has been read by the MPU

Bit 2 Transmit Data Register Empty (TDRE)

"1" - The Transmit Data Register is empty and new data may be transferred
"0" - The Transmit Data Register is full

Bit 3 Data Carrier Detect (DCD)

"1" - There is no carrier from the MODEM
"0" - The carrier from the MODEM is present

Bit 4 Clear to Send (CTS)

"1" - MODEM is not ready for data
"0" - MODEM is ready for data

Bit 5 Framing Error (FE)

"1" - Framing Error indicates that the received character is improperly framed by the start and stop bit and indicates a synchronization error, faulty transmission, or a break condition
"0" - The received character is properly framed

Bit 6 Receiver Overrun (ROV)

"1" - Overrun is an error flag that indicates that one or more characters in the data stream were lost
"0" - No Receiver Data Overrun have occurred

Bit 7 Parity Error (PE)

"1" - The parity error flag indicates that the number of highs (ones) in the character does not agree with the presented odd or even parity
"0" - No parity error occurred

Bit 8 Interrupt Request (IRQ)

"1" - There is an interrupt in the ACIA
"0" - No interrupt present

2.7.8 Space for the MODEM shall be provided in the controller unit conforming to the details shown on the plans.

2.7.9 Card guides shall be provided for the MODEM board.

2.7.10 See "Electrical Requirements" of this Chapter for MODEM power requirements.

2.7.11 All electrical connections in and out of the MODEM module shall be through a printed circuit connector having 2-rows of 22 independent bifurcated contacts on 0.156-inch centers. Connector contact assignments shall be as shown on the plans.

2.7.12 The MPU shall write into the CR by addressing Location 6000. The CR shall comply with the following bit requirements:

CONTROL REGISTER (CR)

8	7	6	5	4	3	2	1
Receiver Interrupt	Transmitter Control		Word Select			Counter Divide	

The baud rate for the communication system in the controller shall be switch selectable and the baud rate for each switch position shall be clearly marked. The relationship between the switch selected position to the Counter Divide Select Bits shall be as follows:

Bit 1 and 2 - Counter Divide Select Bits (CDS)

Switch Position (Baud Rate)	Bit 1 = 0 Bit 2 = 1	Bit 1 = 1 Bit 2 = 0
9600	2400	9600
4800	1200	4800
2400	600	2400
1200	300	1200
300		300
150		150

Bit 3, 4, 5 - Word Select Bits (WS)

CR5	CR4	CR3	FUNCTION
0	0	0	7 Bit + EP + 2SB
0	0	1	7 Bit + OP + 2SB
0	1	0	7 Bit + EP + 1SB
0	1	1	7 Bit + OP + 1SB
1	0	0	8 Bit + 2SB
1	0	1	8 Bit + 1SB
1	1	0	8 Bit + EP + 1SB
1	1	1	8 Bit + OP + 1SB

Note: EP = Even Parity
OP = Odd Parity
SB = Stop Bits

Bits 6 and 7 - Transmitter Control (TC)

CR6	CR7	FUNCTION
0	0	RTS = Low Transmitting Interrupt Disabled (TIE)
1	0	RTS = Low Transmitting Enabled (TIE)
0	1	RTS = High Transmitting Interrupt Disabled(TIE)
1	1	RTS = Low Transmitting Interrupt Disabled (TIE) and transmits a Break level on the transmit data output

Bit 8 Receiver Interrupt Enable

"1" - Enables interrupts caused by:
a) Receiver Data Register Full going high
b) A low to high transition on the Data Carrier Detect signal line

"0" - Cleared by selecting the Receiver Data Register or by resetting the Receiver Interrupt Enable Bit.

2.8 STANDBY POWER

2.8.1 A Chassis Standby Battery shall be provided to power the Restart Timer, Downtime Accumulator, and to achieve nonvolatility in the RAM during power failure. The battery shall have sufficient capacity for a continuous backup requirement of 2 seconds for the Restart Timer, 255 minutes for the Downtime Accumulator Counting Circuits (Minutes Register shall be retained the same duration as RAM) and shall retain full RAM memory for a minimum of 30 days. Battery power shall be activated by a transfer circuit immediately upon sensing power failure. Battery float circuit is not acceptable.

2.8.2 The Chassis Standby battery shall be sealed, fast rechargeable, lead-acid gel-cell type or equivalent suitable for standby operation. It shall be securely installed inside the controller unit chassis. The total weight of the standby battery shall not exceed 3 pounds. The battery shall have a minimum capacity rating of 2.5 ampere-hours.

2.8.3 A battery charging circuit shall be provided which shall, under normal operating conditions, fully recharge within 24 hours and float the Chassis Standby Battery consistent with the battery manufacturer's recommendations. An indicator, located on the front panel, shall be illuminated when the battery charging current exceeds a present limit indicating that the Chassis Standby Battery is in a "High Charge Mode".

2.8.4 Means of disconnecting the battery from its load circuit shall be provided in the form of a cut off switch. The cut off switch shall be located so that it is easily accessible with the front door open. It shall not be required to insert hands or fingers within the controller housing in order to access the cut off switch.

2.9 FRONT PANEL

2.9.1 The front panel shall be securely fastened to the chassis and shall be removable without the use of 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.

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

2.9.3 The Front Panel Layout shall be as shown on the plans. The character displays shall be hexadecimal with circuits to accept, store and display 4-bit binary data. The characters shall be 0.40-inch high, minimum. Each character shall have a latch strobe input and a blanking input. The second character from the right (lower row) shall have a right 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.

2.9.4 The front panel shall be provided with 10 LED's (Light Emitting Diodes) as shown on the plans.

2.9.5 A keyboard shall be provided as shown on the plans. 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 one 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 functional character, shall have a minimum surface area of 0.075 square inches and shall be mounted on a minimum of 0.50-inch centres; shall have an actuation force between 50 and 100 grams and shall provide positive tactical indications of contact. Key contacts shall have a design life of over three million operations, shall be rated for the current and voltage levels used, and shall stabilize within five (5) milliseconds following contact opening. Use Grayhill HEX Keypad 86 BC2-101 or equivalent.

2.9.6 The front panel shall be provided with a toggle switch to enable the stop time function. The switch shall be of the heavy-duty miniature type rated for over one million operations. The voltage and current ratings for the switch shall be selected to satisfy the application in which the switch is used.

2.9.7 The front panel shall be provided with an ON-OFF toggle switch and fuse for AC power. The switch shall be rated for over one million operations. The voltage and current ratings for the switch shall be selected to satisfy the application in which the switch is used.

2.9.8 Toggle switches referred to in Sections 2.9.6 and 2.9.7 shall be easily accessible from the front without the front panel door being opened. The toggle switches shall not be mounted on the front panel door.

2.9.9 The front panel shall provide an opening for the insertion and removal of the PROM module.

2.10 POWER SUPPLY

2.10.1 All DC power necessary to operate the controller unit shall be developed from within the unit. The maximum DC voltage generated shall not exceed 45 volts. All DC power supplies shall be held up for at least twice the time required to recognize power failure.

2.10.2 Four internal DC voltages, in addition to any other required voltages, shall be supplied to operate all internal circuitry of the controller unit. The power supply shall provide the following voltages and minimum currents:

	DC VOLTAGES			
	+12	-12	+5	-5
Modem	150 mA	150 mA	----	----
Traffic Prom	600 mA	10 mA	500 mA	400 mA

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

2.10.4 The power supply shall be of ferro-resonant design having no active components. A regulating switching supply may be used in place of a ferro-resonant supply provided that a power supply and design drawings are submitted to The Traffic Management and Engineering Office for written approval prior to its use.

2.10.5 The Power Supply shall be so designed that no further filtering or regulation is required for supplied DC voltages.

2.11 CHASSIS

2.11.1 The controller unit shall be housed in a compact, portable metal enclosure suitably protected against corrosion. The enclosure shall be not more than 7" high, 14" deep including the male Connector Cl, and shall be mountable in a 19" rack. The enclosure shall be designed for convenient removal of printed circuit boards without the use of tools. The controller unit shall be designed to prevent water from collecting within the housing and damaging circuitry. The controller chassis shall be fabricated from min 1/16 inch aluminum. The controller front panel shall be fabricated from min 1/8 inch aluminum. The cabinet shall be complete with two handles attached to front panel, one each side, for ease of removal. The handle shall not protrude more than 1.25 inches from face of panel and shall be 4 inches minimum in length.

2.11.2 All circuit boards within the controller unit shall be mounted vertically. The operation of the controller unit shall not be disrupted by either frost or water condensing on the components within the controller housing.

2.11.3 It is the manufactures responsibility to provide suitable ventilation within the controller housing in order to allow the controller to operate properly within the temperature range specified in Chapter 1.

Should the controller be equipped with a fan, thermal overload protection for the fan shall be provided.

2.11.4 The weight of the controller unit shall not exceed 25 pounds.

2.11.5 Lateral spacing for the MODEM board shall be a minimum of one inch from any active component or shall have a grounded metal isolation shield between it and any adjacent components. The shield shall be grounded at the closest point to chassis ground.

2.12 DATA AND ADDRESS BUS REQUIREMENTS

2.12.1 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 nanoseconds.

2.12.2 All Address Bus Inputs shall be buffered and shall load the bus by not more than one TTL date load and 100 picofarads.

2.12.3 Address decoding on the CPU board shall be designed such that the Prom Module Board can respond to all address in the range Hex 0000 to Hex FFFF. Address Decoding for the memory ranges located on the Prom Module Board will be carried out on the Prom Module Boards.

2.12.4 At no time shall the address and data buffers leading to the Prom Module Board be disabled, thus preventing the Prom Module Board from responding to Addresses indicated in 9.3.

2.12.5 Address decoding for the memory ranges outline in Section 6 on the CPU and Prom Module Board shall be carried by means of PAL's, PLA's, FPAL's or FPLA's.

2.13 MISCELLANEOUS

2.13.1 A single pole/single throw momentary contact push button switch shall be easily accessible with the front panel open for the purpose of grounding the reset line of the microprocessor chip. The switch shall be of the miniature type rated for over one million operations. The voltage and current ratings for the switch shall be selected to satisfy the application in which the switch is used.

2.13.2 Power Failure/Restoration Hysteresis Separation shall be a minimum of 3 VAC with a threshold drift of no more than plus minus 0.2 volts.

2.13.3 The Controller Unit shall comply with the limits for a Type B computing device in accordance with the specifications in Subpart J of Part 15 of FCC Rules.

2.13.4 A serial number shall appear on all components purchased by the Ministry; serial numbers shall also appear on all removable printed circuit boards and modules included within the components purchased. The serial numbers for the components shall be the same as the serial numbers used for the modules and printed circuit boards. All serial numbers shall be etched or stamped or engraved on the components, modules and printed circuit boards supplied to the Ministry. The serial numbers shall be a minimum of 1/4" in height.

2.13.5 All printed circuit boards shall conform to the IPC-600 standard.

2.13.6 Unless otherwise specified, the Model 170 controller shall be supplied complete with the Traffic Prom Module Unit, Model 411.

3 INTERRUPT REQUIREMENTS

3.1 NON MASKABLE INTERRUPT (NMI)

3.1.1 A power failure shall cause the MPU NMI line to immediately go low. Controller Unit power shall be held up (DC Logic Voltages at normal operating levels) for a minimum of 50 ± 17 milliseconds beyond the NMI line going low.

3.1.2 The Controller Unit shall be furnished with a Restart Timer whose output state is normally high. Upon NMI line going low, the Restart Timer shall begin timing. The Restart Timer output shall go low when the timer reaches 1.75 ± 0.25 seconds and remain in low state for 50 ± 24 milliseconds after the RES line goes high. If power is restored prior to the time out point, the timer shall reset. The Restart Timer shall not require a battery for its operation.

3.2 RESET INTERRUPT (RES)

3.2.1 The RES line shall go low 3 ± 2 milliseconds following the NMI line going low.

3.2.2 The RES line shall remain low for 100 plus minus 25 milliseconds following power restoration.

3.3 INTERRUPT REQUEST (IRQ)

3.3.1 Real Time Clock (RTC) - The Controller Unit shall initiate an IRQ once every 1/60 of a second during the 0 to 150 degree portion of the negative attenuation of the AC sine wave. The RTC Request shall be reset only by writing to Address 5FFF.

3.3.2 An incoming signal via the Asynchronous Communications Interface Adapter (ACIA) shall initiate and IRQ.

3.4 SOFTWARE INTERRUPT (SWI)

3.4.1 A "Software Interrupt" shall be provided.

3.5 WAIT FOR INTERRUPT (WAI)

3.5.1 A "Wait for Interrupt" interrupt, shall be provided.

4 ELECTRICAL REQUIREMENTS

4.1 GENERAL

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

4.1.2 Metal oxide varistors (MOV) be provided between AC+ to AC- lines and between AC+ to chassis ground and between AC- to chassis ground for protection against power line noise transients. The three MOV's shall be capable of meeting the following requirements:

Recurrent peak voltage 212 volts
Energy rating maximum 20 joules
Power dissipation, average 0.85 watts
Peak current 2000 amperes for pulses less than 6 ms
Standby current less than 1 milliampere

4.1.2.1 Two one-ohm, 10 watt wire-wound power resistors shall be provided (one on the AC+ power line and one on the AC- line) for protection of the surge arrestors.

4.1.3 A test waveform shall be applied to all ungrounded I/O (input/output) lines of the controller unit, while the controller is operating the Ontario local program.

4.1.3.1 The I/O lines shall be tested in common-mode (with the test waveform applied between each I/O line and DC ground), and in differential mode (with the test waveform applied to all ungrounded I/O pairs).

4.1.3.2 The test waveform parameters shall be:

i) 300 volts amplitude, positive and negative polarity

ii) 1000 ohms nominal pulse source impedance

iii) 1 pulse per second repetition rate, for a minimum of 5 pulses

iv) 1 microsecond (ms) pulse rise time

v) 10 microseconds pulse width

4.1.3.3 The controller shall be considered to have passed the transient interference tests if:

i) the equipment is able to maintain all of its defined functions and the controller shall continue to cycle without malfunction, when the test waveform has occurred on the I/O lines.

ii) there is no damage to any part of the equipment as a result of having been exposed to the interference.

4.1.4 The AC power to the controller unit shall be supplied by a 3 conductor cable at least 3 feet in length. The cable shall terminate in a NEMA Type 5-15P grounding type plug.

4.1.5 Test points shall be provided for monitoring all power supply voltages. All test points shall be readily accessible when the front panel is opened and all p.c. boards are installed.

4.1.5.1 Test point shall be a binder post or approved equal.

5 CONNECTOR REQUIREMENTS

5.1 GENERAL

5.1.1 Controller Unit Connector physical requirements and contact assignments shall be as shown on the plans and as detailed in this section.

5.1.2 All logic connections into or out of the controller unit shall be made through a 104 socket connector (Connector C1S).

5.1.2.1 Contacts shall be beryllium copper construction, subplated with 0.00005 inch nickel and plated with 0.00003 inch gold. Sockets shall accept pin contacts 0.062 inch in diameter. The connector shall contain the socket contacts.

5.1.2.2 Corner guide pin assemblies for pin connectors shall be stainless steel and shall be 1.097 inches in length. Corner guide socket assemblies shall be stainless steel and shall be 0.625 inch in length.

5.1.2.3 The 104 socket connector (C1S) shall be recessed and mounted on the right rear panel of the chassis. C1S shall be AMP connector No. 205720-2 or equivalent.

5.1.2.4 The connector block shall have an insulation resistance of 5000 megohms. Contacts shall be secured in the blocks with stainless steel springs.

5.1.3 All MODEM and ACIA connections into and out of the controller unit shall be made through Connector C2 and Terminal Block Tl.

5.1.3.1 Terminal Block Tl shall be a one-position ten-pole terminal block. The terminal block shall be barrier type with 6/32 x 1/4 inch or longer, nickel plated brass binder head screws. Terminals shall be permanent identified as to their function.

5.1.3.2 Connector C2S shall be attached to the back plane of the controller unit and shall be a D type 25 pin female connector which allows a mating connector to be secured to the female connector by means of two jackscrews or jackposts without having to remove any parts to do so. The part number(s), manufacturer(s), supplier(s) of the mating connector(s) for the C2S-D-25 shall be supplied in the reference manual issued on the 170 controllers.

6 170 SYSTEM ADDRESSING

6.1 MEMORY MAP

6.1.1 The 170 memory shall be mapped in accordance with OTSCES Drawing 0210.03

6.1.2 All data written into the ram shall be the same polarity as the data output by the CPU. All data read by the CPU shall be the same polarity as the data output by the ram.

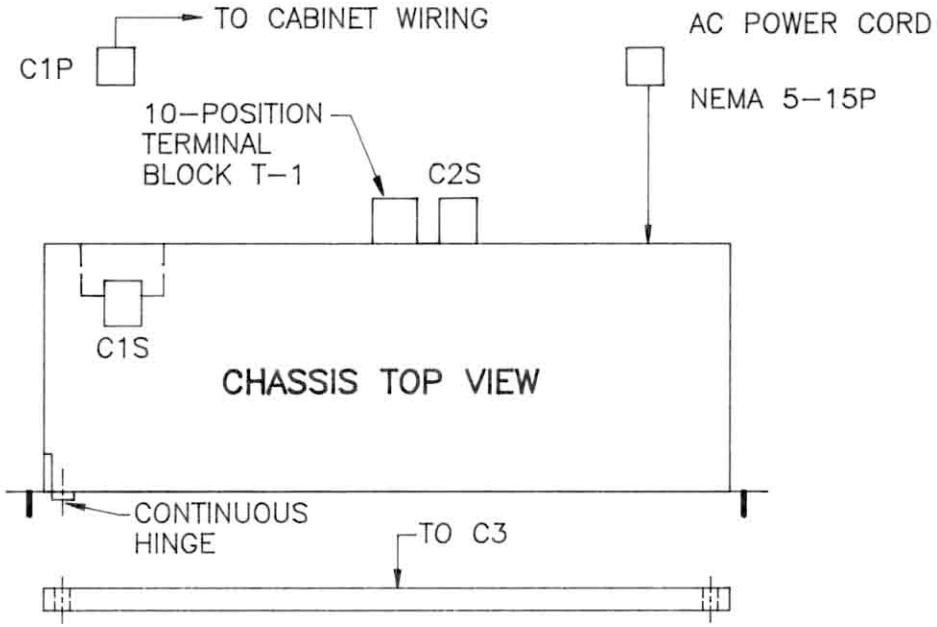
7 170F REQUIREMENTS

7.1 GENERAL

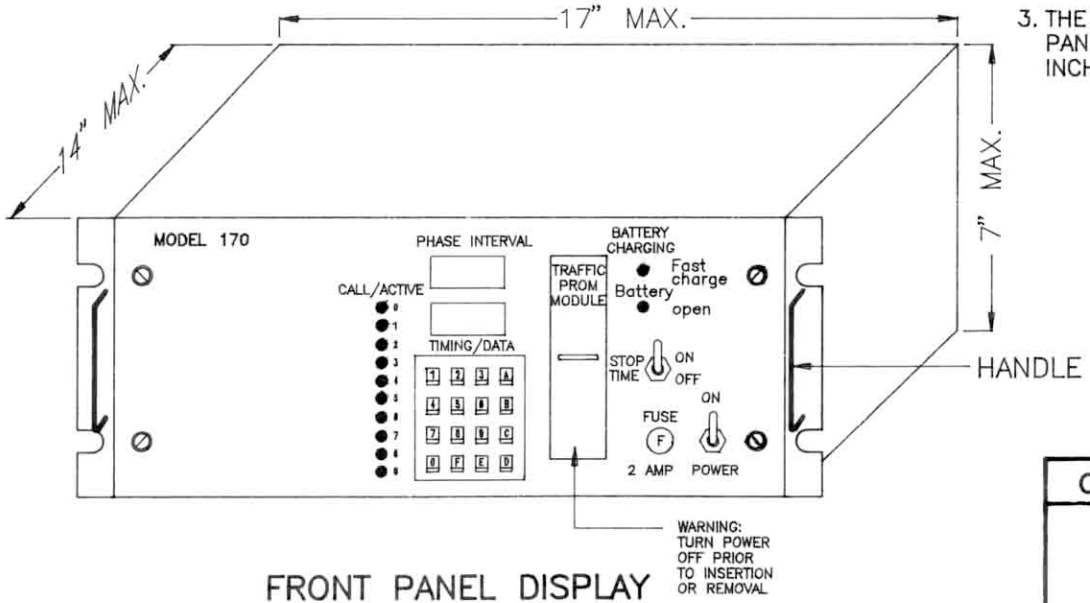
7.1.1 The Model 170F shall consist of a 170 controller unit complete with 20k of RAM memory. The Model 170F shall be shipped with a 411F Traffic Prom Module Board complete with seven blank 2732A EPROM chips as specified in Chapter 3.

7.1.2 The Controller unit shall be tested for proper operation of the Ontario 170 Step Diagnostics program software at both 1 MHz and 2 MHz operating speeds.

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FRONT PANEL TOP VIEW



FRONT PANEL DISPLAY

MODEL 170 CONTROLLER UNIT NOTES

1. THE TERMINAL BLOCK T1 SHALL BE BARRIER TYPE WITH 6–32x0.375 INCH NICKEL PLATED BRASS BINDER HEAD SCREWS. TERMINALS SHALL BE PERMANENTLY IDENTIFIED AS TO THEIR FUNCTION.

2. ALL LOGIC CONNECTIONS INTO OR OUT OF THE CONTROLLER UNIT SHALL BE MADE THROUGH 104–SOCKET CONNECTOR C1. THE CONNECTOR BLOCK SHALL HAVE AN INSULATION RESISTANCE OF 5000 MEGOHMS. CONTACTS SHALL BE SECURED IN THE BLOCKS WITH STAINLESS STEEL SPRINGS.

   (A.) CONTACTS SHALL BE BERYLLIUM COPPER CONSTRUCTION, SUBPLATED WITH 0.00005–INCH NICKEL AND PLATED WITH 0.00003–INCH GOLD. SOCKETS SHALL ACCEPT PIN CONTACTS 0.062–INCH IN DIAMETER. THE CONNECTOR SHALL CONTAIN THE SOCKET CONTACTS.

   (B.) CORNER GUIDE PIN ASSEMBLIES FOR PIN CONNECTORS SHALL BE STAINLESS STEEL AND SHALL BE 1.097 INCHES IN LENGTH. CORNER GUIDE SOCKET ASSEMBLIES SHALL BE STAINLESS STEEL AND SHALL BE 0.625 INCH IN LENGTH.

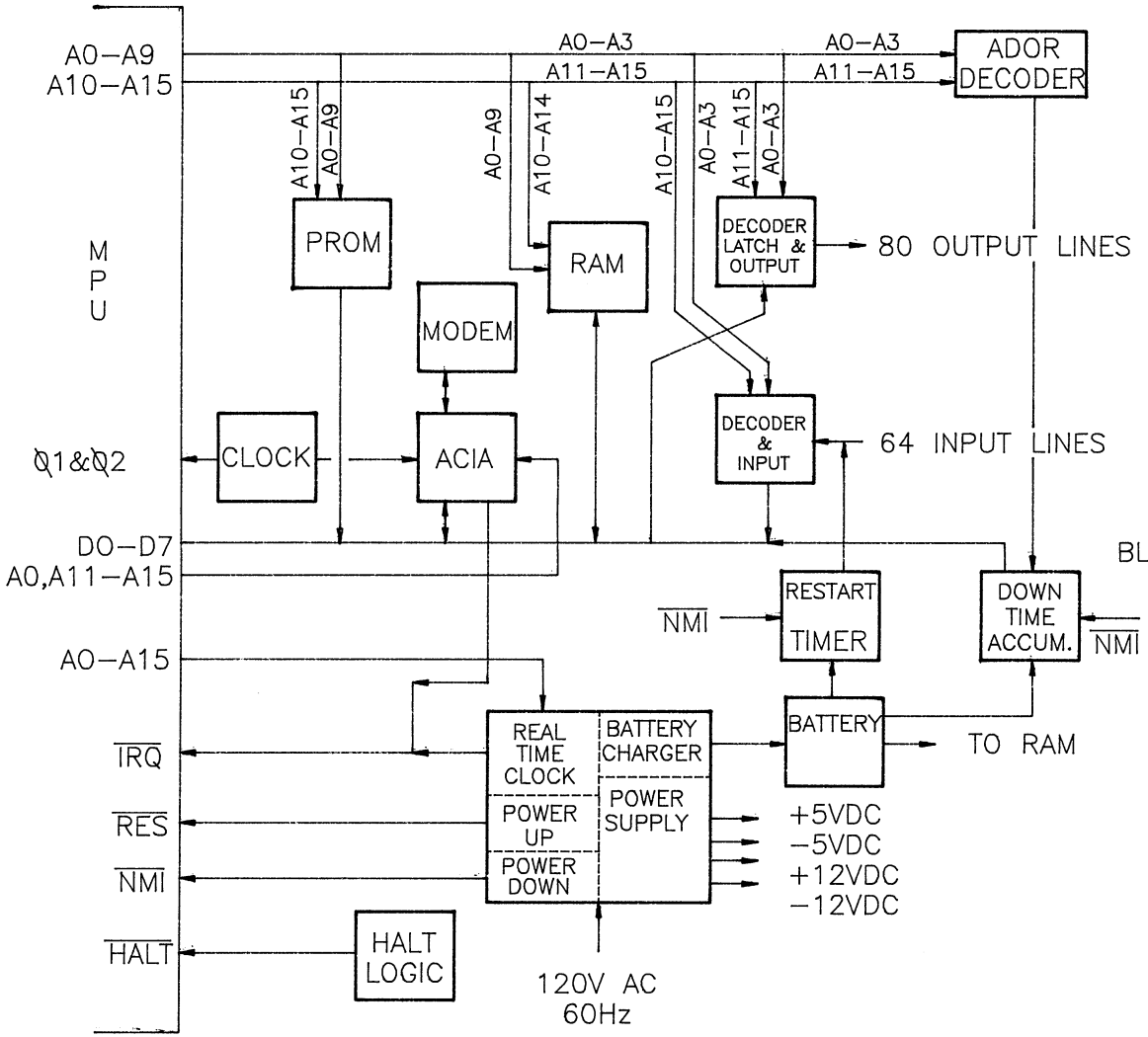
   (C.) CONNECTOR C1S SHALL BE RECESSED AND MOUNTED ON THE RIGHT REAR PANEL OF THE CHASSIS.

3. THE DIMENSIONS OF THE TRAFFIC PROM MODULE OPENING ON THE FRONT PANEL SHALL BE A MINIMUM OF 1.52 INCHES HORIZONTALLY AND 5.02 INCHES VERTICALLY TO PROVIDE MODULE CLEARANCE.

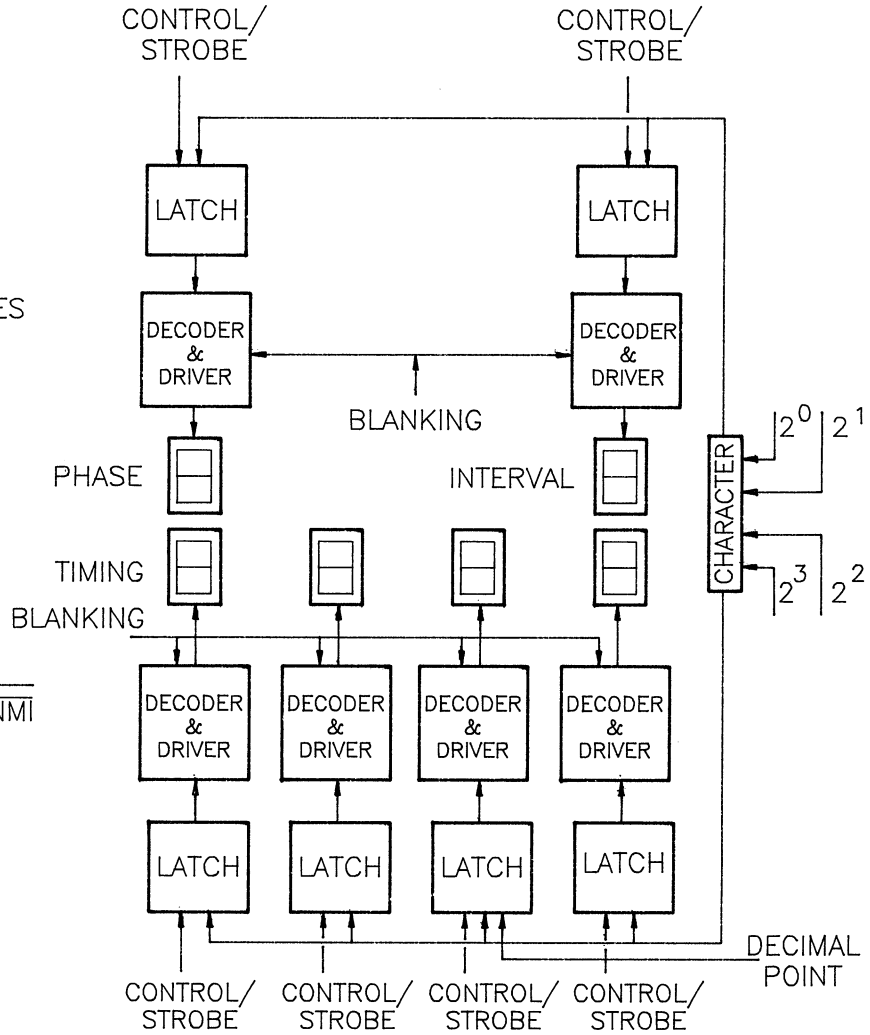
ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

170 CONTROLLER – OUTLINE

Date	92 06 01	Rev		OTSCES – 0210.01



ORGANIZATION OF MODEL 170
CONTROLLER UNIT
BLOCK DIAGRAM



FRONT PANEL DISPLAY
BLOCK DIAGRAM

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

170 CONTROLLER BLOCK DIAGRAM

Date	92 06 01	Rev		OTSCES – 0210.02

SYSTEM ADDRESSING

FUNCTION	ADDRESS RANGE	No. OF BYTES	MPU ADDRESS LINES A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
PROM	8000–FFFF	32K	1	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V
RESERVED	7000–7FFF	4K	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V
RAM	0000–4FFF	20K	0	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V
DTA (MINUTES)	5000	1	0	1	0	1	0	–	–	–	–	–	–	–	0	0	0	0
DTA (SECONDS)	500F	1	0	1	0	1	0	–	–	–	–	–	–	–	1	1	1	1
INPUT/ OUTPUT	5001–500A	10	0	1	0	1	0	–	–	–	–	–	–	–	V	V	V	V
REAL TIME CLOCK RESET	5FFF	1	0	1	0	1	1	–	–	–	–	–	–	–	1	1	1	1
ACIA (RDR & TDR)	6001	1	0	1	1	0	0	–	–	–	–	–	–	–	–	–	–	1
ACIA (SR & CR)	6000	1	0	1	1	0	0	–	–	–	–	–	–	–	–	–	–	0

V = VARIABLE
0 = GROUND
1 = + 5 VDC
– = DON'T CARE

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

170 CONTROLLER–MEMORY MAP

Date	90 06 01	Rev		OTSCES – 0210.03

CONNECTOR C1 AND CONNECTOR C3 CONTACT ASSIGNMENTS AND OUTPUT PORT ADDRESS ASSIGNMENTS

OUTPUT PORT ADDRESS	BIT	CONNECTOR C1 SOCKET CONTACTS	CONNECTOR C3	OUTPUT PORT ADDRESS	BIT	CONNECTOR C1 SOCKET CONTACTS	CONNECTOR C3
5001	1	2		5006	1	83	
5001	2	3		5006	2	84	
5001	3	4		5006	3	85	
5001	4	5		5006	4	86	
5001	5	6		5006	5	87	
5001	6	7		5006	6	88	
5001	7	8		5006	7	89	
5001	8	9		5006	8	90	
5002	1	10		5007	1	91	
5002	2	11		5007	2	93	
5002	3	12		5007	3	94	
5002	4	13		5007	4	95	
5002	5	15		5007	5	96	NC
5002	6	16		5007	6	97	NC
5002	7	17		5007	7	98	NC
5002	8	18		5007	8	99	NC
5003	1	19		5008	1		CC–PHASE
5003	2	20		5008	2		CC–INTERVAL
5003	3	21		5008	3		CC–TIMING LS
5003	4	22		5008	4		CC–TIMING NLS
5003	5	23		5008	5		CC–TIMING NMS
5003	6	24		5008	6		CC–TIMING MS
5003	7	25		5008	7		CALL LT8
5003	8	26		5008	8		CALL LT9
5004	1	27		5009	1		CH–LS
5004	2	28		5009	2		CH–NLS
5004	3	29		5009	3		CH–NMS
5004	4	30		5009	4		CH–MS
5004	5	31		5009	5		DP
5004	6	32		5009	6		BL–P&I
5004	7	33		5009	7		BL–TIMING
5004	8	34		5009	8		NC
5005	1	35		500A	1		CALL LT0
5005	2	36		500A	2		CALL LT1
5005	3	37		500A	3		CALL LT2
5005	4	38		500A	4		CALL LT3
5005	5	100		500A	5		CALL LT4
5005	6	101		500A	6		CALL LT5
5005	7	102		500A	7		CALL LT6
5005	8	103		500A	8		CALL LT7

DEFINITIONS

CC = CHARACTER CONTROL OR BLANKING.
CH = CHARACTER
BL = BLANKING
NC = TERMINATED AT CONNECTOR FOR FUTURE USE.
NLS = NEXT LEAST SIGNIFICANT
LS = LEAST SIGNIFICANT.
NMS = NEXT MOST SIGNIFICANT.
MS = MOST SIGNIFICANT.
DP = DECIMAL POINT.
P&I = PHASE AND INTERVAL

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

170 CONTROLLER OUTPUT PORT DATA

Date	92 06 01	Rev		OTSCES – 0210.04

CONNECTOR C1 AND CONNECTOR C3 CONTACT ASSIGNMENTS AND INPUT PORT ADDRESS ASSIGNMENTS

INPUT PORT ADDRESS	BIT	CONNECTOR C1 SOCKET CONTACTS	CONNECTOR C3 SOCKET CONTACTS	INPUT PORT ADDRESS	BIT	CONNECTOR C1 SOCKET CONTACTS	CONNECTOR C3 SOCKET CONTACTS	
5001	1	39		5005	1	67		
5001	2	40		5005	2	68		
5001	3	41		5005	3	69		
5001	4	42		5005	4	70		
5001	5	43		5005	5	71		
5001	6	44		5005	6	72		
5001	7	45		5005	7	73		
5001	8	46		5005	8	74		
5002	1	47			1	75		
5002	2	48		5006	2	76		
5002	3	49		5006	3	77		
5002	4	50		5006	4	78		
5002	5	51		5006	5	79		
5002	6	52		5006	6	80		
5002	7	53		5006	7	81		
5002	8	54		5006	8	82		
5003	1	55		5007	1			KEYBOARD CONTROL
5003	2	56		5007	2			KEYBOARD CH LS
5003	3	57		5007	3			KEYBOARD CH NLS
5003	4	58		5007	4			KEYBOARD CH NMS
5003	5	59		5007	5			KEYBOARD CH MS
5003	6	60		5007	6			STOP TIMING
5003	7	61		5007	7			NC
5003	8	62		5007	8			NC
5004	1 *1			5008	1			NC
5004	2 *2			5008	2			NC
5004	3 *3			5008	3			NC
5004	4 *4			5008	4			NC
5004	5		63	5008	5			NC
5004	6		64	5008	6			NC
5004	7		65	5008	7 *5			
5004	8		66	5008	8 *6			

DEFINITIONS

CH = CHARACTER
NC = TERMINATED AT CONNECTOR FOR FUTURE USE.
NLS = NEXT LEAST SIGNIFICANT
LS = LEAST SIGNIFICANT.
NMS = NEXT MOST SIGNIFICANT.
MS = MOST SIGNIFICANT.

* = ALSO GOES TO THE "PROM "MODULE MATING CONNECTOR PIN #51, "TEST COMPLETE".

*1 = GOES TO THE OUTPUT OF THE RESTART TIMER.
*2 = GOES TO THE "PROM" MODULE MATING CONNECTOR PIN #50, "NEXT TEST".
*3 = GOES TO THE "PROM" MODULE MATING CONNECTOR PIN #49, "REPEAT TEST".
*4 = GOES TO THE "PROM" MODULE MATING CONNECTOR PIN #52, "SKIP TEST".
*5 = GOES TO THE "PROM" MODULE MATING CONNECTOR PIN #55, SPARE.
*6 = GOES TO THE "PROM" MODULE MATING CONNECTOR PIN #54, SPARE.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

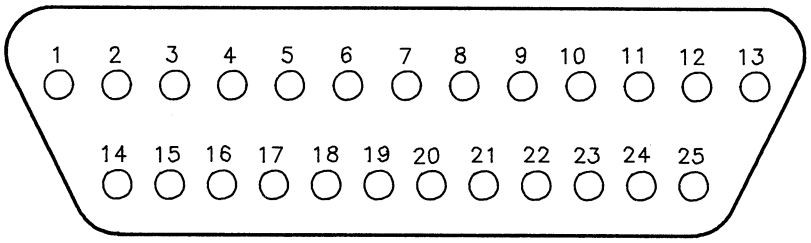
170 CONTROLLER INPUT PORT DATA

Date	92 06 01	Rev		OTSCES – 0210.05

CONNECTOR C2S – D – 25

THE 170 SHALL BE WIRED AS A D.T.E. DEVICE

RS – 232 COMMUNICATIONS
INPUT / OUTPUT PIN ASSIGNMENTS



RS – 232 FEMALE CONNECTOR

1. EQ GND (CHASSIS GND)
2. DATA IN (TRANSMITTED DATA)
3. DATA OUT (RECEIVED DATA)
4. RTS (REQUEST TO SEND)
5. CTS (CLEAR TO SEND)
6. NC
7. DC GND (SIGNAL GND)
8. CD RECEIVED SIGNAL DETECTOR
9. + 5 V
10. – 5 V
11. AUDIO IN
12. AUDIO IN
13. AUDIO OUT
14. AUDIO OUT
15. NC
16. NC
17. NC
18. NC
19. NC
20. NC
21. NC
22. NC
23. NC
24. NC
25. NC

TERMINAL BLOCK T1 ASSIGNMENT

1. AUDIO IN
2. AUDIO IN
3. CD
4. RTS
5. DATA IN
6. CTS
7. DATA OUT
8. AUDIO OUT
9. AUDIO OUT
10. DC GND

ONTARIO TRAFFIC SIGANAL CONTROL EQUIPMENT SPECIFICATIONS

170 CONTROLLER COMMUNICATION ASSIGNMENT

Date	92 06 01	Rev		OTSCES – 0210.06

CHAPTER 2

Specifications

For

Controller Unit

Model 170MC

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Date	OTSCES No.	Rev	Title
March 3, 1997	0220.02	-	170MC Controller - C1 & C3 Connector Address Assingment
March 3, 1997	0220.01	-	170MC Controller - C1 Connector detail
March 3, 1997	0220.02	-	170MC Controller - Block Diagram
March 3, 1997	0220.03	-	170MC Controller - Memory Map
March 3, 1997	0220.04	-	170MC Controller - Output Port Data
March 3, 1997	0220.05	-	170MC Controller - Input Port Data
March 3, 1997	0220.06	-	170MC Controller - Communication Assignment

1 GENERAL REQUIREMENTS

1.1 SCOPE

1.1.1 This chapter defines the general specifications applicable to Controller Unit Model 170MC.

1.1.2 These specifications shall supplement the General Specifications for Traffic Control Equipment and in case of conflict the specification of this Chapter will govern.

2 CONTROLLER REQUIREMENTS

2.1 MICROPROCESSOR UNIT

2.1.1 The controller unit shall properly execute existing Province owned object programs developed to operate with a Motorola 6800 Microprocessor Unit.

2.2 CONTROLLER UNIT CLOCK TIMING

2.2.1 CPU Clock Timing - The CPU clock circuitry shall be provided to generate the MPU clock timing. The clock circuitry and the MPU shall provide a selectable MPU machine cycle time of 1.302 (+/- 0.0015) us. The CPU clock circuitry shall be located no further than 2 inches form the MPU clock pin inputs.

2.3 INPUT-OUTPUT INTERFACE

2.3.1 The input-output interface shall utilize a ground true logic. The transfer of data between interface and working registers within the MPU shall be in 8-bit work increments, minimum. The steering of data from inputs or outputs for a given address shall be controlled by the state of the MPU read/write command at the time the given address is valid.

2.3.2 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 50 volts DC and sinking up to 100 milliamperes. The output driver shall be a ULN-2003A high-voltage, high-current Darlington transistor array (Sprague or equivalent). A logic state one from the MPU shall be presented as a grounded collector (0 to 2 volts), and a logic state zero 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.

2.3.3 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 volts, and shall be turned OFF (false) when the input current is less than 100 microamperes or the input voltage exceeds 8.5 volts, each input bit shall pull up to 12 Volts

DC, and shall not deliver in excess of 20 milliamperes to a short circuit to logic level common. A 100 kilo Ohm (minimum) series resistor shall be installed for all DC input lines. 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 "one" and an open on any input or the presence of a voltage greater than 8.5 volts shall be interpreted as a "zero" by the MPU when that input is read.

2.4 THE SYSTEM READ ACCESS TIME

2.4.1 With Model 412C Module resident in the Controller Unit, valid data shall be present at the MPU at least 100ns prior to the end of the machine cycle.

2.5 THE DIAGNOSTIC AND ACCEPTANCE TEST (DAT) PROGRAMS

2.5.1 The DAT-2.2 Program developed by Caltrans, shall be provided resident on the Model 412CProgram Module U1 memory device. See Configuration 1, Section 2.6.4.2

2.6 SYSTEM ADDRESS ORGANIZATION

2.6.1 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 ministry uses to directly reproduce the device.

2.7 ADDRESS ORGANIZATION

2.7.1 The general system address organization of the Model 170MC shall be as listed below. The internal module address organization shall be as specified in the appropriate module section.

FUNCTION	ADDRESS RANGE	COMMENTS
CPU SRAM	0000 - 07FF	
Reserved	0800 - 0FFF	
U4 Memory	1000 - 4FFF	412C
DTA Minutes	5000 - READ	5000 Write Reset DTA
INPUT/OUTPUT	5001 - 500A	5004 BIT 1 INPUT Assigned to RESTART Timer. 5009 & 500A READ Reserved.
Reserved	500B - 500E	
DTA Seconds	500F - READ	500F READ Reserved
Reserved	5010 - 5FFE	
REAL TIME Clock RESET	5FFF - WRITE	5FFF READ Reserved
ACIA	6000 - 6003	WRITE CR, READ SR WRITE TDR, READ RDR
Reserved	6004 - 6FFF	
Program Module - 412C		
Memory WRITE Protect	7000 - WRITE	
I.D. Feature	7000 - READ	
I.D. Location	7001 - READ	7001 WRITE Reserved
Reserved	7002 - 7009	
RTCA VALID/RESET	700A	
RTCA Counters 1 to 4	700B - 700E READ	700B-700E WRITE Reserved
U3 MEMORY	7010 - 7FFF	Function 700F Reserved
U1 & U2 Memory	8000 - FFFF	

Address locations noted as "Reserved" are assignable by MTO only and shall not be used.

2.7.2 Each memory device shall stabilized to normal operation within 10ms following Power Restoration and shall be in Standby until addressed. Each device shall have the following maximum power drain at +5VDC in its various states:

2.7.3

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

2.8 CPU MEMORY SOCKETS

The CPU memory sockets shall be AUGAT #5281828 Series AG10DPC or equivalent. Each socket number shall be permanently marked on the PCB adjacent to its pin. Should the "... or equivalent MPU" socket be used, it shall match the above specified socket features.

2.9 DOWNTIME ACCUMULATOR (DTA)

2.9.1 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.

2.9.2 A Downtime Accumulator shall be provided to accumulate time during power failures. Upon restoration of power, the DTA shall present two 8-bit data inputs indicating the number of minutes and seconds of power failure with an emergency of plus minus 1 second over the 255 minute range of the DTA. The DTA shall indicate all ones on the Minutes Register for power failures greater than 255 minutes. 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 reset the other registers to "0".

2.9.3 Total current drain for DTA and Restart Timer Circuitry (powerdown mode) shall no exceed 400 ua at 5 VDC, 35°C while timing and 100 ua at 5 VDC when timeout is latched.

2.10 RAM MEMORY

2.10.1 The RAM chip shall be socket mounted.

2.10.2 The SRAM Memory of 2048 eight-bit words shall be provided on the CPU.

2.10.3 The RAM shall retain full memory for a minimum of 30 days in the controller unit with AC power off.

2.11 CENTRAL PROCESSING UNIT (CPU)

2.11.1 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:

2.11.1.1 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.

2.11.1.2 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.

2.11.1.3 Interrupt Request (IRQ) - The IRQ Line shall be jointly used by the RTC and the Two ACIAs to initiate IRQ to the MPU.

2.11.1.4 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 OK from the Local Power Company (Hydro) - 120 VAC, 60 HZ. frequency. The RTC shall be reset by a WRITE to address 5FFF.

2.11.1.5 ACIA - 2 ACIAs 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).

2.11.1.6 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 LOW and remain in that state for 50 (± 24)ms aftertheRESline 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".

2.12 COMMUNICATION SYSTEM COMPONENTS

2.12.1 The components of the communication system required as part of the Model 170 Controller Unit include an asynchronous communications interface adapter (ACIA): space, power, mounting facilities, and a connector for installation of a Model 400 MODEM within the controller unit; and Connectors C2, C20 and Terminal Block Tl.

2.12.2 Connector C2S-D-25 shall be wired to appear as a D.T.E. to external devices as per EIA RS-232-C standard, see drawings.

NOTE: The signals DATA OUT, DATA IN, AUDIO IN, AUDIO OUT are referenced with respect to the model 400 modem; all other communication signals are referenced with respect to the serial chip on the 170 controller, see drawings.

2.12.3 The purpose of the communication system is to provide for bi-directional communications from a controller unit to another controller unit at a different location over standard 3002 voice grade telephone lines, or equivalent. The communication system shall be capable of both two wire, half-duplex operation and four wire, full-duplex operation.

2.12.4 The ACIA shall be capable of receiving and transmitting up to eight-bits of data from the MPU for serial data communications. The ACIA shall have four registers which may be addressed 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). The interface

between the ACIA and the Model 400 shall comply with EIA-RS-232-C standards. The TRS and TX Data Lines to the MODEM shall have MARK and SPACE Voltages of -12 and +12 VDC respectively.

2.12.5 The MPU shall be able to read the converted serial to parallel data on the RDR by addressing Locations 6001 and 6003.

2.12.6 The MPU shall be able to store data in the TDR for parallel to serial conversion by addressing Locations 6001 and 6003.

2.12.7 The SR shall be read by the MPU by addressing Locations 6000 and 6002. The SR shall comply with the following bit requirements:

STATUS REGISTER (SR)

8	7	6	5	4	3	2	1
IRQ	PE	ROV	PE	CTS	DCD	TDRE	RDRF

Bit 1 Receiver Data Register Full (RDRF)

"1" - The Receiver Data Register is full
"0" - The Receiver Data Register has been read by the MPU

Bit 2 Transmit Data Register Empty (TDRE)

"1" - The Transmit Data Register is empty and new data may be transferred
"0" - The Transmit Data Register is full

Bit 3 Data Carrier Detect (DCD)

"1" - There is no carrier from the MODEM
"0" - The carrier from the MODEM is present

Bit 4 Clear to Send (CTS)

"1" - MODEM is not ready for data
"0" - MODEM is ready for data

Bit 5 Framing Error (FE)

"1" - Framing Error indicates that the received character is improperly framed by the start and stop bit and indicates a synchronization error, faulty transmission, or a break condition
"0" - The received character is properly framed

Bit 6 Receiver Overrun (ROV)

"1" - Overrun is an error flag that indicates that one or more characters in the data stream were lost
"0" - No Receiver Data Overrun have occurred

Bit 7 Parity Error (PE)

"1" - The parity error flag indicates that the number of highs (ones) in the character does not agree with the presented odd or even parity
"0" - No parity error occurred

Bit 8 Interrupt Request (IRQ)

"1" - There is an interrupt in the ACIA
"0" - No interrupt present

2.12.8 Space for the MODEM shall be provided in the controller unit conforming to the details shown on the plans.

2.12.9 Card guides shall be provided for the MODEM board.

2.12.10 See "Electrical Requirements" of this Chapter for MODEM power requirements.

2.12.11 All electrical connections in and out of the MODEM module shall be through a printed circuit connector having 2-rows of 22 independent bifurcated contacts on 0.156-inch centers. Connector contact assignments shall be as shown on the plans.

2.12.12 The MPU shall write into the CR by addressing Locations 6000 and 6002. The CR shall comply with the following bit requirements:

CONTROL REGISTER (CR)

8	7	6	5	4	3	2	1
Receiver Interrupt	Transmitter Control		Word Select			Counter Divide	

The baud rate for the communication system in the controller shall be jumper selectable and the clock rate for each jumper position shall be clearly marked. The relationship between the jumper selected position to the Counter Divide Select Bits shall be as follows:

Bit 1 and 2 - Counter Divide Select Bits (CDS)

Jumper Position (Clock Rate)	Bit 1 = 0 Bit 2 = 1	Bit 1 = 1 Bit 2 = 0
38.4 KHZ	600	2400
19.2 KHZ	300	1200

Bit 3, 4, 5 - Word Select Bits (WS)

CR5	CR4	CR3	FUNCTION
0	0	0	7 Bit + EP + 2SB
0	0	1	7 Bit + OP + 2SB
0	1	0	7 Bit + EP + 1SB
0	1	1	7 Bit + OP + 1SB
1	0	0	8 Bit + 2SB
1	0	1	8 Bit + 1SB
1	1	0	8 Bit + EP + 1SB

1	1	1	8 Bit + OP + 1SB

Note: EP = Even Parity
OP = Odd Parity
SB = Stop Bits

Bits 6 and 7 - Transmitter Control (TC)

CR6	CR7	FUNCTION
0	0	RTS = Low Transmitting Interrupt Disabled (TIE)
1	0	RTS = Low Transmitting Enabled (TIE)
0	1	RTS = High Transmitting Interrupt Disabled(TIE)
1	1	RTS = Low Transmitting Interrupt Disabled (TIE) and transmits a Break level on the transmit data output

Bit 8 Receiver Interrupt Enable

"1" - Enables interrupts caused by:
a) Receiver Data Register Full going high
b) A low to high transition on the Data Carrier Detect signal line

"0" - Cleared by selecting the Receiver Data Register or by resetting the Receiver Interrupt Enable Bit.

2.13 STANDBY POWER

2.13.1 A Chassis Standby Battery shall be provided to power the Restart Timer, Downtime Accumulator, and to achieve nonvolatility in the RAM during power failure. The battery shall have sufficient capacity for a continuous backup requirement of 2 seconds for the Restart Timer, 255 minutes for the Downtime Accumulator Counting Circuits (Minutes Register shall be retained the same duration as RAM) and shall retain full RAM memory for a minimum of 30 days. Battery power shall be activated by a transfer circuit immediately upon sensing power failure. Battery float circuit is not acceptable.

2.13.2 The Chassis Standby battery shall be sealed, fast rechargeable, lead-acid gel-cell type or equivalent suitable for standby operation. It shall be securely installed inside the controller unit chassis. The total weight of the standby battery shall not exceed 3 pounds. The battery shall have a minimum capacity rating of 2.5 ampere-hours.

2.13.3 A battery charging circuit shall be provided which shall, under normal operating conditions, fully recharge within 24 hours and float the Chassis Standby Battery consistent with the battery manufacturer's recommendations. An indicator, located on the front panel, shall be illuminated when the battery charging current exceeds a present limit indicating that the Chassis Standby Battery is in a "High Charge Mode".

2.13.4 Means of disconnecting the battery from its load circuit shall be provided in the form of a cut off switch. The cut off switch shall be located so that it is easily accessible with the front door open. It shall not be required to insert hands or fingers within the controller housing in order to access the cut off switch.

2.14 FRONT PANEL

2.14.1 The front panel shall be securely fastened to the chassis and shall be removable without the use of 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.

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

2.14.3 The Front Panel Layout shall be as shown on the plans. The character displays shall be hexadecimal with circuits to accept, store and display 4-bit binary data. The characters shall be 0.40-inch high, minimum. Each character shall have a latch strobe input and a blanking input. The second character from the right (lower row) shall have a right 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.

2.14.4 The front panel shall be provided with 10 LED's (Light Emitting Diodes) as shown on the plans.

2.14.5 A keyboard shall be provided as shown on the plans. 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 one 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 functional character, shall have a minimum surface area of 0.075 square inches and shall be mounted on a minimum of 0.50-inch centres; shall have an actuation force between 50 and 100 grams and shall provide positive tactical indications of contact. Key contacts shall have a design life of over three million operations, shall be rated for the current and voltage levels used, and shall stabilize within five (5) milliseconds following contact opening. Use Digitran # KL-0037 or equivalent.

2.14.6 The front panel shall be provided with a toggle switch to enable the stop time function. The switch shall be of the heavy-duty miniature type rated for over one million operations. The voltage and current ratings for the switch shall be selected to satisfy the application in which the switch is used.

2.14.7 The front panel shall be provided with an ON-OFF toggle switch and fuse for AC power. The switch shall be rated for over one million operations. The voltage and current ratings for the switch shall be selected to satisfy the application in which the switch is used.

2.14.8 Toggle switches referred to in Sections 2.9.6 and 2.9.7 shall be easily accessible from the front without the front panel door being opened. The toggle switches shall not be mounted on the front panel door.

2.14.9 The front panel shall provide an opening for the insertion and removal of the PROM module.

2.15 POWER SUPPLY

2.15.1 All DC power necessary to operate the controller unit shall be developed from within the unit. The maximum DC voltage generated shall not exceed 45 volts. All DC power supplies shall be held up for at least twice the time required to recognize power failure.

2.15.2 Four internal DC voltages, in addition to any other required voltages, shall be supplied to operate all internal circuitry of the controller unit. The power supply shall provide the following voltages and minimum currents:

	DC VOLTAGES			
	+12	-12	+5	-5
Modem	150 mA	150 mA	----	----
Traffic Prom	600 mA	10 mA	500 mA	400 mA

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

2.15.4 The power supply shall be of ferro-resonant design having no active components. A regulating switching supply may be used in place of a ferro-resonant supply provided that a power supply and design drawings are submitted to The Traffic Management and Engineering Office for written approval prior to its use.

2.15.5 The Power Supply shall be so designed that no further filtering or regulation is required for supplied DC voltages.

2.16 CHASSIS

2.16.1 The controller unit shall be housed in a compact, portable metal enclosure suitably protected against corrosion. The enclosure shall be not more than 7" high, 14" deep including the male Connector C1, and shall be mountable in a 19" rack. The enclosure shall be designed for convenient removal of printed circuit boards without the use of tools. The controller unit shall be designed to prevent water from collecting within the housing and damaging circuitry. The controller chassis shall be fabricated from min 1/16 inch aluminum. The controller front panel shall be fabricated from min 1/8 inch aluminum. The cabinet shall be complete with two handles attached to front panel, one each side, for ease of removal. The handle shall not protrude more than 1.25 inches from face of panel and shall be 4 inches minimum in length.

2.16.2 All circuit boards within the controller unit shall be mounted vertically. The operation of the controller unit shall not be disrupted by either frost or water condensing on the components within the controller housing.

2.16.3 It is the manufactures responsibility to provide suitable ventilation within the controller housing in order to allow the controller to operate properly within the temperature range specified in Chapter 1.

Should the controller be equipped with a fan, thermal overload protection for the fan shall be provided.

2.16.4 The weight of the controller unit shall not exceed 25 pounds.

2.16.5 Lateral spacing for the MODEM board shall be a minimum of one inch from any active component or shall have a grounded metal isolation shield between it and any adjacent components. The shield shall be grounded at the closest point to chassis ground.

2.17 DATA AND ADDRESS BUS REQUIREMENTS

2.17.1 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 nanoseconds.

2.17.2 All Address Bus Inputs shall be buffered and shall load the bus by not more than one TTL date load and 100 picofarads.

2.17.3 Address decoding on the CPU board shall be designed such that the Prom Module Board can respond to all address in the range Hex 0000 to Hex FFFF. Address Decoding for the memory ranges located on the Prom Module Board will be carried out on the Prom Module Boards.

2.17.4 Address decoding for the memory ranges outline in Section 6 on the CPU and Prom Module Board shall be carried by means of PAL's, PLA's, FPAL's or FPLA's.

2.18 MISCELLANEOUS

2.18.1 A single pole/single throw momentary contact push button switch shall be easily accessible with the front panel open for the purpose of grounding the reset line of the microprocessor chip. The switch shall be of the miniature type rated for over one million operations. The voltage and current ratings for the switch shall be selected to satisfy the application in which the switch is used.

2.18.2 Power Failure/Restoration Hysteresis Separation shall be a minimum of 3 VAC with a threshold drift of no more than ± 0.2 volts.

2.18.3 The Controller Unit shall comply with the limits for a Type B computing device in accordance with the specifications in Subpart J of Part 15 of FCC Rules.

2.18.4 A serial number shall appear on all components purchased by the Ministry; serial numbers shall also appear on all removable printed circuit boards and modules included within the components purchased. The serial numbers for the components shall be the same as the serial numbers used for the modules and printed circuit boards. All serial numbers shall be etched or stamped or engraved on the components, modules and printed circuit boards supplied to the Ministry. The serial numbers shall be a minimum of 1/4" in height.

2.18.5 All printed circuit boards shall conform to the IPC-600 standard.

2.18.6 Unless otherwise specified, the Model 170MC Controller shall be supplied complete with the Traffic Prom Module Unit, Model 412C.

3 INTERRUPT REQUIREMENTS

3.1 NON MASKABLE INTERRUPT (NMI)

3.1.1 A power failure shall cause the MPU NMI line to immediately go low. Controller Unit power shall be held up (DC Logic Voltages at normal operating levels) for a minimum of 50 ± 17 milliseconds beyond the NMI line going low.

3.1.2 The Controller Unit shall be furnished with a Restart Timer whose output state is normally high. Upon NMI line going low, the Restart Timer shall begin timing. The Restart Timer output shall go low when the timer reaches 1.75 ± 0.25 seconds and remain in low state for 50 ± 24 milliseconds after the RES line goes high. If power is restored prior to the time out point, the timer shall reset. The Restart Timer shall not require a battery for its operation.

3.2 RESET INTERRUPT (RES)

3.2.1 The RES line shall go low 3 ± 2 milliseconds following the NMI line going low.

3.2.2 The RES line shall remain low for 100 ± 25 milliseconds following power restoration.

3.3 INTERRUPT REQUEST (IRQ)

3.3.1 Real Time Clock (RTC) - The Controller Unit shall initiate an IRQ once every 1/60 of a second during the 0 to 150 degree portion of the negative attenuation of the AC sine wave. The RTC Request shall be reset only by writing to Address 5FFF.

3.3.2 An incoming signal via the Asynchronous Communications Interface Adapter (ACIA) shall initiate and IRQ.

3.4 SOFTWARE INTERRUPT (SWI)

3.4.1 A "Software Interrupt" shall be provided.

3.5 WAIT FOR INTERRUPT (WAI)

3.5.1 A "Wait for Interrupt" interrupt, shall be provided.

4 ELECTRICAL REQUIREMENTS

4.1 GENERAL

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

4.1.2 Metal oxide varistors (MOV) be provided between AC+ to AC- lines and between AC+ to chassis ground and between AC- to chassis ground for protection against power line noise transients. The three MOV's shall be capable of meeting the following requirements:

Recurrent peak voltage 212 volts
Energy rating maximum 20 joules
Power dissipation, average 0.85 watts
Peak current 2000 amperes for pulses less than 6 ms
Standby current less than l milliampere

4.1.2.1 Two one-ohm, 10 watt wire-wound power resistors shall be provided (one on the AC+ power line and one on the AC- line) for protection of the surge arrestors.

4.1.3 A test waveform shall be applied to all ungrounded I/O (input/output) lines of the controller unit, while the controller is operating the Ontario local program.

4.1.3.1 The I/O lines shall be tested in common-mode (with the test waveform applied between each I/O line and DC ground), and in differential mode (with the test waveform applied to all ungrounded I/O pairs).

4.1.3.2 The test waveform parameters shall be:

i) 300 volts amplitude, positive and negative polarity

ii) 1000 ohms nominal pulse source impedance

iii) 1 pulse per second repetition rate, for a minimum of 5 pulses

iv) 1 microsecond (ms) pulse rise time

v) 10 microseconds pulse width

4.1.3.3 The controller shall be considered to have passed the transient interference tests if:

i) the equipment is able to maintain all of its defined functions and the controller shall continue to cycle without malfunction, when the test waveform has occurred on the I/O lines.

ii) there is no damage to any part of the equipment as a result of having been exposed to the interference.

4.1.4 The AC power to the controller unit shall be supplied by a 3 conductor cable at least 3 feet in length. The cable shall terminate in a NEMA Type 5-15P grounding type plug.

4.1.5 Test points shall be provided for monitoring all power supply voltages. All test points shall be readily accessible when the front panel is opened and all p.c. boards are installed.

4.1.5.1 Test point shall be a horinzontal test jack.

5 CONNECTOR REQUIREMENTS

5.1 GENERAL

5.1.1 Controller Unit Connector physical requirements and contact assignments shall be as shown on the plans and as detailed in this section.

5.1.2 All logic connections into or out of the controller unit shall be made through a 104 socket connector (Connector C1S).

5.1.2.1 Contacts shall be beryllium copper construction, subplated with 0.00005 inch nickel and plated with 0.00003 inch gold. Sockets shall accept pin contacts 0.062 inch in diameter. The connector shall contain the socket contacts.

5.1.2.2 Corner guide pin assemblies for pin connectors shall be stainless steel and shall be 1.097 inches in length. Corner guide socket assemblies shall be stainless steel and shall be 0.625 inch in length.

5.1.2.3 The 104 socket connector (C1S) shall be recessed and mounted on the right rear panel of the chassis. C1S shall be AMP connector No. 205720-2 or equivalent.

5.1.2.4 The connector block shall have an insulation resistance of 5000 megohms. Contacts shall be secured in the blocks with stainless steel springs.

5.1.3 All MODEM and ACIA connections into and out of the controller unit shall be made through Connectors C2, C20 and Terminal Block Tl.

5.1.3.1 Terminal Block Tl shall be a one-position ten-pole terminal block. The terminal block shall be barrier type with 6/32 x 1/4 inch or longer, nickel plated brass binder head screws. Terminals shall be permanent identified as to their function.

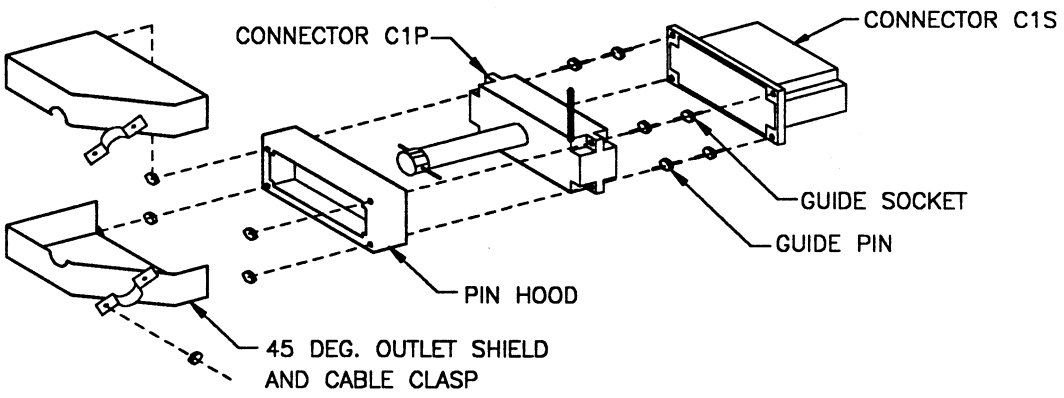
5.1.3.2 Connector C2S and C20S shall be attached to the back plane of the controller unit and shall be a D type 25 pin female connector which allows a mating connector to be secured to the female connector by means of two jackscrews or jackposts without having to remove any parts to do so. The part number(s), manufacturer(s), supplier(s) of the mating connector(s) for the C2S-D-25 shall be supplied in the reference manual issued on the 170 controllers.

6 170 SYSTEM ADDRESSING

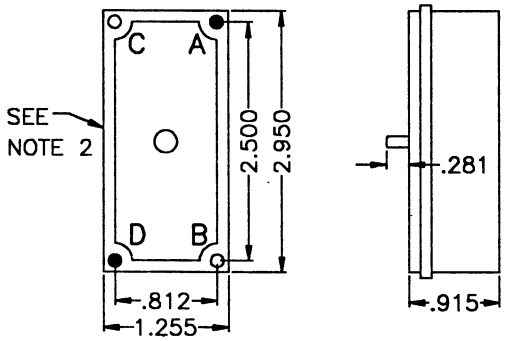
6.1 MEMORY MAP

6.1.1 The 170MC memory shall be mapped in accordance with OTSCES Drawing 0220.02

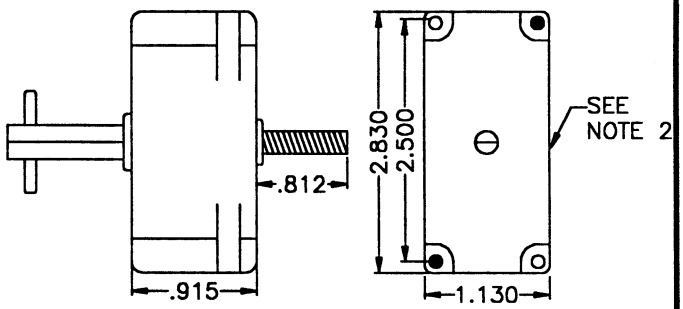
6.1.2 All data written into the ram shall be the same polarity as the data output by the CPU. All data read by the CPU shall be the same polarity as the data output by the ram.



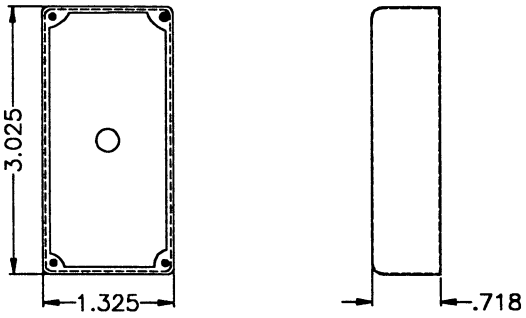
CONNECTOR C1 DETAIL



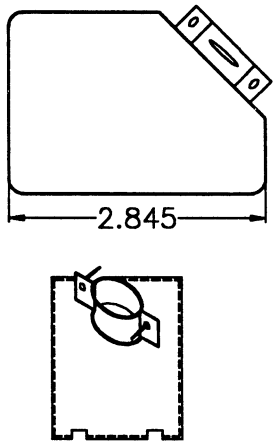
CONNECTOR C1S



CONNECTOR C1P



HOOD FOR C1P



SHIELD FOR C1P

NOTES:

1 PROVIDE CLEARANCE FOR CP1 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.
A ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SHOWN.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

C1 CONNECTOR DETAIL

Date:	97 03 01	Rev		OTSCES – 0220.01

OUTPUT PORT ADDRESS ASSIGNMENTS FOR CONNECTORS C1 AND C3

OUTPUT PORT ADDRESS	CONNECTOR BIT	C1 SOCKET CONTACTS	OUTPUT PORT ADDRESS	CONNECTOR BIT	C1 SOCKET CONTACTS	C3
5001	1	2	5006	1	83	
5001	2	3	5006	2	84	
5001	3	4	5006	3	85	
5001	4	5	5006	4	86	
5001	5	6	5006	5	87	
5001	6	7	5006	6	88	
5001	7	8	5006	7	89	
5001	8	9	5006	8	90	
5002	1	10	5007	1	91	
5002	2	11	5007	2	93	
5002	3	12	5007	3	94	
5002	4	13	5007	4	95	
5002	5	15	5007	5	96	
5002	6	16	5007	6	97	
5002	7	17	5007	7	98	
5002	8	18	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 NMS
5003	6	24	5008	6		CC-TIMING MS
5003	7	25	5008	7		CALL LT8
5003	8	26	5008	8		CALL LT9
5004	1	27	5009	1		CH-LS
5004	2	28	5009	2		CH-NLS
5004	3	29	5009	3		CH-NMS
5004	4	30	5009	4		CH-MS
5004	5	31	5009	5		DP
5004	6	32	5009	6		BL-P&1
5004	7	33	5009	7		BL-TIMING
5004	8	34	5009	8		NA
5005	1	35	500A	1		CALL LT0
5005	2	36	500A	2		CALL LT1
5005	3	37	500A	3		CALL LT2
5005	4	38	500A	4		CALL LT3
5005	5	100	500A	5		CALL LT4
5005	6	101	500A	6		CALL LT5
5005	7	102	500A	7		CALL LT6
5005	8	103	500A	8		CALL LT7

INPUT PORT ADDRESS ASSIGNMENTS FOR CONNECTORS C1 AND C3

OUTPUT PORT ADDRESS	CONNECTOR BIT	C1 SOCKET CONTACTS	C3	OUTPUT PORT ADDRESS	CONNECTOR BIT	C1 SOCKET CONTACTS	C3
5001	1	39		5005	1	67	
5001	2	40		5005	2	68	
5001	3	41		5005	3	69	
5001	4	42		5005	4	70	
5001	5	43		5005	5	71	
5001	6	44		5005	6	72	
5001	7	45		5005	7	73	
5001	8	46		5005	8	74	
5002	1	47		5006	1	75	
5002	2	48		5006	2	76	
5002	3	49		5006	3	77	
5002	4	50		5006	4	78	
5002	5	51		5006	5	79	
5002	6	52		5006	6	80	
5002	7	53		5006	7	81	
5002	8	54		5006	8	82	
5003	1	55		5007	1		KEYBOARD CONTROL
5003	2	56		5007	2		KEYBOARD CH LS
5003	3	57		5007	3		KEYBOARD CH NLS
5003	4	58		5007	4		KEYBOARD CH NMS
5003	5	59		5007	5		KYEBOARD CH MS
5003	6	60		5007	6		STOP TIMING
5003	7	61		5007	7		NA
5003	8	62		5007	8		NA
5004	1	55		5008	1		NA
5004	2	56		5008	2		NA
5004	3	57		5008	3		NA
5004	4	58		5008	4		NA
5004	5	59		5008	5		NA
5004	6	60		5008	6		NA
5004	7	61		5008	7		NA
5004	8	62		5008	8		NA

NOTE:

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

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

C1 AND C3 CONNECTOR ADDRESS ASSIGNMENTS

Date:	97 03 01	Rev		OTSCES – 0220.02

MC1 CONNECTOR PIN ASSIGNMENTS *

PIN	FUNCTION	PIN	FUNCTION
2	MODEM 1 AUDIO IN	A	DC GND
3	MODEM 1 AUDIO IN	B	DC GND
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

BACKPLANE COMMUNICATIONS CONNECTIONS *

T1 (ACIA1/MODEM1)	
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
11	MODEM 1 AUDIO IN
12	MODEM 1 AUDIO IN
13	MODEM 1 AUDIO OUT
9	+5 VDC
14	MODEM 1 AUDIO OUT
10	−5 VDC
8	ACIA 1 DCD**
4	ACIA 1 RTS**
3	ACIA 1 TXD**
2	ACIA 1 RXD**
5	ACIA 1 CTS**
4	DC GND
6	+12 VDC
15−25	−12 VDC
1	EQUIPMENT GROUND

C20S	
PIN	FUNCTION
11	MODEM 2 AUDIO IN
12	MODEM 2 AUDIO IN
13	MODEM 2 AUDIO OUT
9	+5 VDC
14	MODEM 2 AUDIO OUT
10	−5 VDC
8	ACIA 2 DCD**
4	ACIA 2 RTS**
3	ACIA 2 TXD**
2	ACIA 2 RXD**
5	ACIA 2 CTS**
4	DC GND
6	+12 VDC
15−25	−12 VDC
1	EQUIPMENT GROUND

DEFINITIONS
TXD TRANSMIT DATA LINE
RXD RECIVE DATA LINE

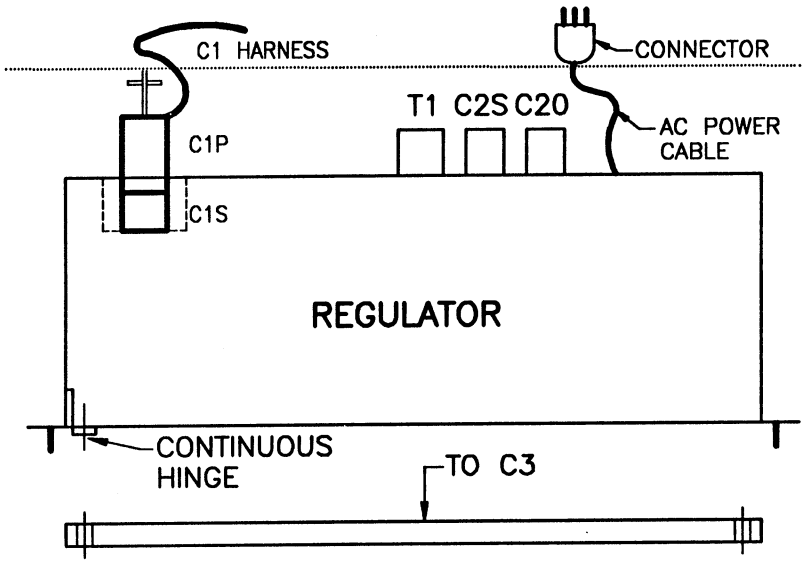
ACIA 1−C2S/MODEM #1
ACIA 2−C20S/MODEM #2

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

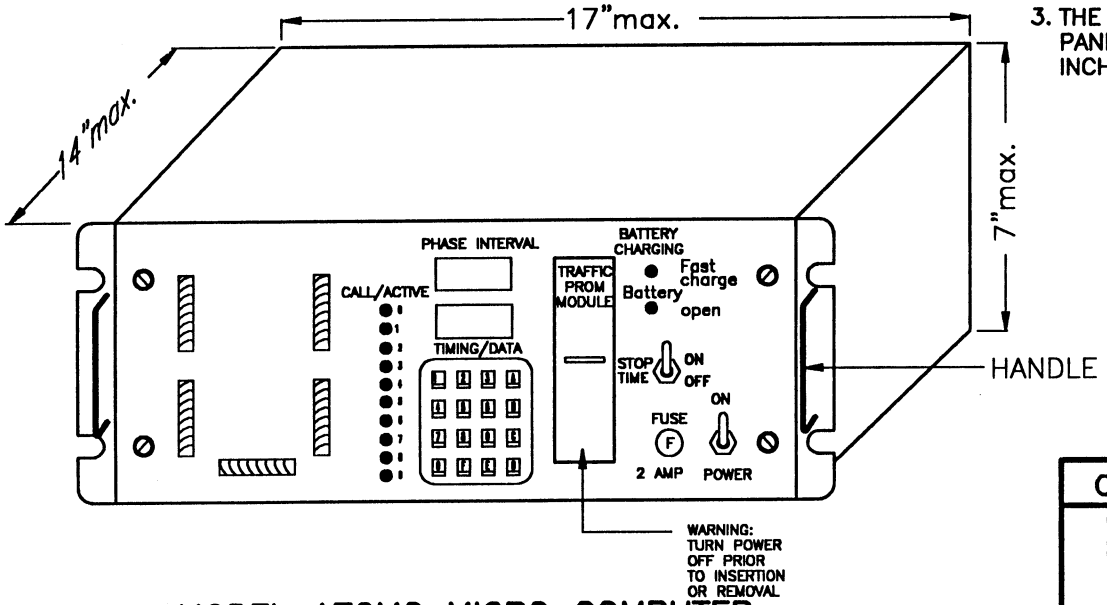
ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

MC1 AND BACKPLANE COMMUNICATION CONNECTION

Date:	97 03 01	Rev		OTSCES − 0220.03



FRONT PANEL TOP VIEW



MODEL 170MC MICRO COMPUTER
FRONT PANEL DISPLAY

MODEL 170MC CONTROLLER UNIT NOTES

1. THE TERMINAL BLOCK T1 SHALL BE BARRIER TYPE WITH 6–32x0.375 INCH NICKEL PLATED BRASS BINDER HEAD SCREWS. TERMINALS SHALL BE PERMANENTLY IDENTIFIED AS TO THEIR FUNCTION.

2. ALL LOGIC CONNECTIONS INTO OR OUT OF THE CONTROLLER UNIT SHALL BE MADE THROUGH 104–SOCKET CONNECTOR C1. THE CONNECTOR BLOCK SHALL HAVE AN INSULATION RESISTANCE OF 5000 MEGOHMS. CONTACTS SHALL BE SECURED IN THE BLOCKS WITH STAINLESS STEEL SPRINGS.

   (A.) CONTACTS SHALL BE BERYLLIUM COPPER CONSTRUCTION, SUBPLATED WITH 0.00005–INCH NICKEL AND PLATED WITH 0.00003–INCH GOLD. SOCKETS SHALL ACCEPT PIN CONTACTS 0.062–INCH IN DIAMETER. THE CONNECTOR SHALL CONTAIN THE SOCKET CONTACTS.

   (B.) CORNER GUIDE PIN ASSEMBLIES FOR PIN CONNECTORS SHALL BE STAINLESS STEEL AND SHALL BE 1.097 INCHES IN LENGTH. CORNER GUIDE SOCKET ASSEMBLIES SHALL BE STAINLESS STEEL AND SHALL BE 0.625 INCH IN LENGTH.

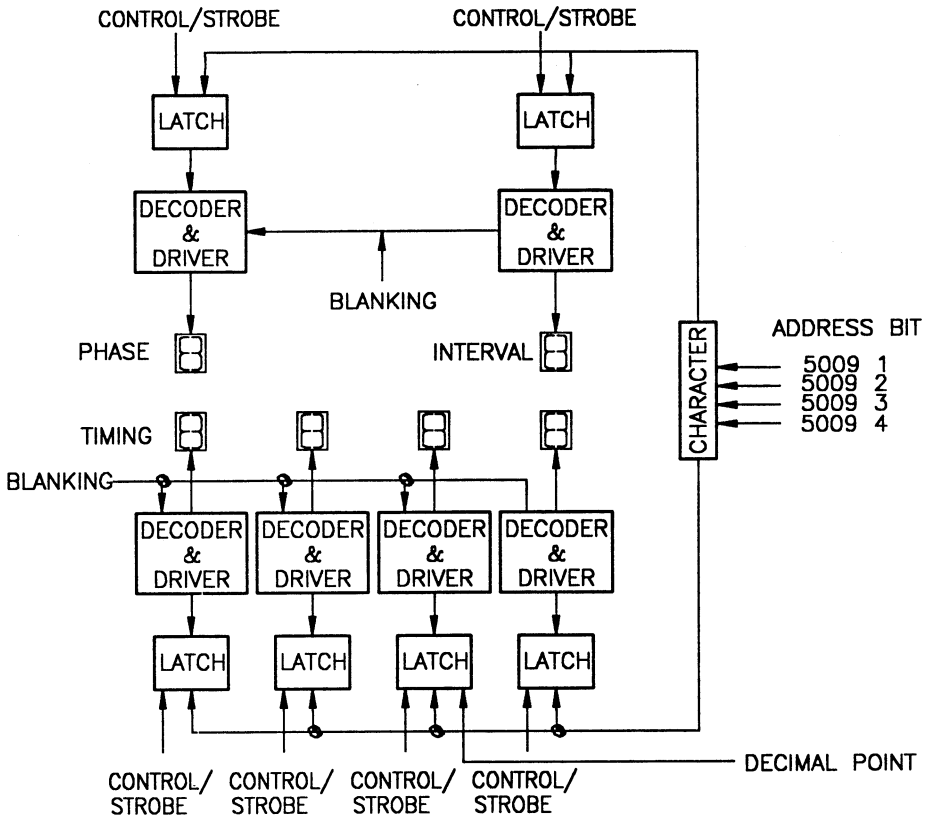
   (C.) CONNECTOR C1S SHALL BE RECESSED AND MOUNTED ON THE RIGHT REAR PANEL OF THE CHASSIS.

3. THE DIMENSIONS OF THE TRAFFIC PROM MODULE OPENING ON THE FRONT PANEL SHALL BE A MINIMUM OF 1.52 INCHES HORIZONTALLY AND 5.02 INCHES VERTICALLY TO PROVIDE MODULE CLEARANCE.

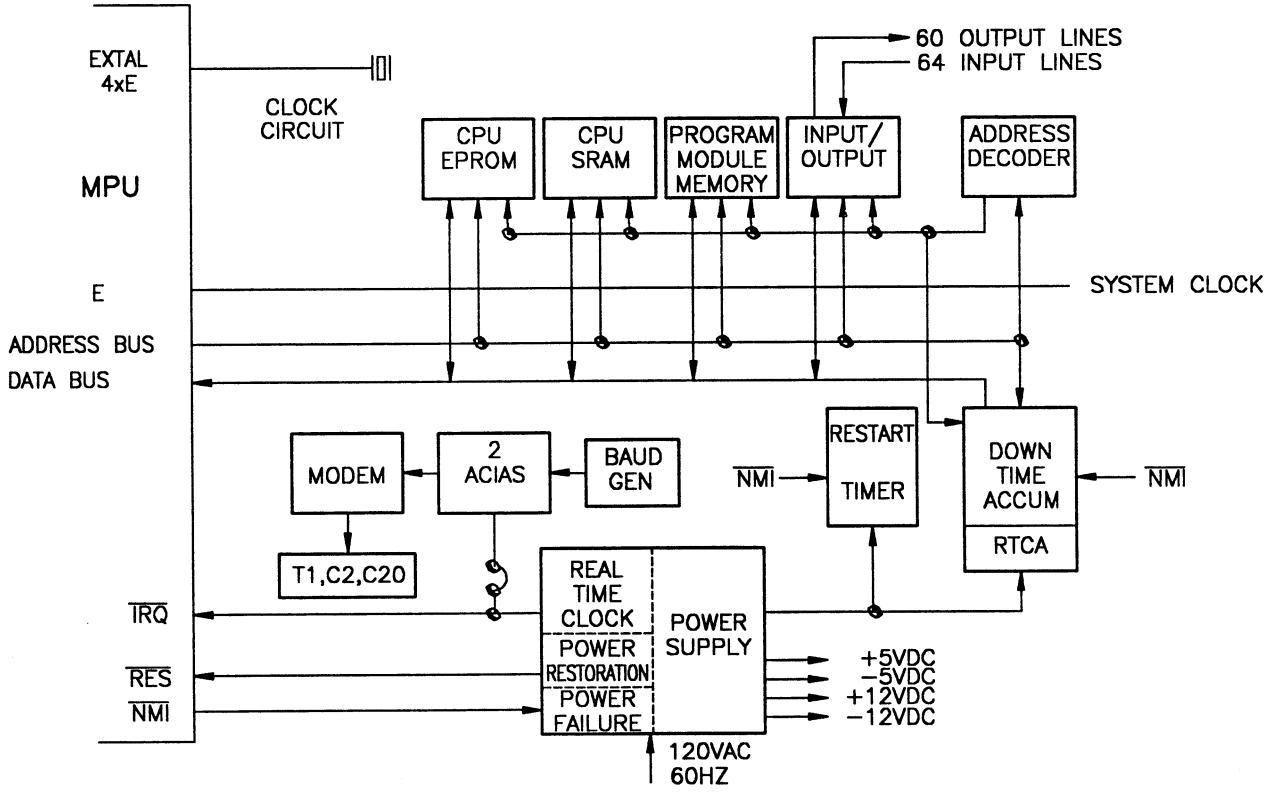
ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

MODEL 170 MC CONTROLLER UNIT DIAGRAM

Date	97 03 01	Rev		OTSCES – 0220.04



FRONT PANEL DISPLAY BLOCK DIAGRAM



ORGANIZATION OF MODEL 170MC CONTROLLER UNIT BLOCK DIAGRAM

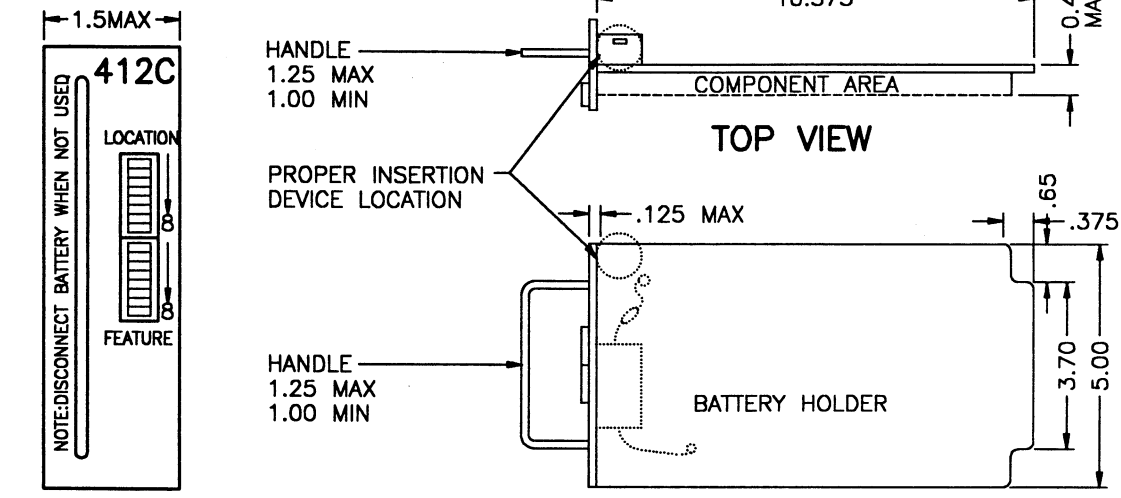
NOTE:

A ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SHOWN.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

MODEL 170MC CONTROLLER UNIT BLOCK DIAGRAMS

Date:	97 03 01	Rev		OTSCES – 0220.05



170MC AND 412C
PROGRAM MODULE CONNECTOR ASSIGNMENTS

CIRCUIT SIDE		COMPONENT SIDE	
FUNCTION	PCB CONNECTOR	NUMBER	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/O2(E)	25	26	NA
READ/WRITE	27	28	NA
NA	29	30	NA
NA	31	32	NA
NA	33	34	EQUIP GND
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	62	−12VDC
			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	GND

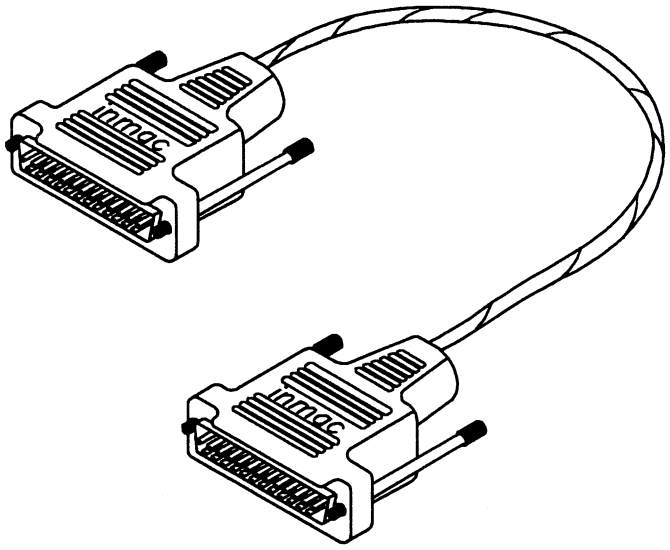
NOTE:

A ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SHOWN.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

MODEL 412C PROGRAM MODULE
AND CONNECTORS M170 AND 170MC

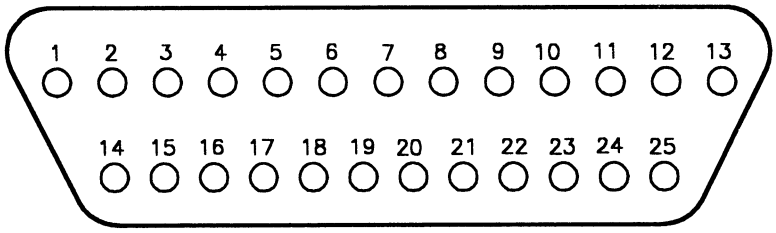
Date:	97 03 01	Rev		OTSCES – 0230.01



170MC (MASTER) C2	SIGNAL NAME	170MC (LOCAL) C2
3	TD	2
2	RD	3
4	RTS	4
5	CTS	5
7	GND	7
8		8
9		9

C2P MODEM INTERCONNECT HARNESS (MASTER TO LOCAL)

THE 170MC SHALL BE WIRED AS A D.T.E. DEVICE
RS – 232 COMMUNICATIONS
INPUT/OUTPUT PIN ASSIGNMENTS



CONNECTOR C2S – (D25)
'X' DENOTES CONNECTOR NUMBER

NOTE:

A ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SHOWN.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

C1,C20 CONNECTOR DETAIL

Date:	97 03 01	Rev		OTSCES – 0230.02

CHAPTER 3

Specifications

For

Traffic Prom Module Units

Model 411 & 411F

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List of Drawings

Date	OTSCES No.	Rev	Title
June 1, 1992	0310.01	-	411 Prom Module - Outline
June 1, 1992	0310.02	-	411 Prom Module - Connector Assignment
June 1, 1992	0320.01	-	Prom Module Board DIP-Switch Adapter

1 GENERAL REQUIREMENTS

1.1 SCOPE

1.1.1 This chapter defines the specifications applicable to the Model 411 and Model 411F Traffic Prom Module Units for use with Controller Units.

1.1.2 These specifications shall supplement the General Specifications for Traffic Control Equipment and in case of conflict the specification of this Chapter will govern.

1.2 MODEL 411 REQUIREMENTS

1.2.1 The Traffic Prom Module Board Dimensions, Contact Assignments and Space Requirements shall comply with the details shown on the plans.

1.2.1.1 The Model 411 Prom Module Board shall be designed to intermate with The Prom Module Board DIP-Switch Adaptor in any socket location.

1.2.2 All electrical connections in and out of the module shall be through a printed circuit connector having two rows of 36 independent bifurcated contacts on 0.100 inch centres.

1.2.3 See Chapter 2 for the allowable power requirements for the Traffic PROM Module.

1.2.4 The module shall be designed so that persons inserting or removing the module will not be required to insert hands or fingers within the controller unit housing. The front of the module shall be flush with the front of the controller unit. The front panel shall be connected to equipment ground.

1.2.5 The module shall be provided with a handle or gripping device secured to the front panel of the module and protruding no more than 1-1/4 inches.

1.2.6 When the PROM module is not being addressed, the data outputs shall be disabled into a high impedance state and the outputs shall not source or sink more than 100 microamperes.

1.2.7 The PROM module shall provide memory sizes. An on board switch shall be provided to select one of the two sizes by the user. The two memory sizes are:

a) 16 k bytes (8 sockets mounted 2048 x 8 bit EPROMS)
b) 32 k bytes (8 sockets mounted 4096 x 8 bit EPROMS)

Each EPROM chip shall be electrically programmable and shall be erasable by exposure to ultra-violet radiation. This memory shall be nonvolatile and shall not be affected by transients resulting from power switching and external loading and underloading conditions. The EPROM chips shall be the INTEL 2716 or equivalent for size a or INTEL 2732A or equivalent for size b. Sockets for EPROM/RAM Chips shall be properly marked on the board adjacent to the socket as to their function and lowest addresses to ensure correct chip mating with its associated socket. Access Time for EPROM chips shall be 200 nanoseconds or less over the specified operating temperature range. A pull-up resistor of 10 ± 10% kohms shall be provided on each of the eight data lines to the EPROM/RAM sockets. The size-selecting switch shall be clearly marked with 16 k on one side and 32 k on the other. The same sockets shall be used for both type EPROM chips.

1.2.8 All sockets used on the Prom Module Card shall be the Augat Low Profile Machined Contact Sockets or equivalent.

1.3 MODEL 411F REQUIREMENTS

1.3.1 The 411F Prom Module shall meet the requirements of the 411 Prom Module as detailed in Section 1.2 and shall be complete with a Prom Module Board DIP-Switch Adaptor mounted in location Hex 8000 (2732 format).

1.4 PROM MODULE BOARD DIP-SWITCH ADAPTER (PMDA)

1.4.1 General

1.4.1.1 The Prom Module Board DIP-Switch Adaptor (PMDA) is an assembly which mates with an IC socket configured for JEDEC 24 or 28 pin EPROM. The assembly shall consist of a 10 position DIP-switch, type AMP 7000 series switch or equivalent, and associated circuitry. The PMDA shall be designed to operate and mate with the Model 411 Prom Module. When mated with an EPROM socket, the PMDA and components on the PMDA shall not extend beyond the front face of the 411 Prom Module Board.

1.4.1.2 The PMDA assembly shall be a maximum of 1.25 inches wide, 1.8 inches long and shall not be more than 1/2 inch high.

1.4.1.3 The pins used for mating the PMDA to the EPROM socket shall be gold plated machined pins.

1.4.2 PMDA Operation

1.4.2.1 The PMDA shall be designed to allow the 10 position DIP-switch settings to be transferred onto the data line of the EPROM socket. The transferring of the DIP-switch settings shall be controlled by the status of A0 and $\overline{CE}$ lines on the EPROM socket as follows:

Control		Contents of Data Lines on EPROM Socket							
A0	$\overline{CE}$	D0	D1	D2	D3	D4	D5	D6	D7
X	1	Z	Z	Z	Z	Z	Z	Z	Z
0	0	SW0	SW1	SW2	SW3	SW4	SW5	SW6	SW7
1	0	SW8	SW9	X	X	X	X	X	X

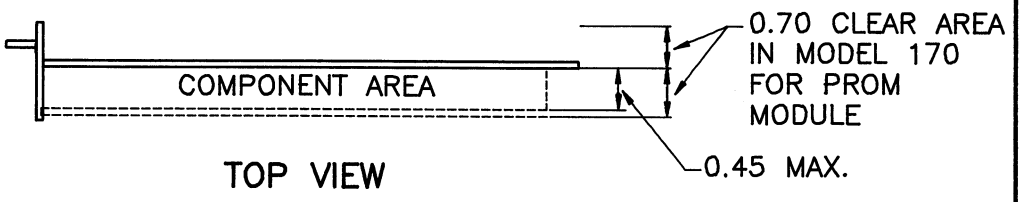
Z - the indicated data line shall be placed in the high impedance state
X - don't care
1 - logic 1, high
0 - logic 0, low
SWx - switch x, of the 10 position DIP-switch
A1-A14 - don't care

1.4.2.2 The transferring of information from the PMDA to the EPROM socket data bus shall occur within 50 nanoseconds of $\overline{CE}$ going low, and shall remain stable for a minimum of 10 nanoseconds following $\overline{CE}$ going high.

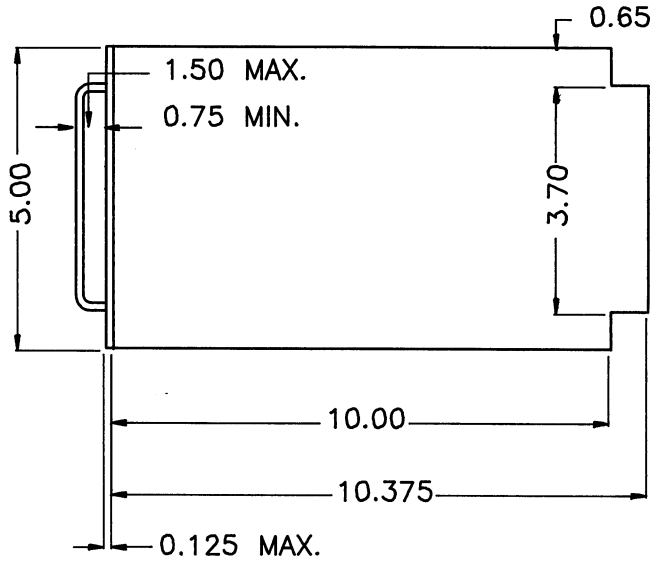
1.4.2.3 The circuitry on the PMDA shall be capable of driving at least two TTL loads.

1.4.2.4 The circuitry on the PMDA shall be designed such that, setting a switch to the ON position shall cause a logic 1 to be transferred to the data lines of the EPROM socket. Similarly, setting a switch to the OPEN or OFF position shall cause a logic 0 to be transferred to the data lines of the EPROM socket.

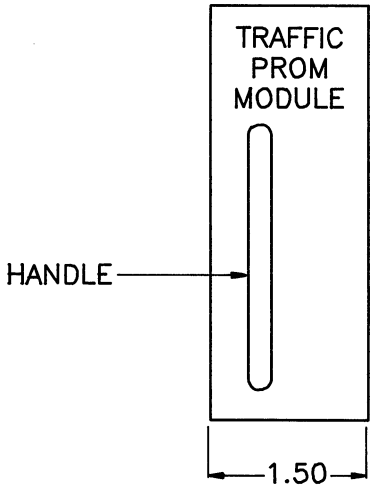
PROM MODULES



TOP VIEW



SIDE VIEW



FRONT PANELS

NOTE:

THE HEIGHT AND WIDTH DIMENSIONS SHOWN FOR THE PROM MODULE ARE MAXIMUS. ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SHOWN.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS				
411 PROM MODULES–OUTLINE				
Date	92 06 01	Rev		OTSCES – 0310.01

CIRCUIT ASSIGNMENTS FOR PROM MODULE CONNECTOR

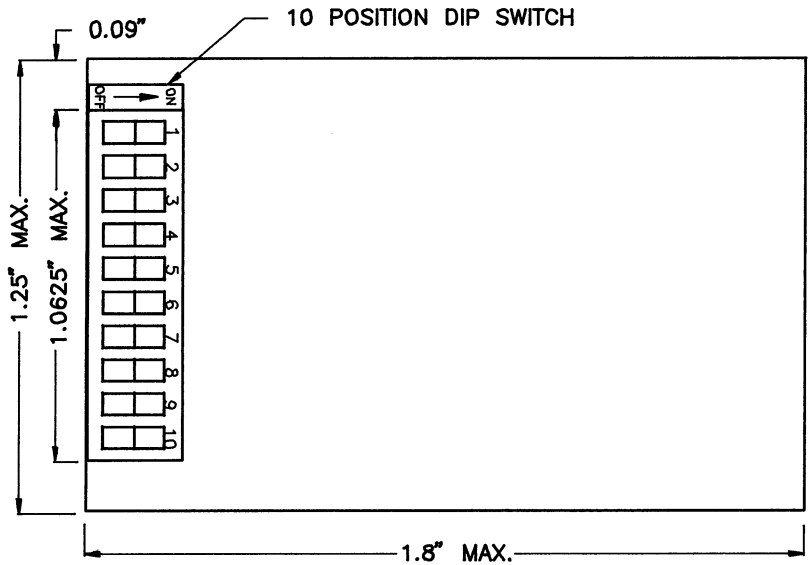
CIRCUIT SIDE			COMPONENT SIDE	
A0	1		2	A1
A2	3		4	A3
A4	5		6	A5
A6	7		8	A7
A8	9		10	A9
A10	11		12	A11
A12	13		14	A13
A14	15		16	A15
$\overline{D0}$	17		18	$\overline{D1}$
$\overline{D2}$	19		20	$\overline{D3}$
$\overline{D4}$	21		22	$\overline{D5}$
$\overline{D6}$	23		24	D7
VMA*	25		26	UNASSIGNED
READ/WRITE	27		28	UNASSIGNED
UNASSIGNED	29		30	UNASSIGNED
UNASSIGNED	31		32	UNASSIGNED
UNASSIGNED	33		34	EQUIPMENT GROUND
UNASSIGNED	35		36	UNASSIGNED
UNASSIGNED	37		38	UNASSIGNED
UNASSIGNED	39		40	UNASSIGNED
UNASSIGNED	41		42	UNASSIGNED
UNASSIGNED	43		44	UNASSIGNED
UNASSIGNED	45		46	UNASSIGNED
UNASSIGNED	47		48	UNASSIGNED
REPEAT TEST	49		50	NEXT TEST
TEST COMPLETE	51		52	SKIP TEST
UNASSIGNED	53		54	UNASSIGNED
UNASSIGNED	55		56	UNASSIGNED
UNASSIGNED	57		58	UNASSIGNED
+12 VDC	59		60	+12 VDC
−12 VDC	$\overline{61}$	KEY	$\overline{62}$	−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

* INCLUDES PHASE 2 CLOCK, LOGIC EXTERNAL TO PROM MODULE.

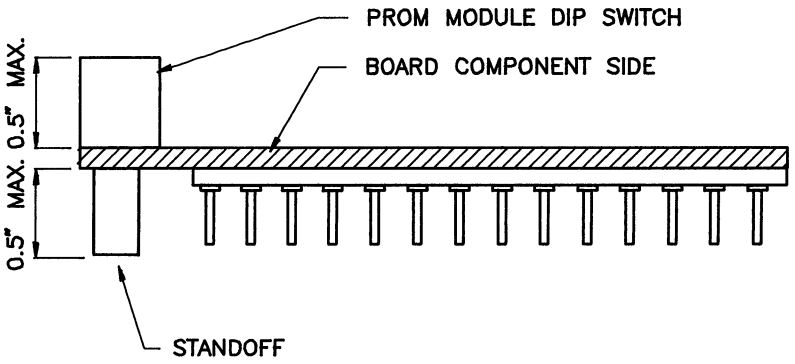
ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

411 PROM MODULE CONNECTOR ASSIGNMENT

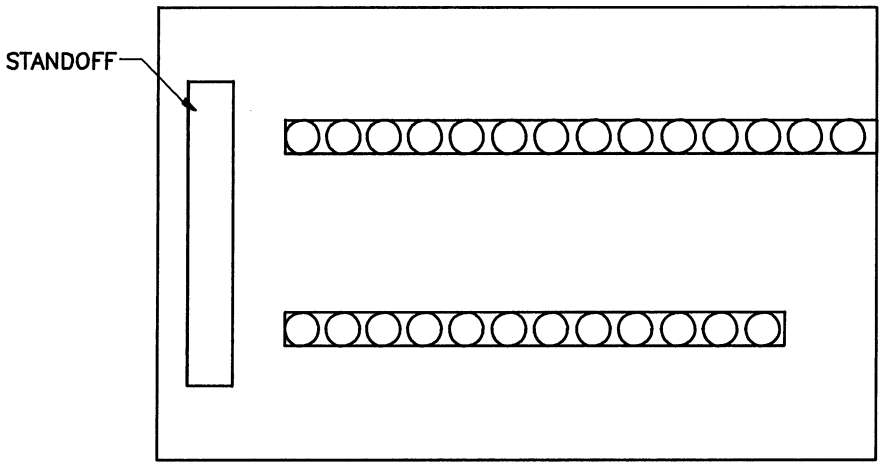
Date	92 06 01	Rev		OTSCES – 0310.02



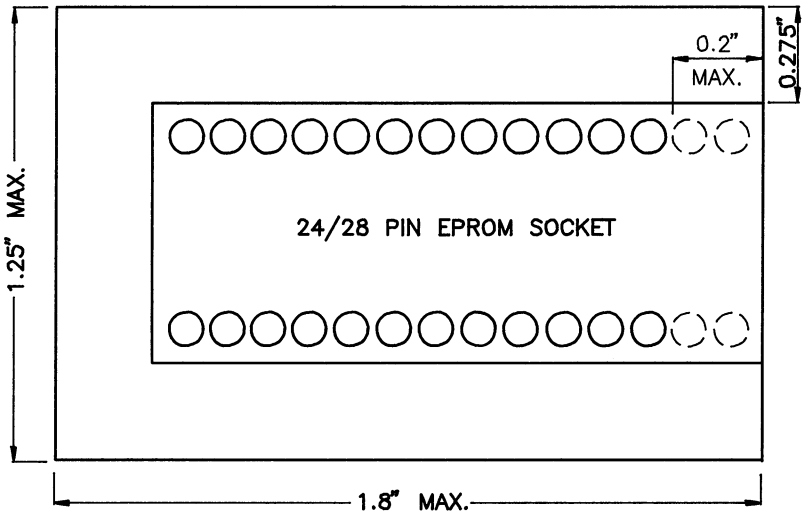
TOP VIEW



SIDE VIEW



REAR VIEW



SOCKET ADAPTOR PLAN

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

PROM MODULE BOARD DIP SWITCH ADAPTER

Date	92 06 01	Rev		OTSCES – 0320.01

CHAPTER 3

Specifications

For

Prom Module

412C

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2 GENERAL REQUIREMENTS ..... -2
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4 MEMORY ..... -3
5 MODULE POWER SUPPLY ..... -4
6 IDENTIFICATION JUMPER CIRCUITRY ..... -5
7 REAL TIME CLOCK ADJUSTER (RTCA) ..... -5

1 GENERAL REQUIREMENTS

1.1 SCOPE

1.1.1 This chapter defines the general specifications applicable to the Prom Module 412C.

1.1.2 These specifications shall supplement the General Specifications for Traffic Control Equipment and in case of conflict the specification of this Chapter will govern.

2 GENERAL REQUIREMENTS

2.1 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.

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

2.3 The VMA/Phase 2 (E) Clock Signal (M/170 Pin 25) shall not be used in a memory device READ operation.

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

2.5 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 Model 412C modules.

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

2.7 The module front panel shall be connected to Equipment Ground at M/170 Pin 34.

2.8 All addressable devices shall be fully decoded.

2.9 All memory sockets shall be a 28 pin AUGAT #5281828 Series AG10DPC or equivalent.

3 FEATURE REQUIREMENTS

3.1 BUS INPUTS AND OUTPUTS

3.1.1 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 lines shall be disabled into a high impedance state and the data lines shall not source or sink more than 100 ua.

3.1.2 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.

4 MEMORY

4.1 Four numbered memory sockets shall be provided and fully decoded using the following method. The module shall be delivered with MEMORY SELECT #4 Configuration designated memory devices (OR EQUIVALENT), address decode and jumpers.

4.2 Device manufacture is designated as INT-Intel, 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	OUT	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.

4.3 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 sockets from a non-standby power socket to a standby power socket or vice versa. Sockets u2 and U3 shall be jumpered for non-standby power. Socket U4 shall be jumpered for standby power.

4.4 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 READ ONLY State. A subsequent WRITE to ADDRESS 7000 shall be decoded and shall deactivate the WPC allowing R/W function. The WPC power drain shall not exceed 40ua at +5 VDC.

5 MODULE POWER SUPPLY

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

5.2 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 maximum of 2% ripple.

5.3 Standby power shall be provided to holdup WPC, SRAM and RTCA circuits during a Model 170MC Controller Unit Power Supply Failure. A circuit shall be provided to sense the +12 VDC M/170 power line and switch to standby power when line is less 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.

5.4 A battery shall be delivered separate from the module. It shall not be used except for test loading check by the Ministry.

5.5 A battery holder for a "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 plus mounting terminal.

6 IDENTIFICATION SWITCH CIRCUITRY

6.1 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 170MC CPU and switch OFF shall denote bit state "0" to the 170 MC CPU.

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

7 REAL TIME CLOCK ADJUSTER (RTCA)

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

7.2 The RTCA shall be continuously powered and not affected by a controller unit power failure. RTCA accuracy shall be +/- 10 ppm at 25'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.

7.3 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).

7.4 The counter bits shall be continuously read out to 4 eight-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 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

7.5 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 deactivate state the RTCA Circuitry shall present NO power drain to standby power supply.

CHAPTER 4

Specifications

For

Conflict Monitor

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List of Drawings

Date	OTSCES No.	Rev	Title
May 31, 1995	0410.01	2	212E Monitor Outline
November 9, 1994	0410.02	1	212E Monitor Pin Assignment
June 1, 1992	0410.03	-	212E Monitor Miscellaneous
May 31, 1995	0420.01	1	212E Programming Card Outline
May 31, 1995	0420.02	1	212E Programming Card Pin Assignment
May 31, 1995	0420.03	1	212E Programming Card Diode Data

1 GENERAL REQUIREMENTS

1.1 SCOPE

1.1.1 This chapter defines the specifications applicable to the Model 212E Conflict Monitor for use in 332 series cabinets.

1.1.2 These specifications describe an enhanced version of the Model 212 conflict monitor. Therefore the monitor unit shall be labelled Model 212E.

1.1.3 These specifications shall supplement the General Specifications for Traffic Control Equipment and in case of conflict the specifications of this Chapter will govern.

1.2 FUNCTIONAL DESCRIPTION

1.2.1 The monitor unit shall be capable of detecting conflicting indications when the signals are operated in either the solid display mode or the Ontario flashing mode as detailed in Section 2.2

1.2.2 The monitor unit shall be capable of monitoring the following conditions:

1.2.2.1 Interfaze conflicts, which refer to conflicting signal indications appearing on two or more fazes.

1.2.2.2 Intrafaze conflicts, which refer to the absence of all signal indications or the presence of multiple signal indications appearing on the same faze.

1.2.2.3 24 volts DC power supply voltage below specified level.

1.2.2.4 Watchdog timer errors.

1.2.3 A power supply or processor failure within the monitor unit shall cause the signal display to switch from normal operation to emergency flash operation.

1.2.4 The monitor unit shall provide a communication port for transmitting to other devices in the controller cabinet.

1.2.5 The monitor shall be able to monitor Ontario Flashing Signal, interfaze conflict and intrafaze conflict.

1.2.6 The monitor shall "remember" the status of a failure prior to a power failure and shall power up again with that failed state indicated. This "remembering" shall be done with the use of non-volatile memory (Battery powered or battery backed memory is not acceptable). Memory storage

shall last for a minimum of 5 days.

1.3 UNUSED MEMORY REQUIREMENT

1.3.1 At least 25 percent of the TOTAL RAM supplied on the conflict monitor shall be unused and available for future enhancements to the conflict monitor. The unused portion of the total RAM shall be organized as one contiguous block of memory.

1.3.2 At least 25 percent of the TOTAL EPROM/PROM supplied on the conflict monitor shall be unused and available for future enhancements on the conflict monitor. The unused portion of the total EPROM/PROM shall be organized as one contiguous block of memory.

1.3.3 Memory maps of both RAM and EPROM/PROM shall be provided. The memory map shall include the following information:

Total RAM, EPROM/PROM, space available in bytes, starting addresses for RAM and EPROM/PROM, starting addresses and terminating address for the used and unused RAM, EPROM/PROM portions. The memory map shall be included in both the hardware and software documentation supplied on the conflict monitor.

2 FUNCTIONAL REQUIREMENTS

2.1 GENERAL

2.1.1 All monitored field output alternating current voltages shall be measured as either average responding or true RMS responsive to both the positive and negative halves of the sine wave. The field output AC voltages may be continuous, or pulsating at rates of 2.5 Hz, or 0.8 to 1.0 Hz, at 50 percent duty cycle.

2.1.2 The conflict monitoring circuitry shall sense voltages greater than 25 volts RMS alternating current and shall not sense voltages less than 15 volts RMS alternating current. The conflict monitoring circuitry may or may not detect a conflict when the voltage is greater than 15 volts RMS but less than 25 volts RMS.

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

2.2 ONTARIO FLASHING SIGNAL MONITORING

2.2.1 Flashing Green Ball

The Province has standardized on the use of the green outputs on switch packs 2, 4, 6, and 8 to present the flashing green ball, when used. The flashing green ball is equivalent in meaning to the display of a left-turn arrow in conjunction with a solid green ball, i.e. it signals a protected left turn in conjunction with a straight through movement. However, since the flashing green ball output appears only on the through faze, it is necessary that the monitor possess circuitry which:

2.2.1.1 determines that a 2.5 Hz flash is present on the through faze;

2.2.1.2 provides downstream encoding to the programming card that equates this output with solid outputs on the through and adjacent left turn fazes.

This will permit monitoring of any flashing green ball on fazes 2, 4, 6, and 8 as if it were a left arrow and an adjacent solid green ball, as described above.

2.2.2 Flashing Indication

The monitor must recognize the appearance of a 2.5 Hz flash on any other output as equivalent to a solid output. More precisely, the appearance of 2.5 Hz flash on any green or yellow output other than the green outputs on switch packs 2, 4, 6 and 8 is to be interpreted as a solid output from the switch pack in question.

2.3 CONFLICT MONITORING

The conflict monitoring circuitry shall detect the following conditions under both solid display and all flashing operations:

2.3.1 Interfaze Conflict

2.3.1.1 The monitor unit shall trigger when yellow or green field output voltages are sensed concurrently on any two or more conflicting fazes for a duration longer than 500 milliseconds.

The monitor unit shall not trigger when the above voltages are sensed for a duration of less than 150 milliseconds.

The monitor unit may or may not trigger when the above voltages are sensed for a duration longer than 150 milliseconds and less than 500 milliseconds.

2.3.2 Intrafaze Conflict

2.3.2.1 The monitor unit shall trigger when red and yellow, or red and green field output voltages on the same faze are sensed concurrently for a duration longer than 1000 milliseconds.

The monitor shall not trigger when the above voltages are sensed for a duration less than 700 milliseconds.

The monitor unit may or may not trigger when the above voltages are sensed for a duration longer than 700 milliseconds and less than 1000 milliseconds.

2.3.2.2 The monitor unit shall trigger when voltages are absent from all three: red, yellow, and green field signal outputs of the same faze for a duration longer than 1000 milliseconds.

The monitor unit shall not trigger when the above voltages are absent for a duration less than 700 milliseconds.
The monitor unit may or may not trigger when the above voltages are absent for a duration longer than 700 milliseconds and less than 1000 milliseconds.

2.3.2.3 An eight position DIP switch shall be provided on the monitor to simulate the red signal display for any unused faze. Setting a switch position ON shall place the equivalent of a present signal on the faze red logic input. Setting a switch position OFF, the monitor shall observe the actual faze red field output voltage. The switch shall be labelled SIMULATED RED. The switch positions shall be easily set in the field with proper markings indicating faze 1 to 8, ON and OFF, and shall be delivered in their OFF position. A clear plastic protective cover shall be installed on top of the DIP switch to prevent accidental setting of switches.

2.3.2.4 The monitor shall not indicate a conflict during normal software programmed or hardware flash operation. Such operation consists of the flashing of either red-red or red-amber signals on two or more fazes simultaneously at

a rate of 0.8 Hz to 1.0 Hz. The monitor shall still indicate a conflict should more than one or less than one circuit be on in any one faze for more than one second.

2.3.2.5 A jumper location labelled "TEST MODE" shall be provided on the printed circuit board of the monitor (underneath the diode card) to enable or disable the monitoring of intrafaze conflicts. By inserting a jumper, the monitor shall disable the intrafaze conflict monitoring circuitry. In this mode, the monitor shall be able to operate within the cabinet in which the eight red field outputs are not connected to the monitor terminals. Without the jumper, the monitor shall enable the intrafaze conflict monitoring circuitry. This TEST MODE shall be used only for test purposes. The monitor shall be delivered without a jumper.

2.3.2.6 An external input from Pin 27 of the monitor terminal shall be assigned as the mode select input. When this input exceeds 8.5V, the TEST MODE setting shall determine the operating mode of the monitor. When this input drops below 3 volts, the monitor shall not monitor intrafaze conflict regardless of the TEST MODE setting until the voltage exceeds 8.5V again.

2.3.3 Power Failure

A power failure for the conflict monitor is said to have occurred when the incoming line voltage falls below 88 ± 2 VAC for 50 milliseconds or longer. The determination of the 50 milliseconds interval shall be completed within 67 milliseconds of the time the voltage falls below 88 ± 2 VAC. The monitor shall not accept any inputs when a power failure occurs until the power is restored.

2.3.4 Power Restoration

Power is said to be restored to the conflict monitor when the incoming line voltage equals or exceeds 94 ± 2 VAC for 50 milliseconds or longer. The determination of the 50 millisecond interval shall be completed within 67 milliseconds of the time the voltage first reaches 94 ± 2 VAC.

Power Failure/Restoration Hysteresis Separation shall be a minimum of 2 VAC with a threshold drift of no more than ± 0.2 V.

The monitor shall maintain the signal displays in emergency flash operation when power is restored.

The monitor shall monitor the AC power. If the power is not restored for at least 10 seconds, the monitor shall continue to monitor the power. If the power is restored for 10 seconds, the monitor shall determine if the monitor was triggered prior to the power failure.

2.3.4.1 The monitor shall be provided with a jumper to select 5 or 10 (± 0.1) seconds in emergency flash operation when power is restored. No jumper means 10 seconds delay, jumper means 5 seconds delay. The monitor shall be supplied with no jumper.

2.3.4.2 If the monitor was triggered, the monitor shall enter the mode described by Section 2.6. If the monitor was not triggered, the monitor shall automatically reset.

2.3.4.3 If AC power failure was less than 2.00 ± 0.20 seconds, the monitor shall not enter the mode as described in section 2.6.

2.3.4.4 If AC power failure was greater than 2.00 ± 0.20 seconds, the monitor shall enter the mode as described in section 2.6.

2.3.4.5 For AC power failure was greater than 2.00 ± 0.20 seconds and less than 2.2 ± 0.20 seconds, the monitor may enter the mode as described in sections 2.3.4.3 and 2.3.4.4.

2.3.5 When the incoming AC line voltage falls below 98 ± 2 volts AC for 50 milliseconds or more, the monitor shall:

2.3.5.1 Not monitor intrafaze conflict regardless of the switch setting in Sections 2.3.2.5 and 2.3.2.6.

2.3.5.2 Stop monitoring the 24V DC supply.

2.3.6 When the incoming AC line voltage rises above 102 ± 2 VAC for 50 milliseconds or more, the monitor shall:

2.3.6.1 Enter the mode directed by Sections 2.3.2.5 and 2.3.2.6 respectively.

2.3.6.2 Resume monitoring the 24 volt DC supply.

2.3.7 The monitor shall power up in the mode directed by 2.3.5 and shall remain in that mode until the requirements of Section 2.3.6 can be met.

2.4 TIMING

All clocking, timing, and time measuring information required by the conflict monitor shall be generated by one main clock on-board the conflict monitor. The conflict monitor shall not use the 60 HZ AC line for any timing, clocking or time measuring function other than for the transmission of communications messages. Failure of the main clock shall be monitored and shall be treated the same as a watchdog failure.

2.4.1 Watchdog Timer

The monitor unit shall trigger when the Watchdog Timer circuit has failed to receive a change in the state from the controller unit for 1 second ± 10 percent. The controller unit will change its output to the Watchdog Timer once every 100 milliseconds. A deviation in the Watchdog Timer pulses, from the controller, by ± 50 milliseconds for greater than 2 seconds ± 5 percent shall cause the monitor to trigger.

2.5 DC POWER SUPPLY MONITORING

The monitor unit shall sense the +24 VDC from the cabinet power supply. A 30 volt zener diode shall be used to protect the +24 volt sensing circuitry from high voltages due to possible power supply malfunction or transient. It shall consider voltages as low as +22 VDC as acceptable, but the monitor unit shall trigger when the DC Power Supply Voltage drops below +18VDC for longer than 500 Milliseconds.

2.5.1 The monitor unit shall not trigger when the above voltage drops below +18VDC for less than 200 milliseconds.

2.5.2 The monitor unit may or may not trigger when the above voltage drops below +18VDC for more than 200 Milliseconds but less than 500 milliseconds.

2.6 TRIGGERED MONITOR

2.6.1 The triggered monitor shall retain the triggered status according to the conditions stated under Sections 2.6.2 and 2.6.3 until reset. Following the failure and restoration of AC power to the cabinet, the triggered monitor unit:

2.6.1.1 Shall retain the information displayed by the 23 front panel indicators prior to the loss of power.

2.6.1.2 Shall maintain the signal displays in emergency flash operation until reset.

2.6.2 An output contact shall close. This shall cause an automatic switching of the field signals from normal operation to emergency flash operation.

2.6.2.1 The output relay contacts shall be rated for a minimum of 3 amperes at 120 VAC. The output shall be electrically isolated from ground with a rating of 2000V DC or better, and 1000 million ohms. Opening and closing time of the contacts shall not exceed 30 milliseconds.

2.6.2.2 The monitor unit shall output a stop time signal. The stop time output shall be an NPN open collector which, when triggered, shall be capable of sinking 50 milliamperes at 30 volts. This output shall be compatible with the appropriate input in the Controller Unit. The output shall have a blocking diode installed to prevent it from sourcing power into the controller unit input.

2.6.3 Front panel indications for conflicting signals shall have the following characteristics for the 23 required indicators:

2.6.3.1 Conflict (Interfaze)

One indicator labelled "CON" shall be normally off and shall be lighted only when an interfaze conflict is detected. An interfaze conflict is signified by a solid display on the conflict light.

2.6.3.2 Conflict (Intrafaze-Multiple)

One indicator labelled "MUL" shall be normally off and shall be lighted only when an intrafaze-multiple conflict is detected. An intrafaze-multiple conflict is signified by illuminating the "MUL" indicator light on the front panel. This indicator light shall be solidly on.

2.6.3.3 Conflict (Intrafaze-Missing)

One indicator labelled "MIS" shall be normally off and shall be lighted only when an intrafaze-missing conflict

is detected. An intrafaze-missing conflict is signified by illuminating the "MIS" indicator light on the front panel. This indicator light shall be solidly on.

2.6.3.4 Watchdog Timer

When the monitor is triggered as a result of sensing a watchdog timing error, it shall illuminate a front panel solid indicator light labelled "WDG". This indicator light is normally off. An internal watchdog muzzle circuit shall be provided to inhibit triggering of the monitor due to watchdog timer errors. This muzzle circuit shall be activated by manually shorting 2 test posts. These 2 test posts shall not be labelled on the printed circuit board but shall be illustrated on the instruction manual. By leaving the path between the 2 test posts open, the watchdog timer circuit shall always be enabled. The watchdog timer circuit shall deactivate when the Incoming AC Line Voltage falls below 98 ± 2 Volts AC for 50 milliseconds or more and shall become active when the Incoming AC Line Voltage rises above 105 ± 2 VAC for 50 milliseconds or more. The watchdog timer circuitry shall not be affected in the case of overvoltage on the 24V DC line. The watchdog timer input shall be protected by a 30V zener diode.

2.6.3.5 24 Volt DC Supply

When the monitor unit is triggered as a result of sensing a voltage error from the 24 Volts DC power supply, it shall extinguish a front panel indicator light labelled "24V DC". This indicator light shall remain extinguished until the +24V DC supply has been restored, then the "24V DC" light shall flash at a visible rate until reset by the front panel reset push-button or the external reset line which shall restore the solid display. This feature is to provide an indication of intermittent problems.

2.6.3.6 Controller Oriented Processor Failure (COP)

When the monitor unit is triggered as a result of sensing an internal watchdog error, it shall illuminate a front panel indicator light labelled "COP". The "COP" indicator light shall normally be off.

2.6.3.7 Power (PWR)
When the monitor unit has AC power, it shall illuminate the front panel indicator light labelled "PWR". The "PWR" indicator light shall normally be on unless there is a power failure.

2.6.3.8 The other 16 indicators, each labelled with respect to its associated faze shall provide the following information:

2.6.3.8.1 Interfaze Conflict Condition

The 16 indicators shall store and display the conflicting field indications existing at the moment of conflict. The displays shall reflect the field voltage status of the green and yellow outputs. The indicator shall be lighted when voltage is sensed on the corresponding green or yellow output terminals. There is no indication for red outputs.

In normal flashing green ball condition, the indication for the flashing faze shall flash at the same rate as the signal display. The indicator for the corresponding left turn faze shall be solidly on. When a conflict is caused by two conflicting even fazes (2, 4, 6 or 8) flashing concurrently, the conflict indications shall show lighted indicators for both flashing fazes and both of their corresponding left turn fazes. This shall provide a clear indication that the conflict has occurred during the flashing green ball operation.

2.6.3.8.2 Intrafaze-Missing Conflict Condition

The 16 indicators shall store and display the cause of conflict for intrafaze-missing conflict conditions. When an intrafaze-missing conflict is caused by the absence of all displays on one faze, only the faze indicator of the associated faze should flash at an easily visible rate, but the "MIS" indicator light shall be solidly on.

2.6.3.8.3 Intrafaze-Multiple Conflict Condition

The 16 indicators shall store and display the cause of conflict for intrafaze-multiple conflict conditions. When an intrafaze-multiple conflict is caused by the presence of multiple displays on the same faze, only the faze indicator of the associated faze should flash at an easily visible rate, but the "MUL" indicator light shall be solidly on.

Examples:

1) The front panel indication for an intrafaze-missing conflict caused by the absence of all signals on faze 8 shall result in:

faze 8 LED	flashing
"MIS" conflict LED	solidly on
24V DC	solidly on

All other indicators shall be blanked out.

2) The front panel indication for an intrafaze-multiple conflict caused by the simultaneous presence of red and green displays on faze 8 shall result in:

faze 8 LED	flashing
"MUL" conflict LED	solidly on
24V DC	solidly on

All other indicators shall be blanked out.

2.6.4 If the monitor unit was triggered before a power failure, the monitor shall enter the mode described by Section 2.6. If the monitor was not triggered and a power failure occured, the monitor shall enter the mode described by Section 2.3.4.

2.7 UNDELAYED CONFLICT

The monitor unit shall output an undelayed conflict signal on pin 26. This output shall be an NPN open collector which shall be triggered within 16.6 milliseconds when a conflict condition is sensed and remain triggered until the conflict

condition is removed. The output circuitry, when triggered, shall be capable of sinking 50 milliamperes at 30 volts. The output shall be compatible with the input interface circuitry in the controller unit and shall have a blocking diode installed to prevent it from sourcing power into the controller unit input.

2.8 PROGRAMMING CARD

2.8.1 The monitor module shall be equipped with a programming card. The programming card shall be a printed circuit board 1/16 inch thick and shall plug into the module through a slot in the front panel. A programming card shall be supplied with a full complement of diodes, with the exception of those detailed. The diodes used on the diode card shall be #IN 4148 or equivalent.

The programming card shall be labelled and laid out as shown on the programming board layout diagram. All switch pack green and amber signals being monitored shall be in conflict with all other switch pack green and amber signals being monitored, unless a diode (anode to numerical pins and cathode to alphabetical pins) has been removed. Removal of a diode shall define a non-conflict. Example: A diode removed from between pins 4 and B indicates the signals on faze 5 are not in conflict with the signals on faze 2. Green and yellow inputs with the same faze number shall be "OR" d together.

2.8.2 The following diodes shall not be installed on the programming card, however, unobstructed holes shall be provided to allow easy insertion of diodes within these holes for the purpose of detecting conflicts in accordance with the rules stated above.

DIODES TO BE REMOVED FROM THE DIODE CARD

1-5	1-6	1-6P	2-5
2-6	2-2P	2-6P	3-7
3-8	3-8P	4-7	4-8
4-4P	4-8P	5-2P	6-2P
6-6P	7-4P	8-4P	8-8P
2P-6P	4P-8P		

NOTE: 1-5 indicates diode which causes faze 1 to be in conflict with faze 5

2.8.3 Four jumper locations shall be provided two for OVERLAP A and the other two for OVERLAP B.

The removal of these jumpers shall produce the same result as the removal of all OLA and OLB diodes. Example: OVERLAP A jumpers removed, OVERLAP B jumpers installed shall produce the same result as all OLA diodes being removed. The diode card shall be shipped with the jumpers removed.

2.8.4 Pin T of the program card called "CONFLICT" shall cause the monitor to trigger when permitted to float, and be inhibited when grounded to Pin 16. All program cards shall have a jumper between Pins 16 and T.

2.8.5 The programming card shall be 6 inches in depth and 5.15 inches to 5.30 inches in height, and shall intermate with a 28/56 pin double sided connector having bifurcated contacts on 0.156 inch centres. The printed circuit board shall bisect its edge board fingers at their centres to within +0.016 inch. The centre of the edge board fingers shall be 2.6375 inches from either edge of the board. This card when installed shall be provided with card ejectors (Stanford Applied Engineering type 6100 or equivalent) for removal from the front panel. This programming card shall be flush with the front panel and slide smoothly on its tracks while being inserted into or removed from the monitor module.

2.9 OUTPUT MONITORING

2.9.1 The monitor, when connected to the switch pack output circuit, shall provide protection against conflicting signals resulting from controller unit failure, switch pack failure, short circuited field wiring, etc.

2.9.2 The input circuitry of the monitor unit which interfaces directly with a switch pack, shall have an impedance of 12.5 KΩ or higher. This is to ensure the detection of an open load circuit at the field output terminal.

2.9.3 Removal or resetting of the monitor unit shall not affect the normal operation of an operating controller or any of the signal displays.

2.9.4 Inserting the monitor unit into a cabinet with power, shall constitute power restoration.

2.9.5 The monitor unit, when inserted properly into the connector, shall provide correct indications via the 19 front panel indicators at all times to reflect the current status of the signal displays and monitored cabinet equipment.

2.10 INTERNAL FAILURE DETECTION

The design of the monitor unit shall be based on a fail-in-flash philosophy in order to prevent operation of the controller when there is no monitor supervision available.

2.10.1 Processor Failure

Microprocessor-based monitor designs must sense the monitor's watchdog change of state and create a corresponding output. This output is to be added with the controller watchdog output and the resulting output used to reset the watchdog timer. This will ensure that failure of either the controller or monitor processors will trigger the monitor.

Loss of the A or B waveforms will result in a continuous zero output at C, and the watchdog timer will time out, triggering the monitor.

Reset is possible if and only if the microprocessor in the monitor is functional. In case of microprocessor failure, the intersection must remain in emergency flash mode.

2.10.2 Internal Power Failure

The monitor unit shall respond to any voltage failure within itself while the rest of the components in the cabinet are operating normally. A voltage failure may be due to the loss of AC supply to the monitor or an internal power circuit failure. This kind of failure shall always cause an automatic switching of the field signals from normal operation to emergency flash operation within 1 second.

3 ELECTRICAL REQUIREMENTS

3.1 GENERAL

3.1.1 The front panel shall be wired to earth ground.

3.1.2 The conflict monitor shall not trigger when sensing radio frequency energy with a frequency of 10 megahertz or greater and an average power of 100 milliwatts or less.

3.1.3 The monitor is required to operate reliably from a cold start at -50°C. The monitor shall meet the requirements of Chapter 1, Section 7 except that Section 7.3.1.1 shall be amended to extend the temperature range to -50°C to +74°C.

3.1.4 No electrical or electronic design constraints are being considered, other than that the design should reflect current technology. Designs based on microprocessors which possess high inherent noise immunity will be considered to meet this criterion. Design technique shall be used to provide maximum noise and transient protection to all circuits.

3.1.5 Three surge arrestors, two - 1 ohm (wattage as required) wire wound power resistors, one capacitor (0.1 microfarad at 250 VDC), and one capacitor (0.6 microfarad at 250 VDC) shall be provided. The components shall be wired in accordance with the OTSCES Drawing 0410.03.

The surge arrestor (MOV) shall be capable of meeting the following minimal requirements:

Recurrent peak voltage 212 volts
Energy rating minimum 20 joules
Power dissipation, average 0.85 watts
Peak current 2000 amperes for pulses less than 6 microseconds
Standby current less than 1 milliampere.

3.1.6 With the monitor under power and operating, the application of transients specified in Sections 3.1.6.1 and 3.1.6.2 shall not cause the monitor to trigger nor in any other way affect the operation of the monitor.

3.1.6.1 For all DC voltage input and output pins, the monitor shall meet the requirements of Chapter 2.

3.1.6.2 The monitor shall withstand the discharge of a 10 microfarad capacitor charged to ± 2000 volts superimposed directly across any two AC voltage input pins or from any AC voltage input pin to the AC bus or chassis ground. An AC voltage pin is one which has the following characteristics: 120 VAC, 60 Hz.

3.1.7 Transorbs, General Semiconductor part #1.5 KE 30C or equivalent, shall be installed between all DC I/O pins (pins 22, 23, 26, 27, z, bb, dd) and the DC ground pin (pin Y). The lead lengths of the transorbs shall be kept short.

3.1.8 The conflict monitor shall be capable of operating when a voltage between +50V DC to -50V DC with a source impedance of ≥ 600 ohms, is impressed on any DC input/output pin.

4 MECHANICAL REQUIREMENTS

4.1 GENERAL

4.1.1 The dimensions of the monitor module shall be as shown on the plans and as described in these specifications.

4.1.2 A handle shall be attached to the front panel, and shall protrude no further than 1.25 inches from the face of the front panel and shall be 4 inches minimum in length.

4.1.3 The module shall be no wider than 1.38 inches. The printed circuit card shall be .0625 inch thick. The module shall intermate with a 28/56 pin double-sided connector having bifurcated contacts on 0.156-inch centres. The printed circuit board connector shall bisect its edge board fingers at their centres to within ± 1/64 of an inch. The centre of the edge board fingers shall be 4.65 inches from either edge of the board. The centre line of the 1/16 inch printed circuit card shall be 0.20 ± 1/64 inch from the left edge of the front panel (Front View).

4.1.4 The 212 Monitor shall fit into the slot designated in the output file for the conflict monitor.

4.1.5 The reset switch shall be a miniature, right angle, SPST- normally open, PC mount, pushbutton switch by Grayhill P/N 39-503 RED or equivalent It shall be rated at 1,000,000 operations at rated load.

5 CONNECTOR REQUIREMENTS

5.1 GENERAL

5.1.1 All electrical connections into or out of the monitor module shall be through a printed circuit connector, having two rows of 28/56 pin independent bifurcated contacts on 0.156-inch centres, and shall intermate with that portion of the printed circuit card which is 4.5 inches wide.

6 COMMUNICATION REQUIREMENTS

6.1 VOLTAGE REQUIREMENTS

6.1.1 The output of the communication port shall be an NPN open collector output which, when triggered shall be capable of driving up to 50V DC in normal operation and sinking up to 100 milliamperes. A blocking diode shall be installed to prevent the output circuitry from sourcing power into the communication line.

6.1.2 The DC input interface shall be capable of being pulled up to +50V DC and source 20 milliamps.

6.1.3 The output and input currents and voltages shall be compatible with the input interface circuitry in the 170 controller unit, as described in the specification in Chapter 2.

6.2 MESSAGE FORMAT

6.2.1 A message is defined as: Header bits + Data bits + Parity bits + Stop bits

6.2.2 Utilizing ground true logic, there are two possible states for each bit:

6.2.2.1 A logic 0 shall cause the communication output to go above 8.5V DC, and deliver an output current less than 100 microamperes at a maximum of 30V DC.

6.2.2.2 A logic 1 shall cause the communication output to go below 3.5V.

6.2.3 Messages shall be transmitted according to the following format:

Bit Seq.	Bit Type	Name		Logic State Description
1	Header 1		1	Header bits define the start of a message.
2	Header 2		1	
3	Header 3		1	
4	Header 4		1	
5	Header 5		1	
6	Header 6		1	
7	Header 7		1	
8	Header 8		0	
9	Data 1	Power up	0	This message is not the first one after power up.
			1	The message is the first one after power up. Power up bit shall be set only for the first transmission after power up.
10	Data 2	Delayed	0	The communication line is free when this Transmission message is ready for transmission.
			1	The communication line is occupied by previous messages when this message is ready for transmission. The state of this bit shall be defined when the message is ready for transmission. Once defined, it shall not change again.
11	Data 3	24 volt DC supply	1	Supply voltage is within acceptable range for 50 milliseconds or longer. The change of state, from 1 to 0, shall take place at 50 milliseconds after the supply voltage has dropped below acceptable range and shall remain in that state until the moment that the voltage is restored. Please refer to Section 2.5.
12	Data 4	Insert	0	The insertion of a logic 0 bit at this location prevents any duplication of the header pattern.
13	Data 5	Watchdog Timer	0	The watchdog timer in the monitor is operating normally.
			1	The watchdog timer in the monitor is deactivated. The change of state, from 0 to 1, shall take place as soon as the watchdog timer is deactivated, and shall remain in that state until the moment that the watchdog timer is restored. Please refer to Section 2.6.4.

Bit Seq.	Bit Type	Name		Logic State Description
14	Data 6	Conflict Indication	See Table #1	The 8 combinations of these 3 bits identify 8 different conflict conditions. The conflict condition shall be transmitted immediately after the monitor is triggered.
15	Data 7			
16	Data 8			
17	Parity 1		0	The parity is odd for data bits 1 to 8
			1	The parity is even for data bits 1 to 8
18	Data 9	F1 Yellow Green (Y/G)	0	Signal display is off
			1	Signal display is on The change of state from 0 to 1, or from 1 to 0, shall take place when a signal display change is detected, and has lasted for a minimum duration of 150 milliseconds.
19	Data 10	F2 Y/G		See data bit 9
20	Data 11	F3 Y/G		
21	Data 12	F4 Y/G		
22	Data 13	F1 RED (R)		
23	Data 14	F2 R		
24	Data 15	F3 R		
25	Data 16	F4 R		
26	Parity 2		0	The parity is odd for data bits 9 to 16
			1	The parity is even for data bits 9 to 16
27	Data 17	F5 Y/G		See data bit 9
28	Data 18	F6 Y/G		
29	Data 19	F7 Y/G		
30	Data 20	F8 Y/G		
31	Data 21	F5 R		
32	Data 22	F6 R		
33	Data 23	F7 R		
34	Data 24	F8 R		
35	Parity 3		0	The parity is odd for data bit 17 to 24
			1	The parity is even for data bit 17 to 24

Bit Seq.	Bit Type	Name		Logic State Description
36	Data 25	OLA Y/G		See data bit 9
37	Data 26	OLB Y/G		
38	Data 27	SP1 Y/G		
39	Data 28	SP2 Y/G		
40	Data 29	F2P Y/G		
41	Data 30	F4P Y/G		
42	Data 31	F6P Y/G		
43	Data 32	F8P Y/G		
44	Parity 4		0	The parity is odd for data bit 25 to 32
			1	The parity is even for data bit 25 to 32
45	Data 33	F2 FGBI (Flashing Green Ball Indicator)	0	This faze is not in flashing green ball condition.
			1	This faze is in flashing green ball condition. The change of state from 0 to 1, shall take place within 50 milliseconds after the display starts to flash at the rate of 2.5 Hz, and shall remain in that state until the flashing is terminated.
46	Data 34	F4 FGBI		See Data Bit 33
47	Data 35	F6 FGBI		See Data Bit 33
48	Data 36	F8 FGBI		See Data Bit 33
49	Data 37	Insert	0	See Data Bit 5
50	Data 38	Programmed/ Emergency Flash (P/E)	0	P/E flash is not on
			1	P/E flash is on The change of state, from 0 to 1, shall take place within 1.3 seconds after the start of P/E flashing condition, and shall remain in that state until the flash is terminated. Please refer to Section VI, paragraph 5 for more detail.
51	Data 39	Mode Switch	0	Monitor is not selected for intrafaze conflict detection.
			1	Monitor is selected for intrafaze conflict detection. The change of state from 0 to 1, or 1 to 0, shall take place immediately after change of mode switch status.

Bit Seq.	Bit Type	Name		Logic State Description
52	Data 40	Overflow	0	There are storage buffers available for more messages.
			1	This message is occupying the last storage buffer, and there are more messages forthcoming.
				Please refer to Sections 6.3.5.6, 6.3.5.7, and 6.3.5.8.
53	Parity 5		0	The parity is odd for data bits 33 to 40
			1	The parity is even for data bits 33 to 40
54	Stop 1		0	Stop bits signify the end of a message
55	Stop 2		0	
56	Stop 3		0	

Table #1

DATA BITS 6 7 8	CONFLICT CONDITION IDENTIFIED
0 0 0	No conflict
1 0 1	Multiple signals on one faze.
0 1 0	Absence of all signal on one faze
0 0 1	Watchdog error
1 1 0	Loss of 24V DC supply
1 1 1	Controller Oriented Processor failure (COP)
0 1 1	Power up with conflict
1 0 0	Interfaze conflict (with more than one conflict present only the first one sensed needs to be communicated).

6.3 MESSAGE TRANSMISSION

6.3.1 The message shall be transmitted 1 bit at a time, at the rate of 60 bits per second clocked by the AC line.

6.3.2 Message bits shall be set before the end of the positive half of the AC cycle, and shall remain unchanged throughout the negative half of the AC cycle.

6.3.3 The communication line shall rest in a logic 0 state, as described in section 6.2.2, when transmission is not taking place.

6.3.4 Power Up

6.3.4.1 A message shall be transmitted automatically starting 1 second after power up, or upon initial detection of a watchdog signal, whichever comes first.

6.3.5 Continuous Monitoring

6.3.5.1 A data bit must be present for at least three half power line cycles to be considered as a change of state, then a message shall be transmitted.

6.3.5.2 If there is no change of state in the data bits for longer than 60 seconds, either because the signal displays are at rest or any other reason, one message shall be transmitted at every 60 seconds to reflect the current condition of the signal display.

6.3.5.3 The data bits shall change their states in accordance with conditions defined in the description column in section 6.2.3.

6.3.5.4 Under a conflict condition, at least one message containing the conflict information shall be transmitted. Conflict information includes both the cause of conflict, which is defined by data bits 6, 7, and 8, and the actual conflicting signal displays.

6.3.5.5 Only one message shall be transmitted for each interval transition.

For example: The transition from Amber to Red on one or more fazes within two half power line cycles shall produce only one message, that is, the red or reds are on.

6.3.5.6 If the state of the data bits changes during a transmission, the Monitor shall provide memory space to store a minimum of 5 complete messages for later transmission.

6.3.5.7 If all storage memory spaces are filled and more messages are forthcoming, the overflow bit of the last stored message shall be set to a logic 1 to indicate that one or more messages have been lost.

6.3.5.8 Under the combined conditions described in section 6.3.5.4 and 6.3.5.7, a message containing conflict information shall never be dropped. It shall overwrite the last message in the storage memory space with its overflow bit set to a logic 1. The overflow bit in the second last message shall also be set to a logic 1.

6.3.5.9 The stored messages shall be transmitted, as soon as possible, in the same sequence as they were created.

6.3.6 Power Down

6.3.6.1 Transmission may terminate upon monitor power failure. The monitor, upon the loss of AC supply, does not have to retain any communication information in its memory.

6.4 FLASHING GREEN BALL INDICATOR

6.4.1 In the flashing green ball condition, the Y/G data bit of the flashing faze shall be set to a logic 1. The corresponding FGBI bit shall be set only while the flash is in effect. This will eliminate transmission of data each time the signal flashes on and off.

6.5 PROGRAMMED/EMERGENCY FLASH

6.5.1 The P/E flash condition is defined by the following condition. At least one signal display is flashing at a rate of 50 to 60 flashes per minute.

6.5.2 After the P/E flash data bit is set from 0 to 1, and the message containing this bit is transmitted, the communication line shall rest in a logic 0 state as described in Section 6.2.2. This will eliminate transmission of data each time the signals flash on and off.

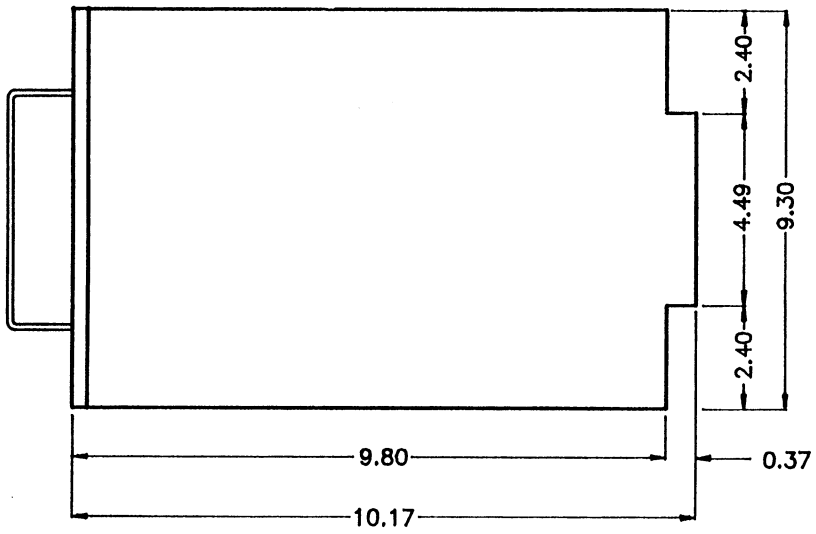
6.5.3 The signal displays shall be monitored continuously, and two updating messages shall be transmitted every 60 seconds, once each for ON and OFF signal display patterns.

6.5.4 A message shall be transmitted immediately upon the detection of any data bit change which is different from the P/E flash pattern.

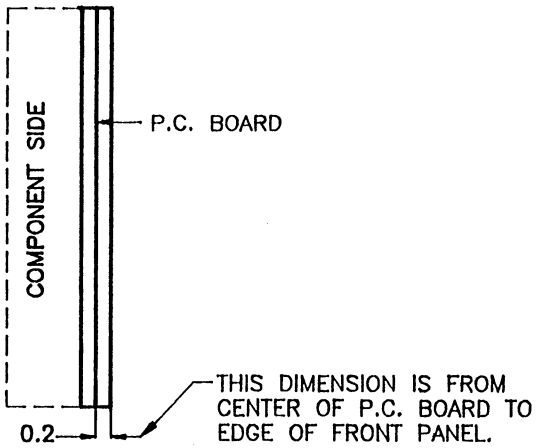
7 SOFTWARE DOCUMENTATION

7.1 GENERAL

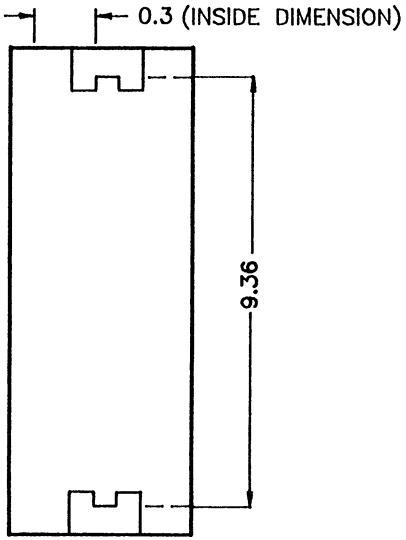
7.1.1 Software documentation shall meet the requirements of Chapter 1, Section 8.



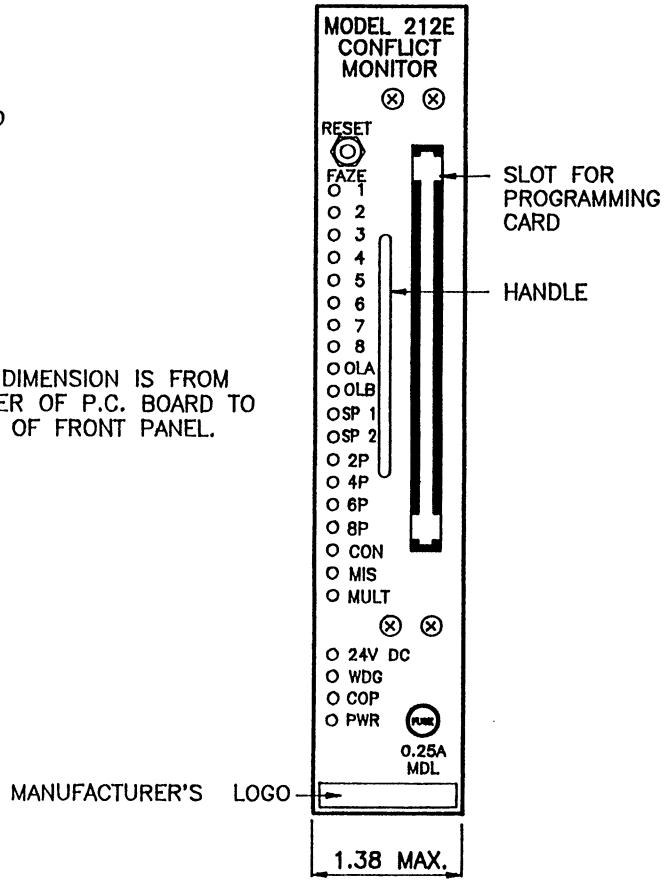
SIDE VIEW



END VIEW



MONITOR UNIT ENCLOSURE AND EDGE GUIDE



FRONT VIEW

NOTES:

PRINTED CIRCUIT BOARDS FOR THE MONITOR SHALL BE 0.0625 ± 0.002 INCHES THICK.
ALL DIMENSIONS ARE IN INCHES WITH ± 0.02 TOLERANCE UNLESS OTHERWISE SHOWN.

NOT TO SCALE

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

212E MONITOR OUTLINE

Date	96 11 29	Rev	2	OTSCES – 0410.01

MODEL 212 MONITOR UNIT PIN ASSIGNMENT

CONNECTOR PIN No.	MONITOR FUNCTION	TERMINATION	CONNECTOR PIN No.	MONITOR FUNCTION	TERMINATION
1	SWPK 2 GRN	FT 130	A	SWPK 2 YELO	FT 129
2	SWPK 2P GRN	FT 115	B	SWPK 6 GRN	FT 136
3	SWPK 6 YELO	FT 135	C	SWPK 6P GRN	FT 121
4	SWPK 4 GRN	FT 103	D	SWPK 4 YELO	FT 102
5	SWPK 4P GRN	FT 106	E	SWPK 8 GRN	FT 109
6	SWK 8 YELO	FT 108	F	SWPK 8P GRN	FT 112
7	SWPK 5 GRN	FT 133	H	SWPK 5 YELO	FT 132
8	T & B		J	SWPK 1 GRN	FT 127
9	SWPK 1 YELO	FT 126	K	T & B	
10	SWPK 7 GRN	FT 124	L	SWPK 7 YELO	FT 123
11	T & B		M	SWPK 3 GRN	FT 118
12	SWPK 3 YELO	FT 117	N	T & B	
13	SWPK 2P YELO	FT 114	P	SWPK 1 RED	FT 125
14	SWPK 2 RED	FT 128	R	SWPK 6P YELO	FT 120
15	T & B		S	T & B	
16	SWPK 4P YELO	FT 105	T	SWPK 3 RED	FT 116
*17	SWPK 4 RED	FT 101	*U	SWPK 8P YELO	FT 111
18	T & B		V	T & B	
19	SWPK 8 RED	FT 107	W	SWPK 7 RED	FT 122
20	EQ GND	01 – 9	X	SWPK 6 RED	FT 134
21	AC–	01 – 10	Y	DC GROUND	02 – 2
22	WATCHDOG TIMER	C4 – 37	Z	EXTERNAL RESET	02 – 5
23	+ 24 VDC	02 – 1	AA	T & B	
24	BD OUT CKT	LOGIC RELAY COIL	BB	STOP TIME	02 – 3
25	BD OUT CKT	DC GROUND	CC	SWPK 5 RED	FT 131
26	UNDELAYED CONFLICT	02 – 8	DD	COMMUNICATION	02 – 7
27	MODE SELECT	02 – 9	EE	OUTPUT SW SIDE 2	01 – 12
28	OUTPUT SW SIDE 1	01 – 15	FF	AC +	01 – 11

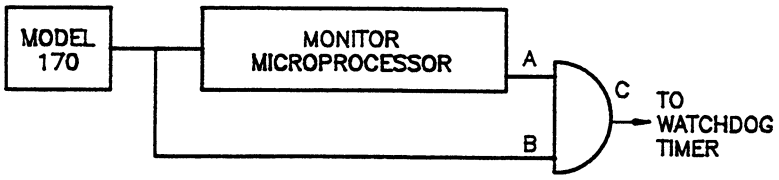
NOTES:

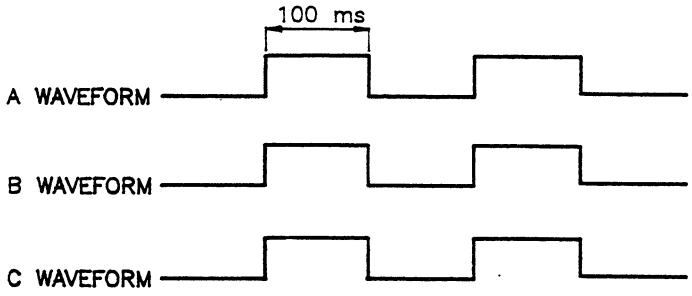
1. * KEYED
2. T & B CONNECTOR CONNECTED TO PIN, 2 FEET IN LENGTH WITH RING LUG ON UNCONNECTED END, BUNDLED AND TIED SEPARATELY.
3. FT FIELD TERMINAL.
4. PIN 24 AND 25 ARE TIED TOGETHER.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

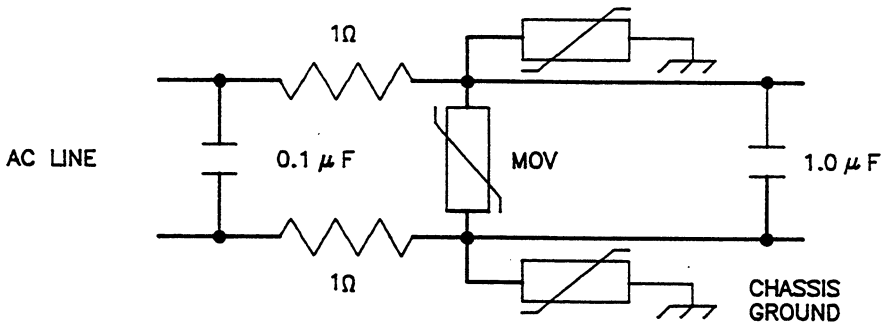
212 MONITOR PIN ASSIGNMENT

Date	94 11 09	Rev	1	OTSCES – 0410.02





INTERNAL FAILURE DETECTION

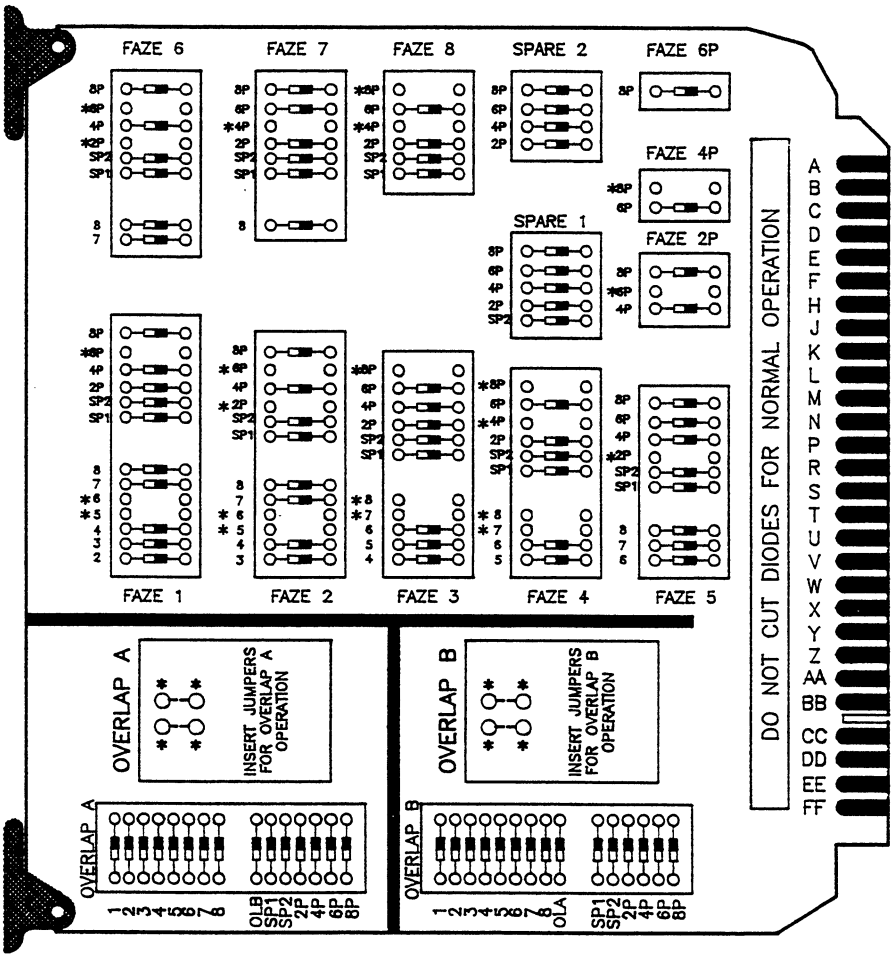


INPUT POWER DISTRIBUTION

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

212 MONITOR MISCELLANEOUS

Date	97 02 01	Rev		OTSCES – 0410.03



LAYOUT AND SILK SCREEN MASK FOR PROGRAMMING CARD

NOTE:

REMOVAL OF OVERLAP A OR B JUMPERS SHALL PRODUCE THE SAME RESULT AS THE REMOVAL OF ALL OVERLAP A OR B DIODES RESPECTIVELY.

* STANDARD 8–PHASE OPERATION

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS				
212 PROGRAMMING CARD OUTLINE				
Date	95 05 31	Rev	1	OTSCES – 0420.01

CIRCUIT SIDE		COMPONENT SIDE	
PIN #	FUNCTION	PIN #	FUNCTION
1	FAZE 2 GREEN	A	FAZE 1 GREEN
2	FAZE 3 GREEN	B	FAZE 2 GREEN
3	FAZE 4 GREEN	C	FAZE 3 GREEN
4	FAZE 5 GREEN	D	FAZE 4 GREEN
5	FAZE 6 GREEN	E	FAZE 5 GREEN
6	FAZE 7 GREEN	F	FAZE 6 GREEN
7	FAZE 8 GREEN	H	FAZE 7 GREEN
8	OVERLAP A GREEN	J	FAZE 8 GREEN
9	OVERLAP B GREEN	K	OVERLAP A GREEN
10	SPARE 1 GREEN	L	OVERLAP B GREEN
11	SPARE 2 GREEN	M	SPARE 1 GREEN
12	FAZE 2P GREEN	N	SPARE 2 GREEN
13	FAZE 4P GREEN	P	FAZE 2P GREEN
14	FAZE 6P GREEN	R	FAZE 4P GREEN
15	FAZE 8P GREEN	S	FAZE 6P GREEN
16	DC GROUND	T	CONFLICT
17	FAZE 1 YELLOW	U	OVERLAP A YELLOW
18	FAZE 2 YELLOW	V	OVERLAP B YELLOW
19	FAZE 3 YELLOW	W	SPARE 1 YELLOW
20	FAZE 4 YELLOW	X	SPARE 2 YELLOW
21	FAZE 5 YELLOW	Y	FAZE 2P YELLOW
22	FAZE 6 YELLOW	Z	FAZE 4P YELLOW
23	FAZE 7 YELLOW	AA	FAZE 6P YELLOW
24	FAZE 8 YELLOW	BB	FAZE 8P YELLOW
—		—	
25	N.C.	CC	N.C.
26	N.C.	DD	N.C.
27	N.C.	EE	N.C.
28	YELLOW INHIBIT COMMON	FF	N.C.

MATING CONNECTOR SHALL BE KEYED BETWEEN PINS 24 AND 25 AND ALSO BETWEEN BB AND CC.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

212 PROGRAMMING CARD PIN ASSIGNMENT

Date	97 02 01	Rev	1	OTSCES – 0420.02

212 PROGRAMMING CARD DIODE DATA

DIODES NOT TO BE INSTALLED (FAZE – DIODE #)	CONFLICT FUNCTION
1 – 5	FAZE 1 IN CONFLICT WITH FAZE 5
1 – 6	FAZE 1 IN CONFLICT WITH FAZE 6
1 – 6P	FAZE 1 IN CONFLICT WITH FAZE 6P
2 – 5	FAZE 2 IN CONFLICT WITH FAZE 5
2 – 6	FAZE 2 IN CONFLICT WITH FAZE 6
2 – 2P	FAZE 2 IN CONFLICT WITH FAZE 2P
2 – 6P	FAZE 2 IN CONFLICT WITH FAZE 6P
5 – 2P	FAZE 5 IN CONFLICT WITH FAZE 2P
6 – 2P	FAZE 6 IN CONFLICT WITH FAZE 2P
6 – 6P	FAZE 6 IN CONFLICT WITH FAZE 6P
2P– 6P	FAZE 2P IN CONFLICT WITH FAZE 6P
3 – 7	FAZE 3 IN CONFLICT WITH FAZE 7
3 – 8	FAZE 3 IN CONFLICT WITH FAZE 8
3 – 8P	FAZE 3 IN CONFLICT WITH FAZE 8P
4 – 7	FAZE 4 IN CONFLICT WITH FAZE 7
4 – 8	FAZE 4 IN CONFLICT WITH FAZE 8
4 – 4P	FAZE 4 IN CONFLICT WITH FAZE 4P
4 – 8P	FAZE 4 IN CONFLICT WITH FAZE 8P
7 – 4P	FAZE 7 IN CONFLICT WITH FAZE 4P
8 – 4P	FAZE 8 IN CONFLICT WITH FAZE 4P
8 – 8P	FAZE 8 IN CONFLICT WITH FAZE 8P
4P– 8P	FAZE 4P IN CONFLICT WITH FAZE 8P

CHAPTER 5

Specifications

For

Two Channel Loop Detector

Model 222

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1.2 GENERAL DESCRIPTION ..... - 1

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List of Drawings

Date	OTSCES No.	Rev	Title
June 1, 1992	0510.01	-	Model 222 - Loop Detector

1 GENERAL REQUIREMENTS

1.1 SCOPE

1.1.1 This chapter defines the specifications applicable to the Model 222 and Model 224 Loop Detector Units.

1.1.2 These specifications shall supplement the General Specifications for Traffic Control Equipment and in case of conflict the specification of this Chapter will govern.

1.2 GENERAL DESCRIPTION

1.2.1 The two-channel (Model 222) and four-channel (Model 224) loop detector sensor units contain two and four detector channels, respectively. The modules shall be compatible with and intermate to the standard input files. The detector channels working independently, will produce output signals when vehicles pass over or remain within wire loops embedded in the roadway.

1.2.2 The detector units shall be solid state design. The method of detection shall be based upon a design that shall render detection when a conductive metallic mass entering a loop causes a change of 0.01 percent in detector input inductance.

2 FUNCTIONAL REQUIREMENTS

2.1 OPERATIONAL SPECIFICATIONS

2.1.1 Each detector channel shall be capable of detecting all types of licensed motor vehicles at a distance of up to 800 feet from the loop to the detector sensor unit.

2.1.2 The detector sensor unit shall be mounted on an edge-connected, printed circuit board.

2.1.2.1 The 4-channel detector unit (Model 224) shall occupy the space of two 2-channel detector units.

2.1.3 Each detector channel shall not draw more than 100 milliamperes from the +24 volt DC cabinet power supply for its operating power.

2.1.4 The detector module front panel shall be provided with a hand pull to facilitate insertion and removal from the input file.

2.1.5 Each detector channel shall have a front panel-mounted indicator to provide visual indication of each vehicle detection.

2.1.6 The detector shall have either automatic or manual tuning and environmental self-tracking capabilities. Only front panel controls shall be used in the manual tuning operation.

2.1.7 The detector shall comply with all performance requirements herein specified when connected to an inductance (loop plus lead-in) of from 50 to 2000 microhenries with a Q-parameter as low as 5 at the detector's operating frequency.

2.1.8 Each detector channel output shall be an opto-isolated NPN open collector capable of sinking 50 milliamperes at 30 volts. This output shall be compatible with the controller unit inputs.

2.1.9 Each sensor unit shall intermate with and operate in a standard input file.

2.1.10 A switch position shall be provided to disable the output of each channel on an individual basis.

2.1.11 Loop inputs to each channel shall be transformer isolated.

2.1.12 Power failure or restoration shall not cause a channel output to the controller unit.

2.2 TUNING

2.2.1 The vehicle detector circuits shall be designed so that drift which occurs with regard to the environment and applied power shall not cause an actuation and shall not affect the normal operation of the amplifier.

2.3 MODE SELECTION REQUIREMENTS

2.3.1 Each detector channel shall have two selectable modes of detection - Pulse and Presence.

2.3.2 Pulse Mode

2.3.2.1 In the pulse mode, each new vehicle presence within the zone of the detection shall initiate a detector channel output pulse of 125±25 milliseconds in duration.

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

2.3.3 Presence Mode

2.3.3.1 In the presence mode, the detector channel shall recover to normal sensitivity within one second after termination of vehicle presence in the zone of detection regardless of the duration of the presence.

2.3.3.2 With the detector channel in its most sensitive setting, the presence of a vehicle in the zone of detection shall be detected a minimum of 3 minutes for a vehicle causing 0.01 percent inductance change and a minimum of 10 minutes for a vehicle causing 0.60 percent inductance change.

2.3.3.3 The lowest sensitivity setting in the presence mode is designated as the "Occupancy" (OCC) setting. With the detector channel in the OCC setting, the presence of a vehicle causing a one percent, or greater, change of inductance shall be detected for a minimum of 4 minutes.

2.4 SENSITIVITY

2.4.1 Each detector channel shall be equipped with panel selectable sensitivity setting(s) in both presence and pulse modes to accomplish the following under operational and environmental requirements of this specification:

2.4.1.1 Each detector channel shall respond to an inductance change of 0.02 percent while connected to the following three turn loop configurations:

2.4.1.1.1 Single 6' by 6' loop with a 50-foot lead-in cable.

2.4.1.1.2 Single 6' by 6' loop with a 800-foot lead-in cable.

2.4.1.1.3 Four 6' by 6' loops connected in series/parallel with a 250-foot lead-in cable.

2.4.1.1.4 Four 6' by 6' loops connected in series with a 800-foot lead-in cable.

2.4.1.2 Each detector channel shall respond to Occupancy (OCC) setting(s) to a nominal change in inductance between 0.15 percent to 0.4 percent while connected to the above loop configurations. This setting shall not respond to an inductance change of less than 0.1 percent.

2.4.2 The detector channel shall not detect vehicles, moving or stopped, at distances of 3 feet or more from any loop perimeter.

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

2.5 RESPONSE TIMING

2.5.1 Response time of the detector channel for the OCC setting shall be less than 20 milliseconds. That is, for any negative inductive change which exceeds its sensitivity threshold, the channel shall output a ground true logic level within 20 milliseconds. When such change is removed, the output shall become an open circuit within 20 milliseconds. For test purposes, the negative change of inductance will be maintained for a minimum of 100 milliseconds and a maximum of 600 milliseconds after it is applied. When the difference between the length of time the inductance change is applied, and the corresponding ground true output time are averaged over ten trials, the value that average difference shall not exceed 10 milliseconds.

2.5.2 The response time of the detector channel for the most sensitive setting shall be less than 250 milliseconds for a 1.0 percent inductance change.

2.5.3 For a two channel loop detector with one or both channels active, the response time at sensitivity settings where the inductance change is 0.32% or greater shall be 20 milliseconds or less. The above performance characteristics shall be met when the detector is connected to an inductance (loop plus lead-in) of 50 to 2000 microhenries, and operating in a temperature range of -37°C to +74°C.

3 ELECTRICAL REQUIREMENTS

3.1 APPLICATION OF POWER

3.1.1 The detector channels shall begin normal operation within ten seconds after the application of power or the reset signal.

3.2 INTERFERENCE

3.2.1 The separate channels contained within a given unit shall include means to prevent cross-talk with one another.

3.2.2 Each unit shall include means to prevent cross-talk with other modules. If the prevention means is manual, the control for it shall be located on the front panel of the unit. No additional external wiring shall be required to implement the prevention means.

3.3 LIGHTNING PROTECTION

3.3.1 Lightning protection shall be installed within the detector unit.

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

3.3.3 The protection shall enable the detector to withstand the discharge of a 10 microfarad capacitor charged to ±2000 volts directly across either the detector input inductance pins or from either side of the detector input inductance pins to earth ground. The detector chassis shall be grounded and the detector input pins shall have a dummy resistive load attached equal to 5.0 ohms.

3.4 TRACKING RATE

3.4.1 The detector shall be capable of compensating or tracking for an environmental change up to 0.001 percent change in inductance per second. This requirement shall be met within two hours after initial application of operating power.

3.5 TRACKING RANGE

3.5.1 The detector shall be capable of normal operation as the input inductance is changed ±5.0 percent from the quiescent tuning point regardless of internal circuit drift.

3.5.2 The detector shall be capable of normal operation as the input resistance is changed ±0.5 percent from the quiescent tuning point regardless of internal circuit drift.

3.6 TEMPERATURE CHANGE

3.6.1 The operation of the detector unit shall not be affected by changes in the inductance of the loop caused by environmental changes with the rate of temperature change not exceeding 1°C per three minutes. The opening and closing of the controller cabinet door with a differential temperature of 18°C between the inside and outside shall not affect the proper operation of the detector.

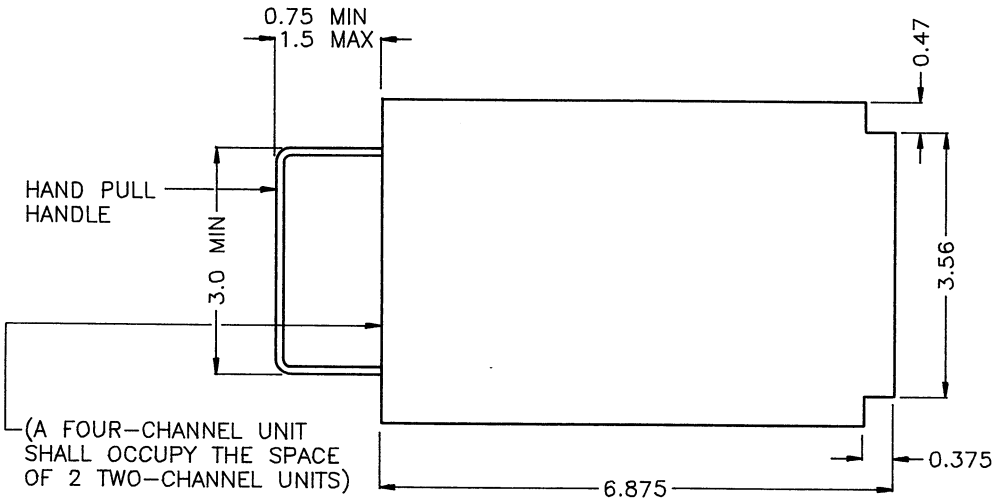
3.7 BOARD EDGE CONNECTOR PIN ASSIGNMENT

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

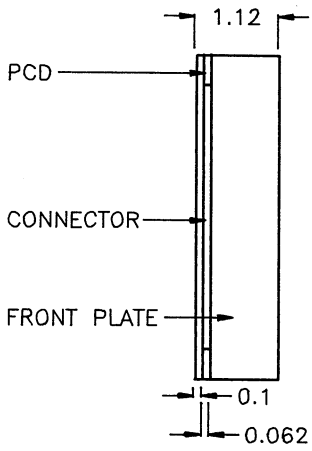
__ Slotted for keying
(C) Collector
(E) Emitter

3.8 RESET

3.8.1 The detector unit shall respond to a ground reset signal of 15 microseconds and begin normal operation within 10 seconds after the reset command.



SIDE VIEW



END VIEW

NOTES:

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SHOWN
NOT TO SCALE

ONTARIO TRAFFIC SIGANAL CONTROL EQUIPMENT SPECIFICATIONS				
MODEL 222 – LOOP DETECTOR				
DATE:	92 06 01	REV.		OTSCE – 0510.01

CHAPTER 7

Specifications

For

Two Channel DC Isolator

Model 242

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List of Drawings

Date	OTSCES No.	Rev	Title
June 1, 1992	0710.01	-	Model 242 - DC Isolator

1 GENERAL REQUIREMENTS

1.1 SCOPE

1.1.1 This chapter defines the specifications applicable to the Model 242 DC Isolator.

1.1.2 These specifications shall supplement the General Specifications for Traffic Control Equipment and in case of conflict the specification of this Chapter will govern.

1.2 GENERAL DESCRIPTION

1.2.1 The 2-channel and 4-channel DC isolators are units, containing two or four isolation channels respectively, which plug into the standard Input File. Each isolation channel, shall be independent and shall provide isolation between electrical contacts external to the module (pedestrian push buttons, pre-emption, etc.) and the controller unit input.

1.2.2 The isolators shall be of solid state design. The method of isolation shall be based upon a design which shall provide reliable operation.

2 FUNCTIONAL REQUIREMENTS

2.1 The DC isolator shall be mounted on an edge-connected printed circuit board.

2.1.1 The 4-channel isolator shall occupy the space of two 2-channel isolators.

2.2 The isolator shall have an internal power supply which shall supply +20±4 Volts DC to the field input side of the isolation channels. The Model 242 Isolator shall not draw more than 2.5 watts of power and the Model 244 more than 5 watts.

2.3 The isolator front panel shall be provided with a hand-pull to facilitate insertion and removal from the input file enclosure.

2.4 Each isolation channel shall have a front panel-mounted indicator to provide visual indication of each electrical contact closure and test switch to place an input to the isolation channel. Both indicator and switch shall be on the field input side of the isolator. Test switch shall be a single pole-double throw, three-position switch; momentary ON, OFF and maintained ON positions. The contacts shall be either silver or coin silver with gold overnickel plate rated for 5 amperes at 120 Volts AC.

2.5 Each isolation channel output shall be an opto-isolated NPN open collector capable of sinking 50 millimperes at 30 volts. This output shall be compatible with the Model 170 Controller Unit. Each isolation channel shall present ground true logic to the controller unit inputs.

2.6 Field contact closure to the isolation channel shall cause a channel output of 100 milliseconds minimum duration. The contact closure input shall be 5 milliseconds minimum in duration before actuating the isolation channel output. The channel shall reset within 10 milliseconds after opening of either field contact or test switch.

2.7 Power failure or restoration shall not cause a channel output to the controller unit.

3 ELECTRICAL REQUIREMENTS

3.1 ELECTRICAL INPUT INTERFACE

3.1.1 Each isolation channel field input shall be turned on (true) when a contact closure causes an input voltage of less than 8 volts DC, and shall be turned off (false) when the contact opening causes the input voltage to exceed 12 volts DC. Each input shall deliver no less than 15 milliamperes, or more than 40 milliamperes to an electrical contact closure or short from the power supply.

3.2 ISOLATION

3.2.1 The minimum isolation shall be 1000 megohms and 2,500 volts DC from input to output.

3.3 BOARD EDGE CONNECTOR PIN ASSIGNMENT

PIN	FUNCTION	PIN	FUNCTION
A	DC Ground	N	AC+
B	+24 VDC	P	Loop #3 Input
C	N/C	R	Loop #3 Input
D	Loop #1 Input	S	Loop #3 Output(C)
E	Loop #1 Input	T	Loop #3 Output(E)
F	Loop #1 Output(C)	U	Loop #4 Input
H	Loop #1 Output(E)	V	Loop #4 Input
J	Loop #2 Input	W	Loop #2 Output(C)
K	Loop #2 Input	X	Loop #2 Output(E)
L	Chassis Ground	Y	Loop #4 Output(C)
M	AC-	Z	Loop #4 Output(E)

__ Slotted for keying
(C) Collector
(E) Emitter
N/C Not Connected

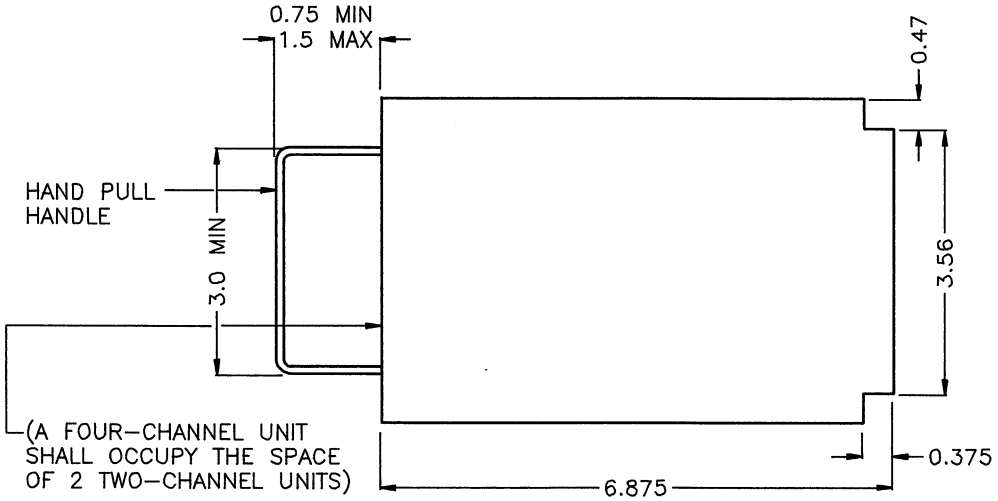
3.4 LIGHTING PROTECTION

3.4.1 Lightning protection shall be installed inside the isolator.

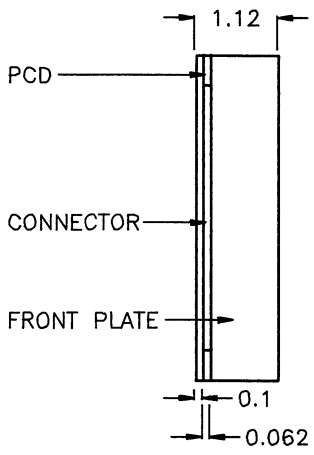
3.4.1.1 The protection shall enable the isolator to withstand the discharge of a 10 microfarad capacitor charged to ±1000 volts directly across the input pins with no load present.

3.4.1.2 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.

3.4.1.3 The input pins shall have a dummy resistive load attached equal to 5.0 ohms.



SIDE VIEW



END VIEW

NOTES:

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SHOWN
NOT TO SCALE

ONTARIO TRAFFIC SIGANAL CONTROL EQUIPMENT SPECIFICATIONS				
MODEL 242 – DC ISOLATOR				
DATE:	92 06 01	REV.		OTSCE – 0710.01

CHAPTER 8

Specifications

For

Two Channel AC Isolator - Model 252

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1.2 GENERAL DESCRIPTION ..... - 1

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3 ELECTRICAL REQUIREMENTS ..... - 3

4 EDGE CONNECTOR PIN ASSIGNMENT ..... - 4

List of Drawings

Date	OTSCES No.	Rev	Title
June 1, 1992	0810.01	-	Model 252 - AC Isolator

1 GENERAL REQUIREMENTS

1.1 SCOPE

1.1.1 This chapter defines the specifications applicable to the Model 252 Two Channel AC Isolator.

1.1.2 These specifications shall supplement the General Specifications for Traffic Control Equipment and in case of conflict the specification of this Chapter will govern.

1.2 GENERAL DESCRIPTION

1.2.1 A Two-Channel AC Isolator is unit containing two isolation channels and plugging into the cabinet input file. Each channel shall be independent and shall provide isolation among the 120 VAC input circuit, the output signal to the controller, the cabinet power supply and all other active circuits.

1.2.2 The AC Isolator shall be of solid-state design.

1.2.3 The AC Isolator shall be mounted on an edge-connected, printed-circuit board.

1.2.4 The AC Isolator shall have a front panel with a hand-pull device to facilitate insertion to and removal from the input file enclosure. The front panel shall be labelled with the model number and the title "AC Isolator".

1.2.5 Each isolation channel shall have a front panel-mounted indicator to provide visual indication of an output signal to the controller and a test switch to simulate a valid input.

1.2.6 The test switch shall be a single-pole, double-throw three-position switch with momentary ON, maintained OFF and maintained ON positions. The contact shall be silver or coin silver with gold over nickel plate rated for 5 amperes at 120 VAC.

2 FUNCTIONAL REQUIREMENTS

2.1 Each isolation output shall be an opto-isolated NPN open collector capable of sinking 50 milliamperes at 30 VDC. The output signal shall be compatible with the Model 170 controller. Each isolation channel shall present a ground true logic to the controller input.

2.2 A valid input to the AC Isolator or the closure of the test switch shall cause an output signal of 100 milliseconds minimum duration. The AC Isolator output shall reset within 20 milliseconds after the valid input is removed or at the opening of the test switch.

2.3 The AC Isolator shall not draw more than 2.5 watts of power per channel from the cabinet power supply.

2.4 Power failure or restoration shall not cause a channel output to the controller unit.

3 ELECTRICAL REQUIREMENTS

3.1 Each isolation channel output shall be turned on when an input of greater than 55 VAC is applied for a period of 100 milliseconds or longer at one-half watt of power.

3.2 Each isolation channel output shall be turned off when the input falls below 40 VAC for a period of 100 milliseconds or longer.

3.3 The minimum isolation among the 120 VAC input circuit, the output signal to the controller, the power supply and all other active circuits shall be 1000 megohms at 2500 VDC.

3.4 A lightning protection shall be installed within the AC Isolator.

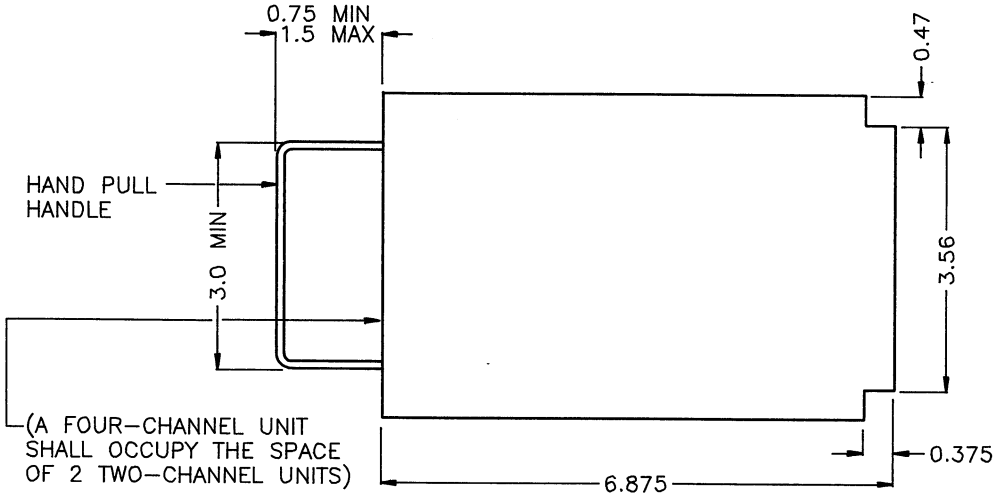
3.5 The protection shall enable the AC Isolator to withstand the discharge of 10 microfarad capacitor, charged to ±1000 volts, directly across the input terminals with no load present and to continue normal operation.

3.6 The protection shall enable the AC Isolator to withstand the discharge of a 10 microfarad capacitor, charged to ±2000 volts, directly across the input terminals or between either side of the input terminals to equipment ground and to continue normal operation. A dummy resistive load of 5 ohms shall be attached to the input terminals during test.

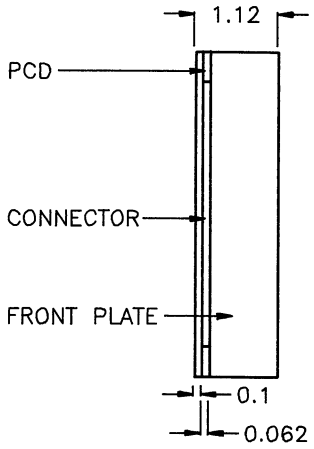
4 EDGE CONNECTOR PIN ASSIGNMENT

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

___ Slotted for keying
(C) Collector
(E) Emitter
N/C Not Connected



SIDE VIEW



END VIEW

NOTES:

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SHOWN
NOT TO SCALE

ONTARIO TRAFFIC SIGANAL CONTROL EQUIPMENT SPECIFICATIONS				
MODEL 252 – AC ISOLATOR				
DATE:	92 06 01	REV.		OTSCE – 0810.01

CHAPTER 9

Specifications

For

Switch Pack - Model 200

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2 **FUNCTIONAL REQUIREMENTS** ..... - 2

3 **SOLID STATE SWITCHES** ..... - 3

4 **CONNECTOR REQUIREMENTS** ..... - 4

List of Drawings

Date	OTSCES No.	Rev	Title
June 1, 1992	0910.01	-	Model 200 - Switch Pack

1 GENERAL REQUIREMENTS

1.1 This chapter defines the specifications applicable to the Model 200 Switch Pack.

1.2 These specifications shall supplement the General Specifications for Traffic Control Equipment and in case of conflict the specification of this Chapter will govern.

2 FUNCTIONAL REQUIREMENTS

2.1 Each solid state switch pack shall be a modular assembly containing three solid state switches to be used for opening and closing connections between the applied power and the traffic signals.

2.2 The overall physical dimensions of the switch pack case shall be 7 3/8 inches ±1/8 inch from the panel surface holding the plug connector to the front of the switch pack. The switch pack shall be no wider than 1.75 inches and no higher than 4.2 inches. The switch pack shall be provided with a connector Cinch-Jones Type #P2412-SB, or equivalent.

2.2.1 A dust resistant, metal enclosure, suitably protected against corrosion, shall be provided to enclose all electrical parts of the switch pack.

2.3 The front panel of the switch pack shall be provided with three light emitting diodes to indicate the output of controller unit circuits "Red", "Yellow" and "Green". Indicators shall be labelled or color coded and mounted as follows:

"Red" at top, "Yellow" in middle, and "Green" at bottom.

2.4 Switch pack control circuitry and switches shall be readily accessible by the use of a screwdriver or wrench.

2.5 Each switch pack shall be so constructed that persons inserting or removing the switch pack will not be exposed to any parts having live voltage, and will not be required to insert hands or fingers into the cabinet output file. A handle or gripping device shall be attached to the front of each switch pack.

2.6 The switch pack shall be so constructed that its lower surface will be no more than 2.100 inches below the centerline of the connector configuration and that no part will extend more than 0.900 inches to the left and 1.100 inches to the right of the centerline of the connector pin configuration.

2.7 Edge guides shall be provided on the switch pack.

2.8 During normal operation (no circuit or one circuit energized) the switch pack shall not use more than 20 milliamperes from a +24 volt DC source.

2.9 The switch pack shall not apply more than 30 volts, peak, to the signal input line, nor shall the input signal source be required to sink more than 20 milliamperes.

2.10 The switch pack handle shall be manufactured with no sharp edges or corners. This will allow safe removal and insertion of the switch pack.

3 SOLID STATE SWITCHES

3.1 Three solid state switches shall be installed within each solid state switch pack. Each switch shall have the capability of switching any current from 0.05 to 10 amperes of tungsten lamp load at 120 volts, 60 Hertz, or 10 amperes at a power factor of 0.85 and a temperature of 74°C.

3.2 A low-level input, negative true logic, from the controller unit (saturated NPN transistor, 0 to +6.0 volts) shall cause the switch to be energized. A high-level input (cut-off NPN transistor, +16 volts or greater) shall cause the switch to de-energize. A transition zone from conducting to nonconducting (or vice versa) shall occur between 6 and 16 volts.

3.3 Each switch shall turn on within plus or minus five degrees of the zero voltage point of the AC sinusoidal line, and shall turn off within plus or minus five degrees of the zero current point of the alternating current sinusoidal line. The zero voltage turn on may be within plus or minus ten degrees of the zero voltage point only during the first half cycle of line voltage during which an input signal is applied.

3.4 Each signal shall be rated for a minimum of 30 million operations while switching a tungsten filament load of 1,000 watts.

3.5 Each switch shall have isolation between input DC control and AC to lights output circuit of 2,000 volts DC, or better, and 10,000 megohms DC.

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

3.7 Each switch shall have an OFF state dv/dt rating of 100 volts per microsecond.

3.8 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 milliamperes peak.

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

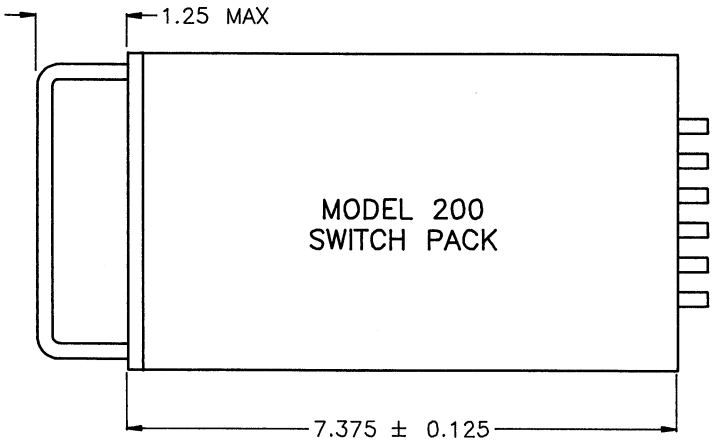
3.10 Each switch shall be isolated so that line transients or switch failure will not adversely affect the controller unit.

3.11 Each switch shall be capable of withstanding a peak inverse voltage of 500 volts.

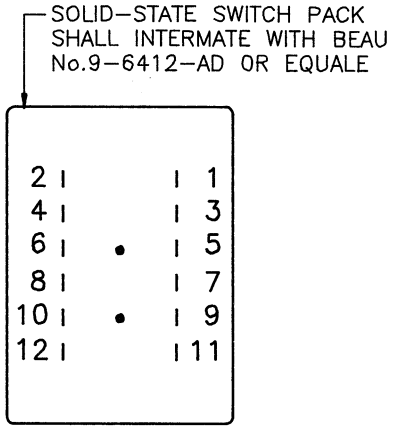
3.12 Solid state switches may utilize encapsulated components.

4 CONNECTOR REQUIREMENTS

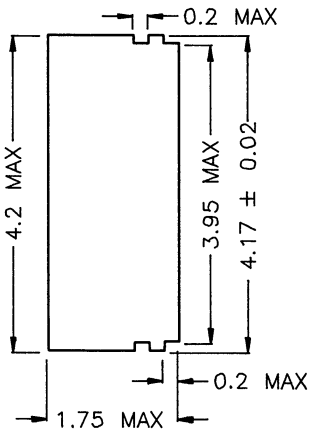
4.1 The connector and pin assignments shall be as shown on the drawing.



SWITCH PACK SIDE VIEW



SOCKET BACK VIEW



SWITCH PACK
CROSS SECTION

PIN	FUNCTION
1	AC+
2	EQUIP GROUND
3	A OUTPUT (RED, DON'T WALK)
4	SPARE
5	B OUTPUT (YELLOW)
6	A INPUT (RED, DON'T WALK)
7	C OUTPUT (GREEN, WALK)
8	B INPUT (YELLOW)
9	+24VDC
10	C INPUT (GREEN, WALK)
11	SPARE
12	SPARE

ONTARIO TRAFFIC SIGANAL CONTROL EQUIPMENT SPECIFICATIONS

MODEL 200-SWITCH PACK

DATE:	92 06 01	REV.		OTSCE – 0910.01

CHAPTER 10

Specifications

For

Flasher Unit - Model 204

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- **1.1 SCOPE** ..... - 1
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3 ELECTRICAL REQUIREMENTS ..... - 3

4 MECHANICAL REQUIREMENTS ..... - 4

5 CONNECTOR REQUIREMENTS ..... - 5

List of Drawings

Date	OTSCES No.	Rev	Title
June 1, 1992	1010.01	-	Model 204 - Flasher Unit

1 GENERAL REQUIREMENTS

1.1 SCOPE

1.1.1 This chapter defines the specifications applicable to the Model 204 Flasher.

1.1.2 These specifications shall supplement the General Specifications for Traffic Control Equipment and in case of conflict the specification of this Chapter will govern.

1.2 GENERAL DESCRIPTION

1.2.1 A Flasher Unit shall be a plug-in device containing a flasher control circuit and solid state switches. This unit will be used for alternate opening and closing connections between the applied power and the traffic signal lamps during flashing operation.

2 FUNCTIONAL REQUIREMENTS

2.1 The Flasher Unit Model 204 shall have an internal power supply for logic and control.

2.2 The Flasher Unit shall commence flashing operation when AC power is applied to the input terminals.

2.3 The Flasher Unit shall provide fifty to sixty flashes per minute with a 50 percent duty cycle.

2.4 The interior of the Flasher Unit shall be readily accessible by the use of screw driver or wrench.

3 ELECTRICAL REQUIREMENTS

3.1 The Flasher Unit shall draw its power from the input AC line.

3.2 Each solid state output switch of the unit shall have an OFF state dv/dt rating of 200 volts per microsecond or better.

3.3 Each output switch shall be capable of withstanding a peak inverse voltage of 500 volts.

3.4 Each output switch shall be capable of switching any current from 0.03 to 10 amperes of tungsten lamp load at 120 volts, 60 Hertz, or 10 amperes at a power factor of 0.85 and at 70°C.

3.5 Each output switch shall turn on within ± 5 degrees of the zero voltage point of the AC sinusoidal line, and shall turn off within ± 5 degrees of the zero current point of the alternating current sinusoidal line. The zero voltage turn on may be within ± 10 degrees of the zero voltage point only during the first half cycle of line voltage during which an input control signal is applied.

3.6 The output switches shall have a mean time between failure of 30 million operations or greater when switching a tungsten filament load of 1000 watts per switch.

3.7 The output switches shall have a one cycle surge rating of 175 amperes RMS of 247.5 amperes peak and a one second surge rating of 40 amperes RMS.

3.8 The output switches shall have isolation between input and output of 2000 VDC or better and 10,000 megohms DC. The unit shall also have 50 million ohms DC resistance from output to earth ground.

3.9 Light emitting diodes shall be mounted on the Flasher Unit to indicate when each output is on and off.

3.10 A surge arrestor shall be provided between Chassis GND (Pin 9) and Flashing Out (Pins 7 and 8). The surge arrestor shall be capable of reducing the effect of a transient voltage applied to the field signal circuits, and shall have the following ratings:

Recurrent peak voltage:	212 volts
Energy rating, maximum:	20 Joules
Power Dissipation, average:	0.85 watts
Stand-by current:	less than 1 milliampere

Peak current for pulses less than 6 microseconds: 2000 amperes

4 MECHANICAL REQUIREMENTS

4.1 The dimensions of the Flasher Unit shall be the same as shown on the plans for Model 200 Switch Pack.

4.2 The Flasher Unit shall be constructed so that its lower surface will be 2.100 inches to 2.100 + 0.05 inches below the centerline and so that no part will extend more than 0.850 inch to the left or more than 1.050 inches to the right of the centerline of the connector configuration.

4.3 When the Flasher Unit is in place, no electrically energized parts shall be exposed.

4.4 The flasher handle shall be manufactured with no sharp edges or corners. This will allow safe removal and insertion of the flasher. A handle or gripping device shall be provided on the front panel of the Flasher Unit.

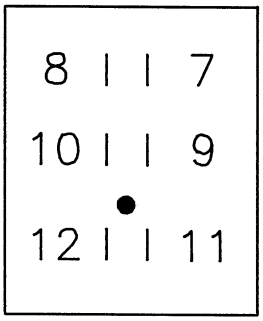
4.5 Edge guides shall be provided on the Flasher Unit.

5 CONNECTOR REQUIREMENTS

5.1 All electrical connections into and out of the Flasher Unit shall be through a multi-terminal connector, Cinch-Jones Type #P-2406-SB or equal. The connector shall be rigidly fixed to the rear or base of the Flasher Unit.

5.2 The Flasher Unit shall intermate with a Beau Type #S5406 or equal connector as shown on the plans.

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PIN CONNECTION

PIN No.	CIRCUIT
7	LD CKT #1
8	LD CKT #2
9	EQ GND
10	AC−
11	AC+
12	NA

ONTARIO TRAFFIC SIGANAL CONTROL EQUIPMENT SPECIFICATIONS

MODEL 204−FLASHER UNIT

DATE:	92 06 01	REV.		OTSCE − 1010.01

CHAPTER 11

Specifications

For

Heavy Duty Relays - Model 430

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2 **FUNCTIONAL REQUIREMENTS** ..... - 2

3 **CONNECTOR REQUIREMENTS** ..... - 3

List of Drawings

Date	OTSCES No.	Rev	Title
June 1, 1992	1110.01	-	Model 430 - Heavy Duty Relay

1 GENERAL REQUIREMENTS

1.1 This chapter defines the specifications applicable to the Model 430 Heavy Duty Relays.

1.2 These specifications shall supplement the General Specifications for Traffic Control Equipment and in case of conflict the specification of this Chapter will govern.

2 FUNCTIONAL REQUIREMENTS

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

2.2 Each relay shall operate in the 8-pin Jones-type socket shown on the plans and shall be enclosed with a removable, clear plastic cover.

2.3 Each relay shall be provided with double-pole, double-throw contacts. Contact points shall be made of fine silver, silver-alloy or superior alternative material. Contact arms shall be flat solid copper strips. Contact points and contact arms shall be capable of carrying a current of 20 amperes tungsten load, per contact, at 120 volts AC without undue pitting. Relay coils shall have a power consumption of 10 volt-amperes or less and shall be designed for continuous duty at 120 volts AC.

2.4 Each relay shall withstand a potential of 1500 volts at 60 hertz between insulated parts and between current carrying parts and non-current carrying parts.

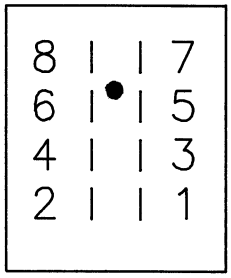
2.5 Each relay shall have a one-cycle surge rating of 175 amperes RMS.

2.6 Contacts shall be designed for 1,000,000 operations.

3 CONNECTOR REQUIREMENTS

3.1 The connector and pin assignments shall be as shown on the plans.

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PIN CONNECTION

PIN No.	CIRCUIT
1	COIL
2	COIL
3	NC CKT #1
4	NC CKT #2
5	COM CKT #1
6	COM CKT #2
7	NO CKT #1
8	NO CKT #2

NOTE:

EACH CONTACT SHALL BE RATED 15 AMPERS MINIMUM

ONTARIO TRAFFIC SIGANAL CONTROL EQUIPMENT SPECIFICATIONS

MODEL 430–HEAVY DUTY RELAY

DATE:	92 06 01	REV.		OTSCE – 1110.01

CHAPTER 12

Specifications

For

Modem - Model 400

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2 MODEM REQUIREMENTS ..... - 2

1 GENERAL REQUIREMENTS

1.1 This chapter defines the specifications applicable to the Model 400 Modem.

1.2 These specifications shall supplement the General Specifications for Traffic Control Equipment and in case of conflict the specification of this Chapter will govern.

2 MODEM REQUIREMENTS

2.1 The MODEM shall provide for 1-way or 2-way, 2-wire half duplex and 4-wire full duplex communications.

2.2 The MODEM shall comply with the following requirements:

2.2.1 Data Rate: Serial, 300 to 9600 Baud Modulation

2.2.2 Modulation: Frequency Shift Keying (FSK)

2.2.3 Operation: Asynchronous

2.2.4 Line and signal requirements: Type 3002 Voice-grade

2.2.5 Interface: EIA RS-232-C Standards

2.2.6 Tone Carrier Frequencies: 1200 Hz - 2200 Hz

2.2.7 Transmitting Output Signal Level:
0, -2, -4, -6, and -8 dbm continuous or switch selectable.

2.2.8 Received Input Sensitivity: 0 to -40 dbm

2.2.9 Receiver Bandpass Filter: shall provide a minimum of 20 db attenuation at frequencies outside the operating band.

2.2.10 Clear-to-Send Delay: Turn around time of 10 milliseconds

2.2.11 Carrier Response Time: 8 milliseconds

2.2.12 Soft Carrier Turn Off Time: 10 milliseconds

2.2.13 MODEM Recovery Time: capable of receiving data within 10 milliseconds after completion of transmissions.

2.2.14 Error Rate: not to exceed 1 bit in 10^5 bits with a signal to noise ratio of 16 db with noise flat weight over a 300 to 3400 Hz band.

2.2.15 ACIA Interface: comply with EIA RS-232-C Standards

2.2.16 Transmit Noise: less than -50 db across 1600 ohm resistive load within the frequency Spectrum of 300 to 3000 Hz at maximum output.

2.3 Communications shall be switch selectable between half and full duplex.

2.4 The MODEM power requirements are as follows:

Input Voltages	Maximum Current
+12 VDC	150 Milliamperes
-12 VDC	150 Milliamperes

2.5 Indicators shall be provided on the front edge of the MODEM indicating Carrier Detect, Transmit Data, and Receive Data.

2.6 Must interface to and operate in Type 170 controller unit.

2.7 Must decode Ontario test program properly.

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CHAPTER 13

Specifications

For

Thermostat Panels

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List of Drawings

Date	OTSCES No.	Rev	Title
June 1, 1992	1310.01	-	Analog Thermostat Panel
November 9, 1994	1320.01	1	Digital Thermostat Panel
November 9, 1994	1330.01	-	Bypass Switch Details

1 GENERAL REQUIREMENTS

1.1 SCOPE

1.1.1 This chapter defines the specifications applicable to the Model 500 series Thermostats for installation in Model 332 series and Model 401 series Cabinets.

1.1.2 These specifications shall supplement the General Specifications for Traffic Control Equipment and in case of conflict the specification of this Chapter will govern.

1.2 MECHANICAL REQUIREMENTS

1.2.1 The mounting position within the rack area is shown in the cabinet details. Conductors and other attachments to the thermostat panel will have sufficient length such that this panel may be positioned in the top of the rear rack. The panel shall not extend below 4 inches of the top of the rack space. The cabinet shall be supplied with the panel mounted as shown on the plans.

1.2.2 The thermostat panel shall be designed for mounting in a standard EIA 19-inch rack. The panel shall utilize no more than 3.5" (89 mm) of rack height and shall not be more than 4" (100 mm) in depth. The panel shall be enclosed on all sides. Adequate ventilation openings shall be provided in the thermostat panel for proper operation of the thermostat.

1.2.3 All thermostats, fuses, switches, indicating lamps, displays and push buttons shall be labelled as to their function.

1.2.4 All equipment terminals and terminal blocks in the cabinet shall be clearly and permanently labelled.

1.2.5 All labelling on or in the cabinet, including components, terminals and terminal blocks, but not including conductors shall be carried out by a process of stamping or screening. Stickers will only be permitted on conductors.

1.2.6 All thermostats shall be labelled and calibrated in degrees celcius for the range specified.

1.3 ELECTRICAL REQUIREMENTS

1.3.1 The thermostat contacts shall have adequate ratings to drive the associated equipment to the following minimum values:

a)	Heater	1500 Watts
b)	Fan	200 Watts
c)	Critical Equipment	1500 Watts

1.3.2 All connections to external equipment shall be easily accessible for servicing. Terminal blocks shall be used to provide break points for easy replacement of the device and the rack. All high voltage points shall be covered with clear insulating material. Printed circuit board and electronic components shall be enclosed.

1.3.3 The terminal blocks for control wires shall be the barrier type and shall be provided with 8/32" x 5/16" minimum nickel plated brass binder head screws and inserts. Terminal blocks shall be rated 15A, 600 V RMS minimum.

1.3.4 All fuses for thermostat and for connected equipment shall be mounted on the front of the panel.

1.3.5 Fuses for the fan shall be 1/4" x 1 1/4" slow blow type. Fuses for the heater shall be 13/32" x 1 1/2" heavy duty, slow blow type. The fuses and the branch conductors shall be rated at 125% of their full load current.

1.3.6 Transient suppression shall be provided at all relay bases (across relay coils), thermostat contacts in the fan circuit and heater circuit.

1.3.7 In the event of a power failure, the thermostat panel shall remove power to all controlling devices (fan, heater and critical equipment). (See Chapter 1, Section 9, Glossary for the definition of a Power Failure)

2 ANALOG THERMOSTATS - MODEL 500A

2.1 FUNCTIONAL REQUIREMENTS

2.1.1 The thermostat panel shall be sized to suit a standard EIA 19 inch rack and shall utilize 3.5 inches of rack height as per OTSCES Drawing 1310.01.

2.1.2 The thermostat panel shall provide thermostat control of fan and heater.

2.1.3 The thermostat shall be of electromechanical or electronic design. Thermostats shall have front dials for temperature setting and shall not require any special tools for adjustment except a slot screwdriver.

2.2 SYSTEM CRITERIA

2.2.1 The heater thermostat shall be manually adjustable to turn on heater between -20°C to +10°C with a differential of not more than 6°C and not less than 3°C.

2.2.2 The fan thermostat shall be manually adjustable to turn on the fan between +33°C to +65°C with a differential of not more than 6°C and not less than 3°C.

2.2.3 The actual turn-on temperature shall be ±2°C within the set point.

3 DIGITAL THERMOSTATS - MODEL 500D

3.1 FUNCTIONAL REQUIREMENTS

3.1.1 The thermostat panel shall be sized to suit a standard EIA 19 inch rack and shall utilize 3.5 inches of rack height as per OTSCES Drawing 1320.01.

3.1.2 The thermostat panel shall provide thermostat control of fan and heater plus provide high and low cut-off circuit for critical equipment.

3.1.3 The thermostat panel shall have three status lights, as per OTSCES Drawing 1320.01 for indicating the status of the thermostat, fan and heater fuses. The lights shall be "ON" at all times and turned "OFF" when their respective fuses are "blown".

3.1.4 The thermostat shall be of microprocessor design with digital entry and display for observing and setting of thermostat parameters. Status lights shall be LED type, 1/8" diameter minimum, colour red. Equipment fuses and status lights shall be mounted on the front panel.

3.1.5 All recorded temperature values, errors and cutoff counts shall not be affected by a power failure.

3.2 FACTORY DEFAULT SETTING

3.2.1 The thermostat panel shall be preset with the following values by the manufacturer:

Function	Description	Preset Value
Ht	Heater turn on temperature	+10.0
Ht.HS	Heater hysteresis value	+5.5
Fn	Fan turn on temperature	+25.0
Fn.HS	Fan hysteresis value	+5.5
HI.Ct	High cut-off temperature of critical equipment	+40.0
HI.HS	High cut-off hysteresis	+2.0
LO.Ct	Low cut-off temperature of critical equipment	-5.0
LO.HS	Low cut-off hysteresis	+2.0
HI.FL	High cut-off count; the number of times the temperature has exceeded HI.Ct to a maximum of 999	0
LO.FL	Low cut-off count; the number of times the temperature has exceeded LO.Ct to a maximum of 999	0
HI.t	Highest temperature since last reset	-99.99
LO.t	Lowest temperature since last reset	+99.99

3.3 SYSTEM CRITERIA

3.3.1 The heater thermostat shall turn on the heater when the temperature inside the cabinet falls to the setting of the thermostat (Ht). The heater will be turned off when the temperature rises to the setting of the thermostat plus the hysteresis value (Ht + Ht.HS).

3.3.2 The fan thermostat shall turn on the fan when the temperature inside the cabinet rises to the setting of the thermostat (Fn). The fan will be turned off when the temperature falls to the setting of the thermostat minus the hysteresis value (Fn - Fn.HS).

3.3.3 The low temperature cut-off thermostat shall remove power to the critical equipment circuits when the temperature inside the cabinet falls to the setting of the thermostat (LO.Ct). The thermostat will resume power to critical equipment when the temperature rises to the setting of the thermostat plus the hysteresis value (LO.Ct + LO.HS). Each time that the thermostat removes power to the equipment, an internal cutoff counter (LO.FL) shall be incremented by one until the top limit is reached. The counter will remain at maximum count until reset by operator.

3.3.4 The high temperature cut-off thermostat shall remove power to the critical equipment circuits when the temperature inside the cabinet rises to the setting of the thermostat (HI.Ct). The thermostat will resume power to critical equipment when the temperature falls to the setting of the thermostat minus the hysteresis value (HI.Ct - HI.HS). Each time that the thermostat removes power to the equipment, an internal cutoff counter (HI.FL) shall be incremented by one until the top limit is reached. The counter will remain at maximum count until reset by operator.

3.3.5 The actual turn-on temperatures for the heater and fan shall be ±0.5°C within the set point (Ht and Fn). The actual turn-off temperatures for the high/low cut-off temperature shall be ±0.5°C within the set point (HI.Ct and LO.Ct).

The tolerance for all the hysteresis setting shall be ±0.5°C.

3.3.6 By means of a jumper strap on the terminal strip at the rear of the thermostat panel (T3-1,2), the selection of "Field" or "Lab" conditions shall be made. Installing the jumper shall place the thermostat in the "Lab" setting. In the "Lab" setting the thermostat panel shall operate as in "Field" condition, except that the display in all modes, shall not be affected by a time out condition and there shall be additional functions provided when in "Manual" or "Default" modes.

3.3.7 On power-up all outputs shall be de-energized until processor has initialized and A/D circuitry has stabilized.

3.3.8 The thermostat panel shall store the highest and lowest temperature registered since the last reading.

3.3.9 A single dip switch located inside the thermostat panel as per OTSCES 1330.01 shall be used to bypass the automatic power control to the fan, heater and critical equipment. The switch shall be designated as "BYPASS SWITCH". The dip switch shall be labelled "NORMAL" in the "OFF" position and "BYPASS" in the "ON" position. Setting the switch

in the "Normal" position shall allow the thermostat panel to control power to the fan, heater and critical equipment. Setting the switch in the "Bypass" position shall allow a bank of dip switches designated as the "Bypass Power Control" switches to control power to the fan, heater and critical equipment. There shall be a separate "Bypass Power Control" switch for controlling power to the fan, heater and critical equipment. Setting a "Bypass Power Control" switch in the "OFF" position shall turn off power to the equipment associated with that switch. Setting a "Bypass Power Control" switch to the "ON" position shall turn on power to the equipment associated with that switch. The "Bypass Power Control" switches shall be located inside the thermostat panel as per OTSCES 1320.01. The label of the "Bypass" and " Bypass Control" switches shall be located on the inside of the thermostat panel cover.

3.3.10 In the event of a fatal error condition as described in 3.7, the thermostat shall remove power to all controlled devices (fan, heater and critical equipment).

3.4 QUICK REFERENCE GUIDE

3.4.1 A Quick Reference Guide shall consist of a Display Menu and a Keyboard Functions as shown in below. It shall be printed onto a Yellow 8½"x11" sheet of paper. The font used for the menu shall be Helvetica or equivalent and a minimum 10 points in size. The guide shall be laminated in clear plastic. One guide card shall be supplied with each cabinet. The guide card shall be shipped in one of the plastic pouches supplied with the cabinet.

DIGITAL THERMOSTAT PANEL 500D : DISPLAY MENU

MODE	MENU ITEM	MODE DISPLAY	FUNCTION DISPLAY	VALUE DISPLAY	MODE	MENU ITEM	MODE DISPLAY	FUNCTION DISPLAY	VALUE DISPLAY
Normal	Normal Conditions	1	°C	<ambient temp>	Manual	Fan Toggle	4	F	<ambient temp>
Temperature	Reset to Default	2	rSt			Heater Toggle	4	H	<ambient temp>
	Heater	2	Ht	<-99.9 - +99.9>		Cutoff Toggle	4	.Ct	<ambient temp>
	Fan	2	Fn	<-99.9 - +99.9>	Default	Heater	5	Ht	<-99.9 - +99.9>
	High Cutoff	2	HI.Ct	<-99.9 - +99.9>		Heater Hysteresis	5	Ht.HS	< 0 - 99.9 >
	Low Cutoff	2	LO.Ct	<-99.9 - +99.9>		Fan	5	Fn	<-99.9 - +99.9>
Diagnostics	Error	3	Err	< error code >		Fan Hysteresis	5	Fn.HS	< 0 - 99.9 >
	High Cutoff Count	3	HI.FL	< 0 - 999 >		High Cutoff	5	HI.Ct	<-99.9 - +99.9>
	Low Cutoff Count	3	LO.FL	< 0 - 999 >		High Cutoff Hysteresis	5	HI.HS	< 0 - 99.9 >
	Highest Temperature	3	HI.t	< HI Temp >		Low Cutoff	5	LO.Ct	<-99.9 - +99.9>
	Lowest Temperature	3	LO.t	< LO Temp >		Low Cutoff Hysteresis	5	LO.HS	< 0 - 99.9 >
	High/Low Reset	3	HL.rt						

Error Code : Err = 1 : Processor Failure Err = 2 : Operational Failure Err = 3 : A/D Circuity Failure

DIGITAL THERMOSTAT PANEL 500D : KEYBOARD FUNCTIONS

Mode Display	Function Display	**MODE** key	**RESET** key	**UP/DOWN** key	**ENTER** key
1	°C	advance to Mode 2	no effect	no effect	no effect
2	rSt	advance to Mode 3	reset all values to the default values presetted in Mode 5	no effect	advance to next menu
	Ht Fn HI.Ct LO.Ct	advance to Mode 3, disable once a UP or DOWN key has been pressed	return to original value once the UP or DOWN key has been pressed	adjust diaplayed value	disable once a UP or DOWN key has been pressed, however, a long ENTER (pressing more than 3 seconds) key will register the adjusted value
3	Err	advance to Mode 4	clear the currently displayed error	no effect	advance to next error if more than one error exist,or go to next menu
	HI.FL LO.FL HI.t LO.t	advance to Mode 4	no effect	no effect	advance to next menu
	HL.rt	advance to Mode 4	reset High / Low cutoff counts and highest / lowest temperatures	no effect	advance to menu Err
4	F H .Ct	advance to Mode 5	toggle output circuit on and off	no effect	advance to next menu
5	Ht Ht.HS Fn Fn.HS HI.Ct HI.HS LO.Ct LO.HS	advance to Mode 1	no effect	no effect	advance to next menu

3.5 KEYBOARD FUNCTIONS

3.5.1 The Mode key shall advance the Mode Display to the next mode in a ring format. The advance shall be from any menu item to the first menu item in the next mode.

3.5.2 The Reset key is used to reset to default values, reset to original value, reset to zero and toggle device status.

3.5.3 The Up/Down keys are used to alter the values displayed were applicable. After either the Up or Down key has been pressed, the Mode key and the Enter key (excluding a Long Enter) are disabled.

3.5.4 The Enter key is used to advance to the next menu item in ring format, or to start the command. A Long Enter (pressing the Enter key for more than 3 seconds) will register the displayed value and cause the Value Display to flash three times.

3.6 OPERATIONAL REQUIREMENTS

3.6.1 When a time out condition occurs (no keyboard activity for 10 minutes), all displays are blanked out except for the 1 hertz flashing decimal point in the Mode display. If there is an error or a cutoff condition, the thermostat panel shall revert to Diagnostics Mode (3) from any mode, and shall not blank out. The display shall only be affected by a time out condition after all the errors and cutoffs have been cleared via the keyboard. While in the Lab condition, the thermostat panel shall not blank out and the Mode Display shall flash for all modes.

3.6.2 From a blank display, pressing any key will bring the display to the Normal Mode (1). Using the Mode key, the mode will be incremented to next mode. From a power failure the thermostat panel shall always start up in Mode 1 unless an Error or Cutoff condition exists and the thermostat panel shall start up in Mode 3 and display the Error or Cutoff with the highest priority.

3.6.3 In Normal Mode (1) the display shall indicate the present temperature in the cabinet.

3.6.4 In Temperature Mode (2), the Function display will start with the first menu item. Pressing the Reset key at this menu will reset all values to the default values in Mode (5) and will cause the Value Display to flash three times. Pressing the Enter key will advance the display to the next menu items as indicated. Pressing the Up/Down keys will allow the displayed value to be adjusted. Pressing the Reset key will return the Value Display to the original value. Pressing a Long Enter, accepts the displayed value and will flash the display three times. Pressing the Enter key again will advance the menu item.

3.6.5 When advancing to Diagnostics Mode (3) via the keyboard, the Function Display shall start by displaying the first menu item Error (Err). The Value Display shall be blank if there are no errors.

3.6.5.1 If an error or a cutoff condition exists, the display shall indicate either of the following:

i) If a fatal error condition as described in Section 3.7 exists, then the error message and the error code shall be displayed. If more than one error exists, the Enter Key shall be used to advance to next error codes. The thermostat panel shall remove power to all controlling devices (fan, heater, critical equipment). The thermostat panel shall not power up the outputs according to the current conditions, until all the Error Codes are reset. Pressing the Reset Key shall clear only the error currently being displayed. To acknowledge the reset the display shall flash three times and then advance to the next error code, if applicable, or to the next menu item. If the error cannot be reset then the display shall not do anything.

ii) If a cutoff condition exists, then the cutoff message and the present count shall be displayed. If more than one cutoff condition exists, the Enter Key shall be used to advance the cutoff message to the next cutoff message. In the event of a power failure the thermostat panel shall retain the record of the previous state or the previous Error or Cutoff. Therefore if a power failure occurs while the thermostat panel is in High or Low Cutoff then the Thermostat shall not increment the High or Low Cutoff Count when power is restored.

3.6.5.2 The cutoff or error display shall always show the error codes or cutoff counts with the highest priority. The priority list in descending order is as follows:

i) Error 1 - Processor Failure
ii) Error 2 - Operational Failure
iii) Error 3 - A/D Circuity Failure
iv) High Cutoff Count
v) Low Cutoff Count

3.6.5.3 The thermostat panel shall remember all errors until the errors are reset. If an error conditon does not exist and another cutoff occurs while not in Mode 3 the thermostat panel shall always revert to Mode 3 and display the cutoff with the highest priority regardless of which cutoff that occured. If an error condition exists the thermostat panel shall not detect any cutoff conditions and shall not revert to Mode 3 to show the cutoff count in the event of a cutoff condition.

3.6.5.4 If there are no High or Low Cutoff Counts, the Value Display shall be zero. At the High/Low Reset menu, pressing the Reset Key shall return High and Low Cutoff Counts to zero and the Highest and Lowest Temperatures to -99.9 and 99.9 respectively. The display shall flash three times to acknowledge the reset.

3.6.6 When the Mode is advanced to Manual Mode (4) the fan, heater and critical equipment shall remain in the state that they were previously in before entering Manual Mode (4). The first menu item shall be Fan Toggle. The Enter Key shall be used to cycle through each menu item and the Reset Key shall be used to toggle the status of each device. A decimal point next to the letter indicating the device that is being toggled, shall turn on when the device is "ON" and shall turn off when the device is " OFF". After exiting Manual Mode (4), the thermostat panel shall revert back to the normal operating mode and set the devices according to the current conditions as determined by automated control. If a time out condition occurs in Mode (4), the thermostat panel shall set the devices according to the current conditions, and revert to Mode (1) and blank out if there is no error or cutoff, or revert to Mode (3) and display the appropriate error codes or cutoff count if there is an error or cutoff condition.

3.6.6.1 When in the Lab condition, the display shall not be affected by a timeout condition and the thermostat panel shall not revert to any modes until exiting the Manual Mode.

3.6.7 In the Default Mode (5), the function display will indicate the menu items. Pressing the Enter key will advance through the menu items. When in the Field condition, all keys shall have no effect except the Mode and Enter key.

3.6.7.1 When in the Lab condition, pressing the Up/Down keys will allow the displayed value to be adjusted. Pressing the Reset key will return the Value Display to the original value. Pressing the Long Enter key accepts the displayed value and will flash the display three times. Pressing Enter key again will advance the menu item.

3.6.7.2 Once the displayed value has been adjusted and accepted, the default setting will be changed permanently. The new value shall be stored in the thermostat panel and shall not be altered by power failure.

3.7 INTERNAL FAILURE DETECTION

The design of the thermostat panel shall be based on a fail/shutdown philosophy in order that critical equipment will not operate when the thermostat has failed.

3.7.1 Processor Failure (Err = 1)

The microprocessor-based panel shall sense the panel's watchdog change of state and create a corresponding output which will reset the watchdog. The watch light shall flash in correspondence with the watchdog change of state. If a watchdog failure occurs a fatal error condition shall exist and the status output shall be set to OFF. The watchdog LED shall be turned OFF. The status output shall be cleared as per 3.6.5 and located on the thermostat panel as per OTSCES 1320.01.

3.7.2 Operational Failure (Err = 2)

The processor shall check memory, internal power circuitry and keyboard logic. A failure during this check shall cause the processor to reset on the first pass. The watchdog circuit shall count the number of attempts to power-up internally. The processor shall wait 5 seconds between each restart attempt. After three failed startup attempts the panel shall enter a fatal error condition and the status output shall be set to OFF.

If a memory fault is detected during data entry or during normal operation of storing new high or low temperature, the thermostat panel shall generate an Error 2 condition and remove power to all the controlled devices.

3.7.3 A/D Circuity Failure (Err = 3)

A failure of the A/D circuitry shall cause the panel to enter to a fatal error condition. The status output shall be set to OFF and the outputs of thermostat will be disabled, removing power from the controlled devices.

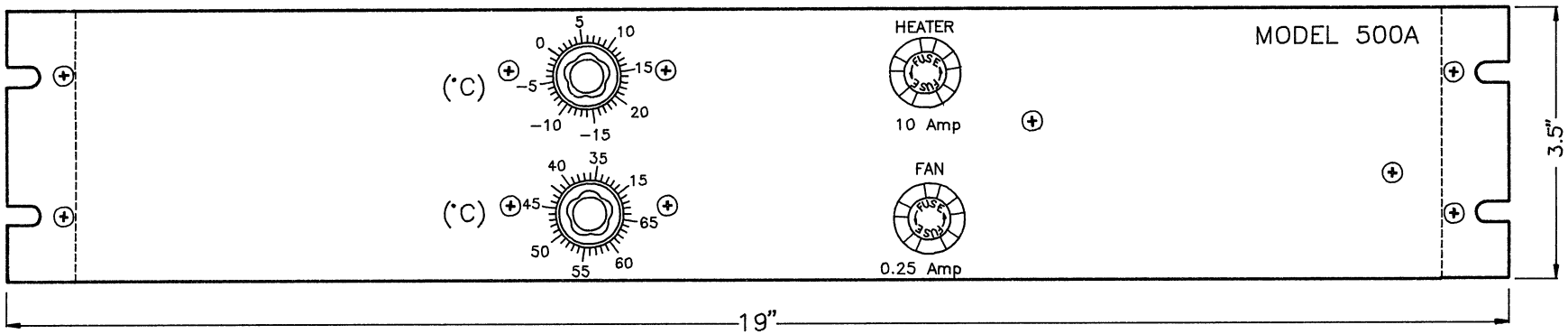
3.8 STATUS OUTPUT

3.8.1 The thermostat panel shall output a status (watchdog) to the rear terminal strip (T3-3). The thermostat panel shall set the status output to 1 (ON) under normal operating conditions. The thermostat panel shall set the status output to 0 (OFF) when there is an error or cutoff.

3.8.2 The logic state 1 from the CPU shall be presented as a grounded collector (0 to 2 Volts), and the logic state 0 shall be presented as an open circuit.

3.8.3 The output shall be an opto-isolated NPN open collector capable of sinking 50 milliamperes at 30 Volts. This output shall be compatible with the controller unit inputs.

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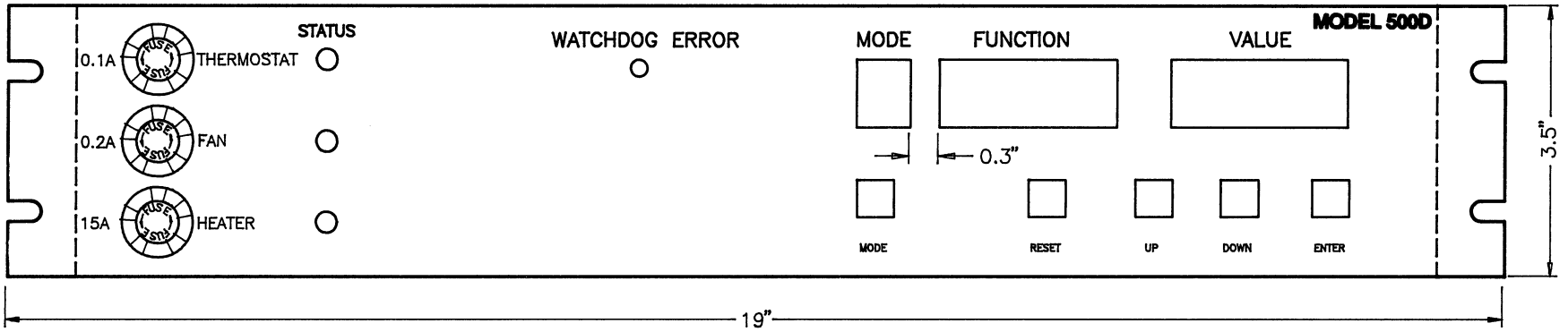


FRONT VIEW

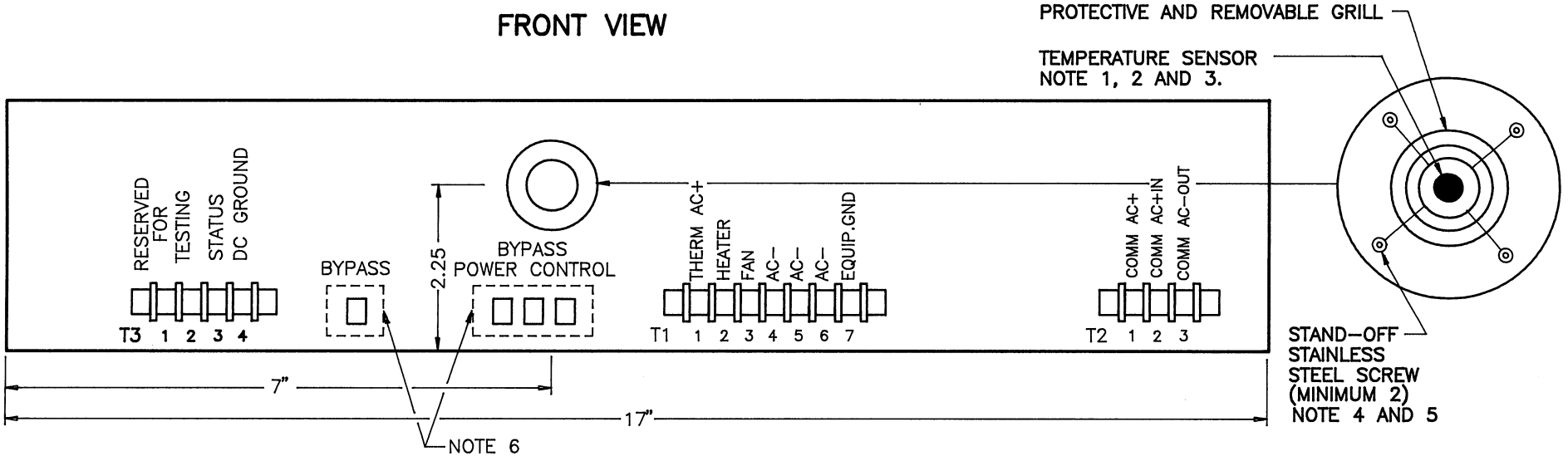
ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

ANALOGUE THERMOSTAT PANEL MODEL 500A

Date	92 06 01	Rev		OTSCES – 1310.01



FRONT VIEW



REAR VIEW

NOTES:

1 The distance between the temperature sensor and the stand–off mounting screw shall be 1 7/16".

2 Temperature sensor shall protrude a minimum of 1/8" and maximum of 1/4".

3 Temperature sensor shall be Analog Devices type AD590L or equivalent.

4 Stand off shall be 1/2" high.

5 The diameter of the mounting screw shall be 1/8".

6 See OTSCES–1330.01 for details of Bypass and Bypass Power Control.

T1 TERMINAL ASSIGNMENTS

1 THERM. AC +
2 HEATER
3 FAN
4 AC –
5 AC –
6 AC –
7 EQUIP. GND

T2 TERMINAL ASSIGNMENTS

1 COMM. AC +
2 COMM. AC + IN
3 COMM. AC – OUT

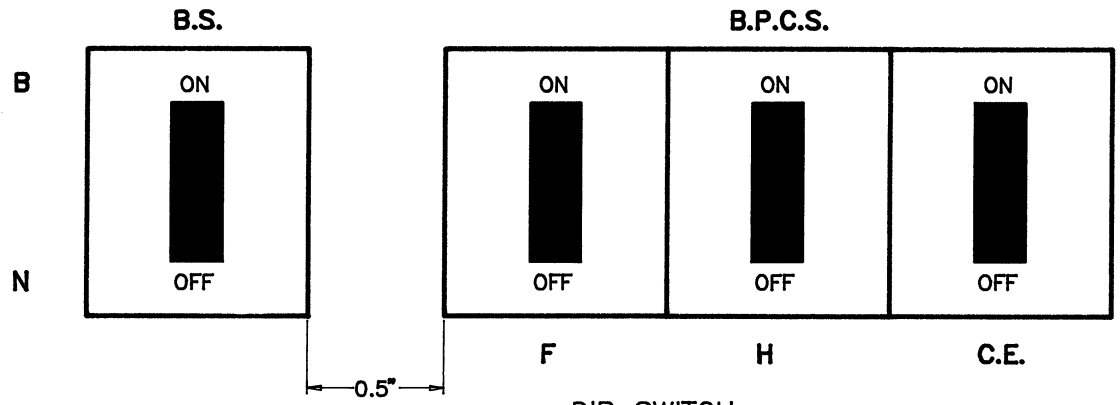
T3 TERMINAL ASSIGNMENTS

1 TEST JUMPER
2 TEST JUMPER
3 STATUS
4 DC GROUND

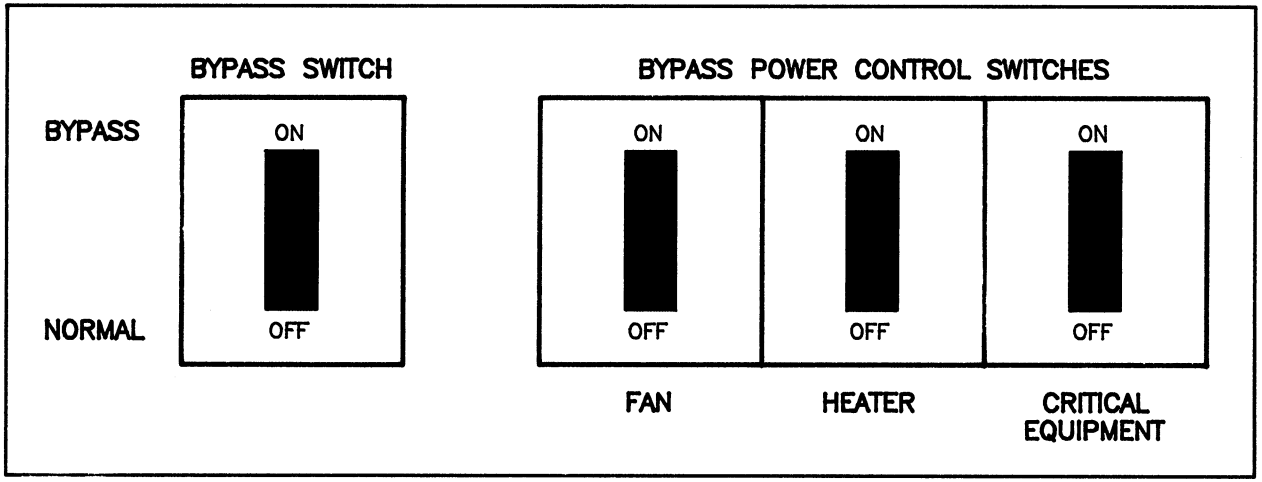
ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

DIGITAL THERMOSTAT PANEL MODEL 500 D

Date:	94 11 09	Rev	1	OTSCES – 1320.01



DIP SWITCH



LABEL

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

BYPASS SWITCH DETAILS

Date	94 11 09	Rev		OTSCES – 1330.01

CHAPTER 14

General Specifications

For

Traffic Control Cabinets

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June 1, 1992	1410.01	-	Traffic Control Cabinet Pedestal
June 1, 1992	1420.01	-	Traffic Control Cabinet Shipping Pallet
June 1, 1992	1430.01	-	I/J Input File - Outline
June 1, 1992	1430.02	-	I/J Input File - Wiring Diagram
November 9, 1994	1440.01	1	24 VDC Power Supply
November 9, 1994	1440.02	-	24 VDC Power Supply - Cover Ventilation
June 1, 1992	1450.01	-	C1 Connectors
November 9, 1994	1460.01	1	Heater Mounting Bracket
November 9, 1994	1460.02	-	Heater
November 9, 1994	1460.03	-	Heater and Bracket Assembly
November 9, 1994	1470.01	-	Louver Vent and Filter
November 9, 1994	1480.01	-	Fan Ventilation Area

1 GENERAL REQUIREMENTS

1.1 SCOPE

1.1.1 This chapter defines the general specifications applicable to Traffic Signal Controller Cabinets, Models 332 Series and 401 Series.

1.1.2 These specifications shall supplement the General Specifications for Traffic Control Equipment and in case of conflict the specification of this Chapter will govern.

2 CONSTRUCTION REQUIREMENTS

2.1 GENERAL

2.1.1 The cabinet shall be a rainproof cabinet with dimensions as shown on the drawings and shall be complete with pedestal and internal components as per Chapters 15 and 16.

2.1.2 The roof of the cabinet shall be domed to assist in water drainage, further drainage shall be provided by means of a rain gutter mounted on the front of the cabinet only.

2.2 FABRICATION

2.2.1 Cabinet fabrication shall conform to the requirements of ASTM Designation: B 209 for 5052-H32 aluminum sheet.

2.2.2 The sheet aluminum shall be at least 0.125 inches thick and adequately reinforced by welded aluminum members. Alternative construction may be approved by the procuring agency. All construction shall be free of dents, scratches, weld burn through and abrasions harmful to the strength and general appearance. All seams shall be of continuously welded construction. All exterior welds shall be ground smooth. All edges shall be filed to a radius of 0.03125 inch minimum.

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

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

2.2.5 The inside edge of the base of the cabinet shall be constructed with a continuous lip extending at least 0.250 inches above the rest of the base.

2.3 CABINET FINISH

2.3.1 Surface Preparation

2.3.1.1 The cabinet shall be properly degreased and cleaned before application of paint finish. A Iron Phosphate conversion coating shall be applied to aluminum parts using immersion or power spray methods of application. The coating shall be applied in three stages.

2.3.2 Painted Aluminum

2.3.2.1 Cabinets shall be finished inside and out with gloss polyester thermosetting powder paint min 3 mils thick. The paint shall be colour no. 501-109 of the Canadian Government Specifications Board's Standard Paint Colours 1-GP-12C. All coating shall be commercially smooth, substantially free of flow lines, paint washout, streaks, blisters, and other defects that would impair serviceability or detract from general appearance.

2.3.2.2 Coating hardness - the finish shall have a pencil lead hardness of HB minimum using an Eagle Turquoise pencil.

2.3.2.3 The cabinet shall suffer no coating loss when subjected to the following: Two samples 4" x 8", made of the same material and coating as the cabinet supplied, shall be furnished for testing. Two 9 inch diagonal scratches exposing bare metal will be made on a samples. It will be soaked in demineralized water for 192 hours. A one inch strip of masking tape shall be tightly affixed to this surface and removed with one quick motion, evidence of blistering, softening or peeling of the paint and/or coating from the base metal shall be cause for rejection.

2.3.2.4 The inside walls, doors and ceiling of the cabinet shall be painted the same as the outside finish.

2.3.3 A certificate of compliance shall be furnished by the manufacturer certifying that the coating system furnished complies in all respects with the above requirements as described in Section 2.3.

2.4 CABINET WIRING DIAGRAM

2.4.1 Two sets of non-fading cabinet wiring diagrams shall be supplied with each cabinet. The diagrams shall be non-proprietary. They shall identify all circuits in such a manner as to be readily interpreted. The cabinet drawings shall show component layout in an elevation view as viewed from the rear of the cabinet with the left and right cabinet walls shown in their relative positions. The set of cabinet wiring diagrams shall include one reduced size drawing (maximum 36 inches x 24 inches) showing all hardwired connections between all terminal blocks and sockets with their associated pin numbers identified for easy field trouble-shooting. The diagrams shall be stored in the drawing storage area.

2.4.2 Detailed equipment layout scale drawings and wiring diagrams of all equipment installed in the cabinet shall be submitted for approval as per the requirements of Chapter 1.

2.5 CABINET COMPONENTS

2.5.1 Doors and Frames

2.5.1.1 The cabinet shall have single front and rear doors each equipped with a lock. When each door is closed and latched, the door shall automatically lock.

2.5.1.2 The cabinet door frame shall be double-flanged out on all four sides and shall be provided with strikers to hold tension on and form a firm seal between door gasketing and cabinet door frame. The flange width shall be a minimum of one inch.

2.5.2 Handles and Latching Mechanism

2.5.2.1 The latching handles shall have provision for padlocking in the closed position. The operating handle shall be cast aluminum or steel with a 7.5 inch handle and provided with a 0.625 inch steel shank. The handle assembly shall be zinc plated and coated with the paint specified in Section 2.3.2. The door handle shall travel and stop below the key hole with 1 1/2" clearance. The handle shall rotate 90°, pointing straight down for the closed position and pointing horizontally to the left for the open position.

2.5.2.2 The latching mechanism shall be a 3-point draw roller type. The centre catch and pushrods shall be plated. Pushrods shall be turned edgewise at the outward supports and shall be 0.25 inch by 0.75 inch, minimum. Supports shall be 0.105 inch steel, minimum. Rollers shall have a minimum diameter of 0.875 inch and shall be equipped with ball bearings and nylon wheels. The centre catch shall be fabricated of 0.1875 inch steel, minimum.

2.5.3 Hinges

2.5.3.1 Each door hinge shall be a single continuous hinge with a fixed pin.

2.5.3.2 Door hinge, pin and bolts shall be made of stainless steel. Flat head bolts shall be used in attaching the hinge to the door and to the cabinet shell. The hinge pin and bolts shall not be accessible from the outside when the door is closed. Pop rivets shall not be used in attaching the hinge to either the door or the cabinet shell.

2.5.4 Catches

2.5.4.1 Front and rear doors shall be provided with automatic self-engaging catches to hold the door open at both 90° and 180° (± 10°) . The catches shall be 0.375 inch diameter minimum, plated steel rods. The catch system shall be capable of holding the door open at 90° in a 60 mph wind at an angle perpendicular to the plane of the door.

The catch holders shall be welded or bolted to the cabinet door and chassis. Size 0.250 inch stainless steel nuts and bolts shall be used.

2.5.5 Fan Requirements

2.5.5.1 Each cabinet shall be equipped with an electric fan with ball or roller bearings and a capacity of at least 100 cubic feet of air per minute.

2.5.5.2 The fan shall be mounted within the cabinet and vented out between the top of the cabinet and the front door as shown on the plans. The fan mounting requirements and dimensions shall be identical to Rotron Fans Model #MU2B2.

2.5.5.3 The fan shall be thermostatically controlled.

2.5.5.4 Intake (including filter) and exhaust areas shall pass a minimum of 60 cubic feet of air per minute. The fan shall be easily replaceable with the cabinet front door opened without removing any of the component in the cabinet.

2.5.5.5 The fan shall be covered with a protective mesh for safe operation to prevent accidental insertion of fingers.

2.5.6 Louvered Vents and Filters

2.5.6.1 Each cabinet shall be provided with louvered vents in the front door with a removable air filter 16 inches wide by 12 inches long by 0.875 inch deep. The air filter shall consist of a frame, with metal mesh for supporting the media on one side, and one ply of dry synthetic fibres filter media. The filter media with graduated density shall be Viledon P15/350S or equivalent. The media shall be easily replaceable and shall fit snugly in the frame. The filter shall cover the vents and shall be held firmly against the vent gasket with brackets and two spring-loaded clamps as shown on the OTSCES drawing 1470.01.

2.5.6.2 The bottom filter bracket shall be formed into a waterproof sump with drain holes to the outside. The louvered vents shall be designed and constructed such that a stream of water from pressure head, such as a Rainbird sprinkler or other type sprinkler, will not enter the cabinet. The louvered area shall be slightly less than the filtered area.

2.5.6.3 A vent cover 16 inches wide by 12 inches long shall be provided for reducing the size of the vent opening in the winter. The cover shall have a one inch diameter hole in the centre and shall fit into the filter bracket without removing the air filter. The cover shall be made from material identical to the cabinet and shall be finished in the same manner.

2.5.6.4 The cabinet shall be shipped with the vent cover held securely on the inside of the rear door by metal brackets or equivalent method.

2.5.6.4.1 The filter frame shall be painted the same as the cabinet in order to prevent the frame from rusting or corroding.

2.5.7 Fan Ventilation Area

2.5.7.1 Fan ventilation area shall have 18 square inch maximum opening and provide a minimum air flow of 100 CFM. Opening shall be vandal resistant. A metal cover, same size as the fan ventilation area, shall be provided to cover up the opening in the winter months. The cover shall have a one inch diameter hole in the centre. The cover shall be permanently mounted to the cabinet with slide brackets to allow the cover to act as a shutter as shown on the OTSCES drawing 1480.01. The cover shall be made of the same material as the cabinet and finished in the same manner. A gasket, as described in Section 2.5.8, shall be mounted on the metal cover. The cover shall be affixed in such a manner that the gasket is continuously engaged.

2.5.8 Gaskets

2.5.8.1 Gasketing shall be provided on all doors front door vent opening and fan ventilation area cover and shall be dust tight. Gaskets shall be 0.25 inch minimum thickness closed cell neoprene and shall be permanently bonded to the metal. The mating surface of the gasketing shall be covered with a silicone lubricant to prevent sticking to the mating surface.

2.5.8.2 Cabinet pedestal to be sealed around the top and bottom perimeter with minimum 0.375 inch thick by 2.5 inch wide neoprene gaskets (see drawings). Gaskets shall have a durometer hardness of 45.

2.5.9 Heater and Heater Bracket

2.5.9.1 Each cabinet shall be equipped with a forced air heater rated 800 watts minimum. The heater assembly shall consist of the heater and fan, a handle and a mounting bracket. The assembly shall fit onto the bracket provided on the rear door. The heater shall be manufactured as shown on the OTSCES drawings. Only Ministry approved heater shall be used. The heater shall be thermostatically controlled. The wiring to the heater shall be 16 AWG 3 conductors type SJ-3 with minimum 19 strands and shall provide for easy removal of the heater, but shall be protected in the door open area. The connector/plug for the heater shall be Bryant Water Tight Model No. 8269-TSC/ 8266-TSP or Woodhead Watertite Model No. 15W47/14W47, or equivalent, with cord diameter of 0.3" or directly connected to the thermostat panel.

2.5.9.2 A bracket shall be welded on the rear door. The bracket shall be positioned such that the bottom of the heater assembly will be located at 6" above the bottom of the rear door. The bracket and heater assembly shall have a minimum clearance of 2 inches from the rear door and a minimum clearance of 4 inches from any other surfaces or wirings when the rear door is closed and locked. The bracket shall be designed to hold the heater securely without the use of screws and shall not obscure the heater air flow (see drawings). The heater assembly shall have a handle and shall be able to slide in and out of the bracket for ease of servicing.

2.5.10 Drawing Storage

2.5.10.1 Two stainless steel carriage bolts shall be provided on the inside upper portion of the front door. Manuals and drawings shall be stored in a minimum size 10 inches x 14 inches heavy duty side-opening clear plastic pouch with 2 eyelets. One extra pouch shall be hung on the hooks.

2.5.11 Cabinet Pedestal

2.5.11.1 A pedestal of single piece construction, shall be supplied separately with each cabinet.

2.5.11.2 The pedestal shall be fabricated from the same material and shall be finished in the same manner as the cabinet. The dimensions shall be as shown on the drawings. The pedestal shall be delivered in a separate cardboard box with each cabinet.

2.5.11.3 The Top of the pedestal shall be clearly identified as "TOP".

2.5.11.4 Four stainless steel bolts 1/2" x 1 1/2" , nuts and washers shall be shipped with the pedestal. These bolts are to be used for mounting the pedestal to the concrete pad.

2.5.12 Equipment Racks

2.5.12.1 A standard EIA 19-inch rack shall be installed inside the cabinet for mounting equipment. The EIA rack shall consist of two pairs of full length, continuous, adjustable equipment mounting angles of 0.1345 inch nominal thickness plated steel tapped with 10-32 threads with EIA universal spacing on the front pair and EIA wide spacing on the back pair. The angles shall comply with Standard EIA RS-310-B and shall be

supported top and bottom by welded support angles to form a cage. The cage shall be able to slide in and out of the cabinet door openings without coming apart.

2.5.12.2 When attaching the rack to the cabinet walls, provisions must be made to allow for the continuous drainage of condensation from the walls to the base of the cabinet.

2.5.13 Lifting Eyes

2.5.13.1 The cabinet shall be provided with 2 lifting eyes to be used when placing the cabinet on the pedestal. The lifting eyes shall be welded from the outside of the cabinet, as shown on the drawings. Each eye shall be capable of lifting 1000 pounds and shall have a minimum diameter of 0.75 inches. The lifting eye shall be fabricated from the same material as the cabinet.

2.5.14 Input File

2.5.14.1 The input file shall be sized to suit 19 inch rack and utilize 5.25 inches of rack height. The input file shall intermate with and support 14 two-channel loop detector units.

2.5.14.2 The input file shall provide non-metallic card guides (top and bottom) and a 22-pin single readout, edge-connector centred vertically for each detector. The input file shall allow air circulation through the top and bottom.

2.5.14.3 Pins D, E, F, J, K, L and W on each edge connector slot shall be terminated on its associated terminal block mounted on the rear of the Input File. Pins F and W from each slot shall be connected to the proper controller unit inputs in the Connector C1S wiring harness through the associated terminal blocks. Common grounding of output emitter pins X and H shall be permitted and the common grounding conductor shall be brought out to TB 15, position 4 (controller DC GND) which is connected to Pin 104 of C1P.

2.5.14.4 The Input File shall be wired and connected as shown on the Input File Detail.

2.5.14.5 The edge connectors shall be double sided connectors with the number side of each pin shorted to its respective lettered side internally.

2.5.14.6 The plastic card guides shall begin 1.0 inch (±0.5) back from

the front face of the file and they shall be the pop-in type. Special tools shall not be required to remove or insert the card guides into their designated spots. The plastic card guides shall meet the requirements of Chapter 1.

2.5.14.7 Minimum four spare card guides shall be supplied for each type supplied, with every cabinet shipped to the Ministry. The spare card guides shall be tied and bundled and stored in one of the plastic pouches supplied with cabinet.

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

2.5.14.9 Two jumper wires shall be provided for each input file at the terminal blocks, connecting slot 10, Pin F (CH 1 output) to slot 3, PIN W (CH 2 output) and from slot 10, PIN W (CH 2 output) to slot 7, PIN W (CH 2 output). These jumpers are used for 7-wire interconnect and not required in the 401 cabinet series.

2.5.14.10 Cables from the primary terminal block to the input files I and J shall be connected according to the plan. These wirings are carrying 120 VAC and shall have a separate harness from the other input file logic wirings. The current carried by these cables under normal operation will not exceed 1 Ampere.

2.5.14.10.1 Wires which carry 120 VAC to the input file shall be routed from above the I file and below the J file. DC logic wires shall be routed between input files I and J.

2.5.14.11 The method of interconnecting the input file terminal blocks T1-T16 to the input file edge connectors shall be done either by hard wiring or printed circuit board. The terminal blocks T1-T16 and the input file edge connectors may be mounted on the same printed circuit board. The terminal blocks T1-T14 shall be mounted such that they are mechanically secured to the chassis of the input file. Mechanical loads applied to the terminal blocks or the input file edge connectors shall not transfer to the printed circuit boards used for interconnecting.

2.5.15 24 Volt DC Power Supply

2.5.15.1 The power supply shall be provided in the cabinet to operate all equipment installed in the cabinet except the controller unit, the monitor and isolators.

2.5.15.2 The power supply shall utilize no more than 3.5 inches of rack height and a maximum depth of 6 inches from the front surface of the front rails.

2.5.15.3 The power supply shall be of ferro-resonant design having no active components and shall conform to the following requirements:

Line Regulation: 2% from 95 to 135 VAC at 60 hertz, plus an additional 1.6% for each additional 1% frequency change.

Load Regulation:	5% from 1 ampere to 5 amperes with a maximum temperature rise of 30 C degrees above ambient.
Design Voltage:	+24 ± 0.3 VDC at 1/2 load and 40°C.
Full Load Current:	Five amperes, minimum.
Ripple Noise:	2 Volts peak-to-peak and 500 millivolts RMS at full load.
Line Voltage:	95 to 135 VAC
Efficiency:	60 percent, minimum.
Minimum Voltage:	22.8 VDC (at extreme operating condition).

2.5.15.4 The power supply front panel shall include:

2.5.15.4.1 Primary and secondary fuses or circuit breakers. The primary fuse shall be 0.25" x 1.25" slow blow type rated 3.0A. The secondary fuse shall be 0.25" x 1.25" fast acting type rated at 6.25A.

2.5.15.4.2 Pilot lamp on output side.

2.5.15.4.3 Test points or meter for monitoring output voltage.

2.5.15.5 The power supply shall be enclosed to prevent accidental contact with energized parts.

2.5.15.6 The power supply shall be ventilated with the natural convection method. Louvered vents shall be provided on the side panels of the power supply and the ventilation holes shall be provided on the top cover of the power supply (see OTSCES drawing 1440.02). The center of the ventilation holes pattern shall be located directly above the center of the ferro-resonant transfomer.

2.5.15.7 The power supply shall obtain its AC input through a six foot line cord and a 3 prong plug. The plug shall be plugged into the receptacle allotted for the 24V power supply at the back of the power distribution panel.

2.5.15.8 The output terminal block shall be located on the back of the power supply enclosure close to the left edge when viewed from the cabinet back door. The terminal block shall consist of 16 terminals. Six terminals shall be wired for 24VDC and the other ten terminals shall be wired for DC logic ground. The terminals shall be clearly labelled with the 24V DC output on the left six terminals and DC logic ground on the other terminals.

2.5.15.9 A 30V, 5 watt zener diode shall be mounted externally on the output terminal block across the 24V DC output and DC logic ground terminals.

2.5.15.10 Three metal oxide varistors (MOV), type General Electric #V150LA10A or equivalent shall be provided internally. One MOV shall be installed across AC+ (L1) to chassis ground, another MOV shall be installed across AC+ (L1) to AC-, another MOV across AC- to chassis ground at the line cord entrance point.

2.5.15.11 The DC capacitors used in the power supply shall have a minimum operating temperature rated from -55°C to +105°C.

2.5.16 Trouble Lamp

2.5.16.1 A trouble lamp with basket protection shall be mounted near the top of the rear door. The trouble lamp shall be mounted

securely to the door without the use of screws etc. and shall be capable of being removed from its holder for inspection purposes, without the use of tool. The wiring for the trouble lamp shall be provided for easy removal of the lamp, but shall be protected in the door open area and from the heater. The trouble lamp shall turn on automatically when the rear door of the cabinet is opened and shall turn off when the door is closed. A minimum of 8 feet of wiring shall be provided with the trouble lamp.

2.5.17 Shipping Requirements

2.5.17.1 The cabinet shall be delivered for testing mounted on a 5/8 inch thick plywood shipping pallet. The pallet shall be bolted to the cabinet base by means of four stainless steel hex-head bolts size 1/2" x 1 1/2" and washers with diameter 3" and 1 1/4" minimum. The botls shall be installed with the thread upward. Pallet dimensions shall be as shown on the drawings. Pallet shall be constructed to withstand the necessary handling without falling apart.

2.5.17.2 A tag stated "The stainless steel hex-head bolts and washers shall be reused to secure the cabinet to the pedestal" shall be attached to one of the bolts. The size of each character shall be 1/2" minimum.

2.5.17.3 The cabinet shall be enclosed in a removable cardboard packing shell. The cabinet shall be enveloped in a plastic slipcover or plastic wrapping prior to enclosing it in the cardboard shell. Extra protection shall be provided on the top four corners of the cabinet.

3 ELECTRICAL REQUIREMENTS

3.1 CABLES

3.1.1 Conductors in the cabinet between the secondary terminal block and the PDA shall be No. 8 or larger.

3.1.2 All conductors used for cabinet wiring shall be No. 22, or larger, with a minimum of 19 strands.

3.1.3 Cables shall conform to Military Specification: MIL-W-16879D Type B or better or Canadian equivalent. The insulation shall have a minimum thickness of 10 mils and shall be nylon jacketed polyvinyl chloride except that cables No. 14 and larger may be UL Type THHN, with a minimum of seven strands.

3.1.4 All cables shall be labelled. Labels attached to each end of the conductor shall identify the destination of its immediate connection.

3.1.5 All cables terminating at a pin connector shall be labelled according to their associated connector pin number.

3.1.6 All cables, terminating at a terminal block shall be labelled according to the designated terminal number and the terminal block number. For example, a conductor that terminates at terminal 2 of terminal block TB1 at the input panel shall bear a label of TB1-2. The terminal block number and the terminal number shall be a different colour from that used for the run number. The wiring harness shall be designed such that wiring for each terminal block shall be grouped individually.

3.1.7 The label identification shall be shown on the associated drawing.

3.2 COLOUR CODES

3.2.1 All cables using in the cabinet wiring shall conform to the following colour-code requirements:

3.2.1.1 The neutral cables of AC circuits shall be identified by a continuous white or natural grey colour.

3.2.1.2 The equipment grounding cables shall be identified by a solid green colour or by a continuous green colour with one or more yellow stripes.

3.2.1.3 The DC logic ground cables shall be identified by a solid white colour with a coloured (except green) stripe.

3.3 LABELLING

3.3.1 All equipment terminals and terminal blocks in the cabinet shall be clearly and permanently labelled.

3.3.2 All labelling on or in the cabinet, including components, terminals and terminal blocks, but not including cables shall be carried out by a process of stamping or screening. Stickers will only be permitted on cables. Where both an alphanumerical and a functional designation have been assigned to an item to be labelled, both shall be included in the label unless space is insufficient, where upon only the functional designation shall be shown.

3.4 CABINET WIRING

3.4.1 A wiring duct shall be installed on the input panel as shown on the drawings. The duct material shall conform to the environmental specifications described in Chapter 1.

3.4.2 All cabinet wiring harnesses shall be neat, firm and routed to minimize crosstalk and electrical interference.

3.4.3 Wiring containing AC shall be routed and bundled separately from all logic voltage control circuits. All AC wiring shall be routed on the right side (service panel side) of the cabinet when looking in from the rear door. All DC and logic voltage wiring shall be routed on the left side (input panel side) of the cabinet when looking in from the rear door. Wiring harness shall not block or interfere with the module back panel when they are opened for service.

3.4.4 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.

3.4.5 All conductors, terminals or parts, which carry line voltage or could be hazardous to maintenance personnel, shall be protected with suitable clear or transparent insulating material.

3.4.6 Within the cabinet wiring, the DC logic ground and Chassis ground shall be electrically isolated from the AC neutral cable and each other by 500 megohms when tested at 250 volts DC with the power line surge protected disconnected.

3.4.7 Cables from Connector C1 to the input files shall be of sufficient length to allow any conductor to be connected to any detector output terminal.

3.4.8 A harness shield shall be used on the C1 harness. This shield shall be a plastic, wraparound type. Also a sleeve shall be installed on the C1 clamp to protect the C1 harness.

3.4.9 A No. 8 or larger conductor shall be connected between the chassis ground bus and the nearest rack rail.

3.4.10 Proper wire gauges which follow the electrical code shall be used by the manufacturer.

3.5 TERMINAL BLOCKS

3.5.1 Terminal blocks shall be provided for terminating cables. All terminals shall be labelled according to their assigned numbers and their function.

3.5.2 The terminal blocks for control wires shall be the barrier type and shall be provided with 8/32 x 5/16 inch minimum nickel plated brass binder head screws and inserts. Terminal blocks shall be rated 15A, 600 V RMS minimum.

3.5.3 The terminal blocks shall be readily accessible through the cabinet rear door.

3.5.4 The DC supply terminal blocks for the output file, input file, and power supply shall be the barrier type and shall be provided with 6/32 x 5/16 inch nickel plated brass binder head screws and inserts. Terminal blocks shall be rated for 15A, 600 V RMS minimum.

3.5.5 The terminals of the primary and secondary power line service terminal blocks shall be labelled AC+ (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 blocks. The terminal blocks shall be rated for 50 amperes at 600 volts minimum.

3.5.6 Only Robertson head or combination of Robertson and slot head screws shall be provided with the terminal blocks except for the terminal required for the primary and secondary power lines service terminal block, which may be slotted head screws.

3.5.7 All terminal blocks carrying AC voltages on all modules within the cabinet shall have covers made of clear insulating materials.

3.6 CONNECTORS

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

3.6.2 Connector C4 shall contain 37 contacts and shall be the circular plastic type with quick connect/disconnect capability, thread assist and positive detent coupling. The plug Connector C4P shall be mounted on the Output file. Contact assignments are shown on the drawings.

3.6.3 Connector C5 shall contain 24 contacts, and shall be the circular plastic type with quick connect/disconnect capability, thread assist and positive detent coupling. The storage plug Connector C5P shall be mounted on the Input Panel. Contact assignments are shown on the drawings. Connector C5 shall be connected to the auxiliary Output File C5P if the auxiliary output file is provided in the cabinet.

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

3.6.5 Unterminated wires from the harness shall be bundled and tied to the rack. A 1/4 inch length of insulation shall be removed from the tied and bundled wires, and the exposed conductors shall be tinned. Heat shrinkable tubing shall be placed over the tinned conductors.

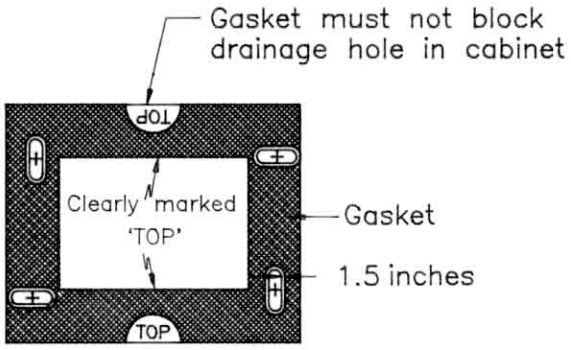
3.7 EQUIPMENT RACK GROUNDING

3.7.1 A 7/16 inch hole shall be drilled through the bottom bar of the back rack, looking in from the rear. The centre of the hole shall be located 3 inches from the bottom right hand corner of the rear rack. A connector shall be supplied to fit in this hole which will accommodate one No. 8 wire and one No. 2 wire. The connector will be mounted securely to the rack with the equipment ground connected with a short length of No. 8 wire to the primary terminal block.

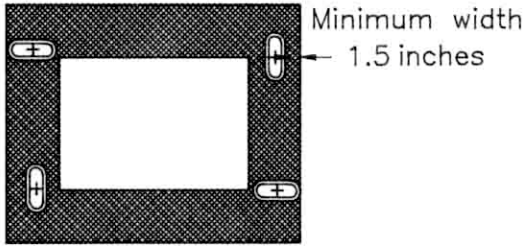
3.8 TRANSIENT SUPPRESSION

3.8.1 Transient suppression shall be provided at all relay bases (across relay coils), thermostat contacts in the fan circuit and heater circuit.

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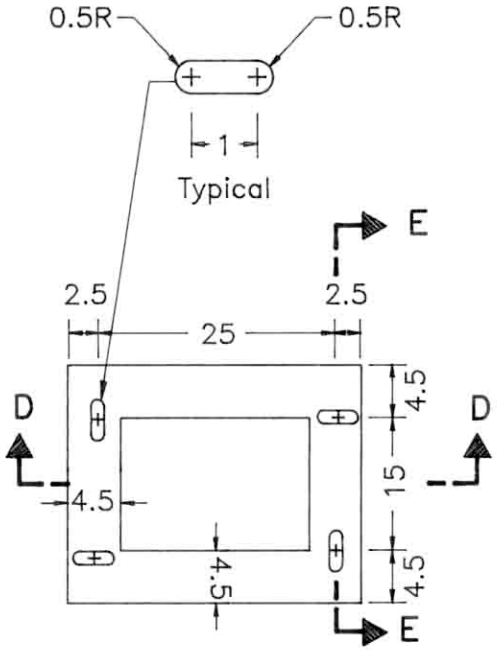


TOP OF PEDESTAL

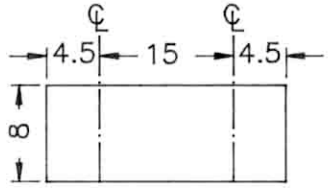


BOTTOM OF PEDESTAL

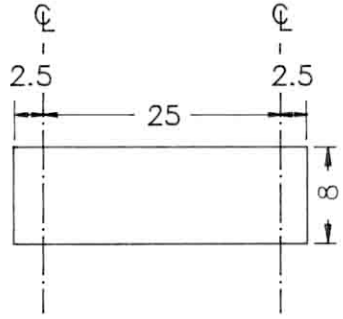
PLAN VIEW



PLAN VIEW



E–E END ELEVATION



D–D SIDE ELEVATION

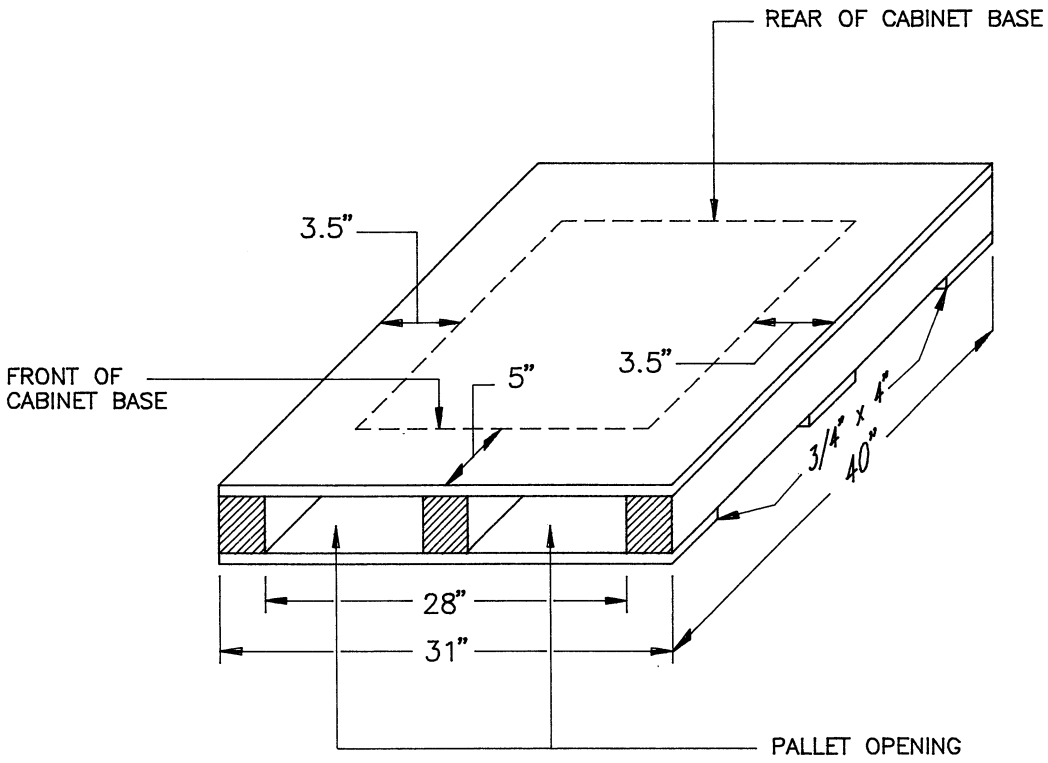
NOTE:
ALL DIMENSIONS SHOWN IN INCHES AND TOLERANCES SHALL BE ± 0.125

PEDESTAL DETAILS

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

TRAFFIC CONTROL CABINET PEDESTAL

Date	92 06 01	Rev		OTSCES – 1410.01



CABINET PALLET

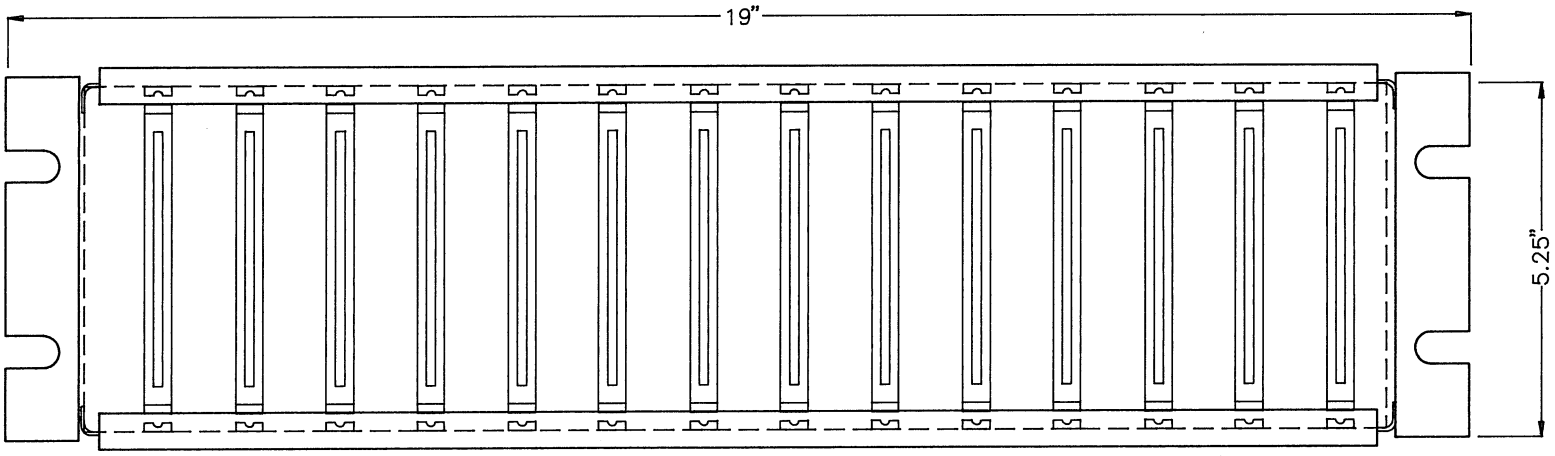
NOTE:

DASHED LINES INDICATE POSITION OF CABINET ON PALLET.

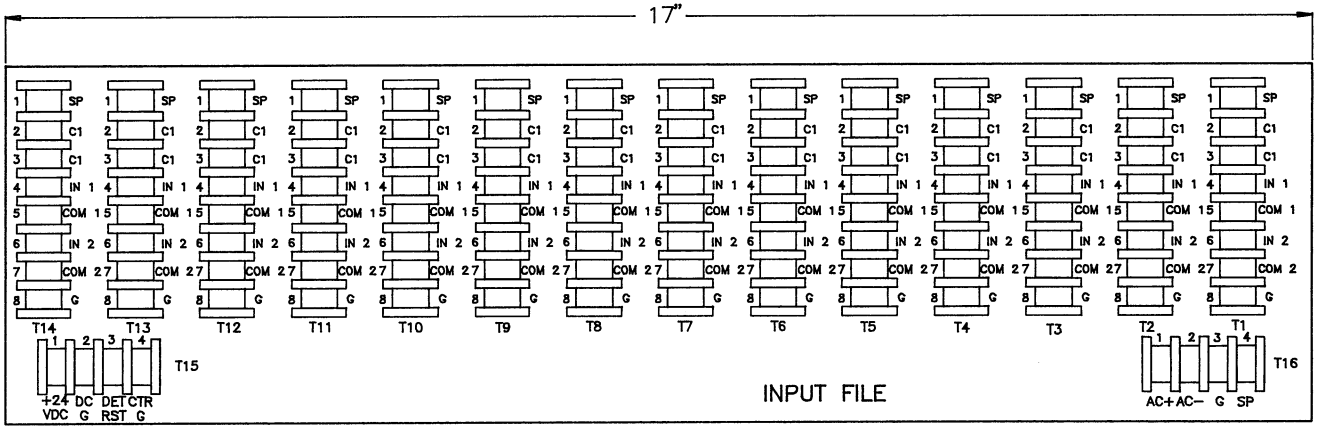
ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

TRAFFIC CONTROL CABINET SHIPPING PALLET

Date	92 06 01	Rev		OTSCES – 1420.01



FRONT VIEW



REAR VIEW

T15 TERMINAL ASSIGNMENTS

1 +24 VDC
2 EQUIP. GND.
3 RESET
4 CONTROLLER GND.

T16 TERMINAL ASSIGNMENTS

1 AC +
2 AC–
3 EQUIP. GND.
4 SPARE

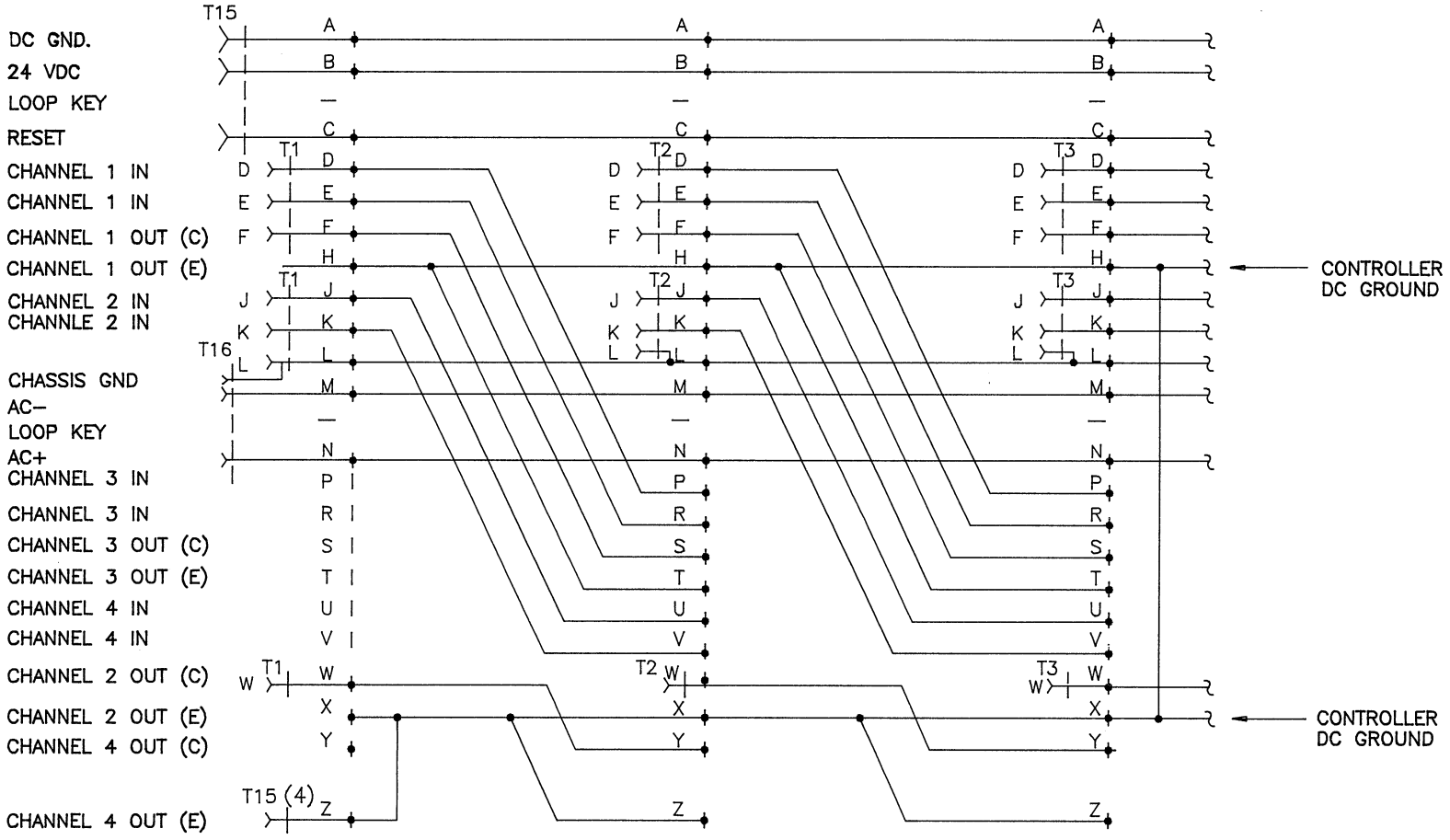
T1–T14 TERMINAL ASSIGNMENT

1 SPARE
2 CHANNEL 1 OUT
3 CHANNEL 2 OUT
4 CHANNEL 1 IN
5 CHANNEL 1 IN
6 CHANNEL 2 IN
7 CHANNEL 2 IN
8 CONTROLLER DC GND.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

I/J INPUT FILE–OUTLINE

Date	92 06 01	Rev		OTSCES – 1430.01



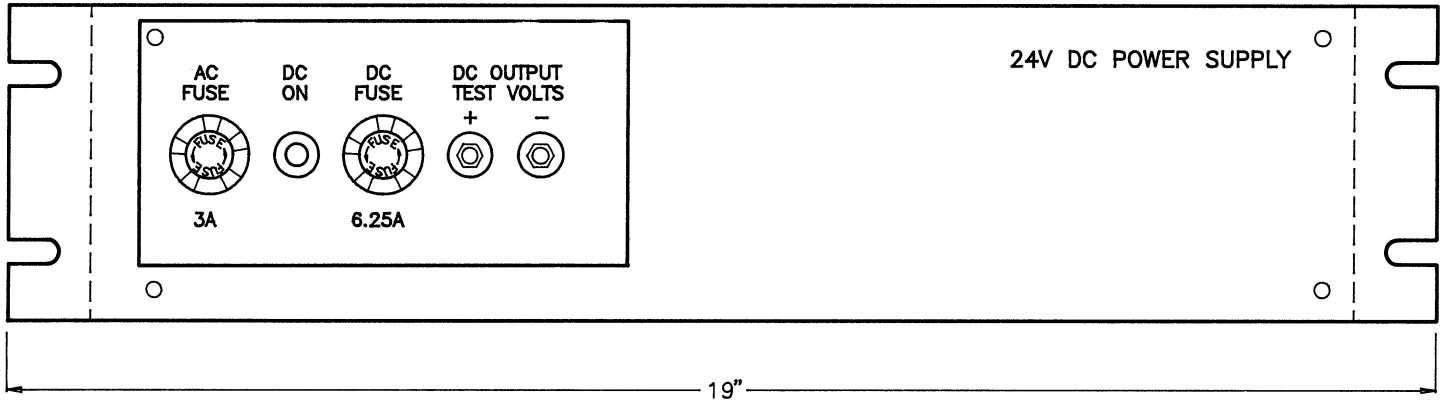
NOTES:

1. KEYWAY PINS SHALL BE BETWEEN POSITIONS B,C AND M,N.
2. (C) – COLLECTOR OUTPUT
3. (E) – EMITTER OUTPUT

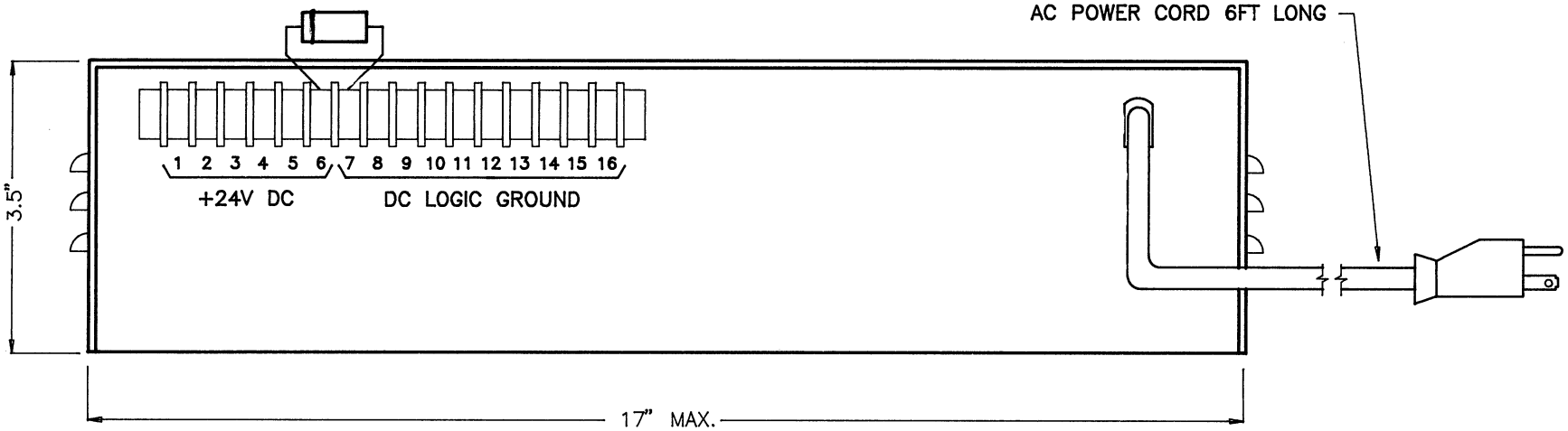
ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

I/J INPUT FILE WIRING DIAGRAM

Date	92 06 01	Rev		OTSCES – 1430.02



FRONT VIEW

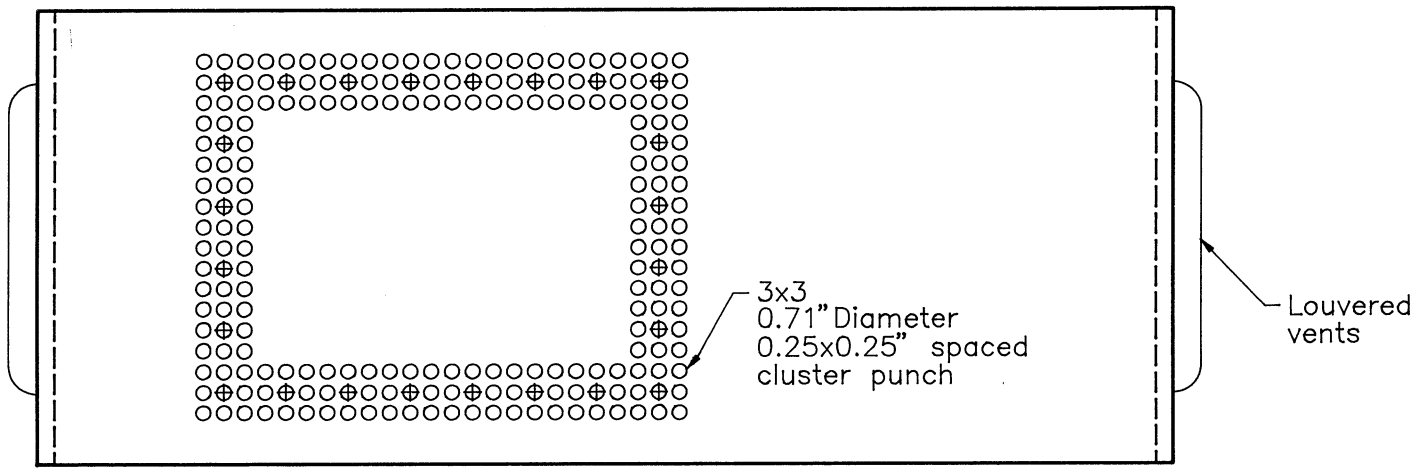


REAR VIEW

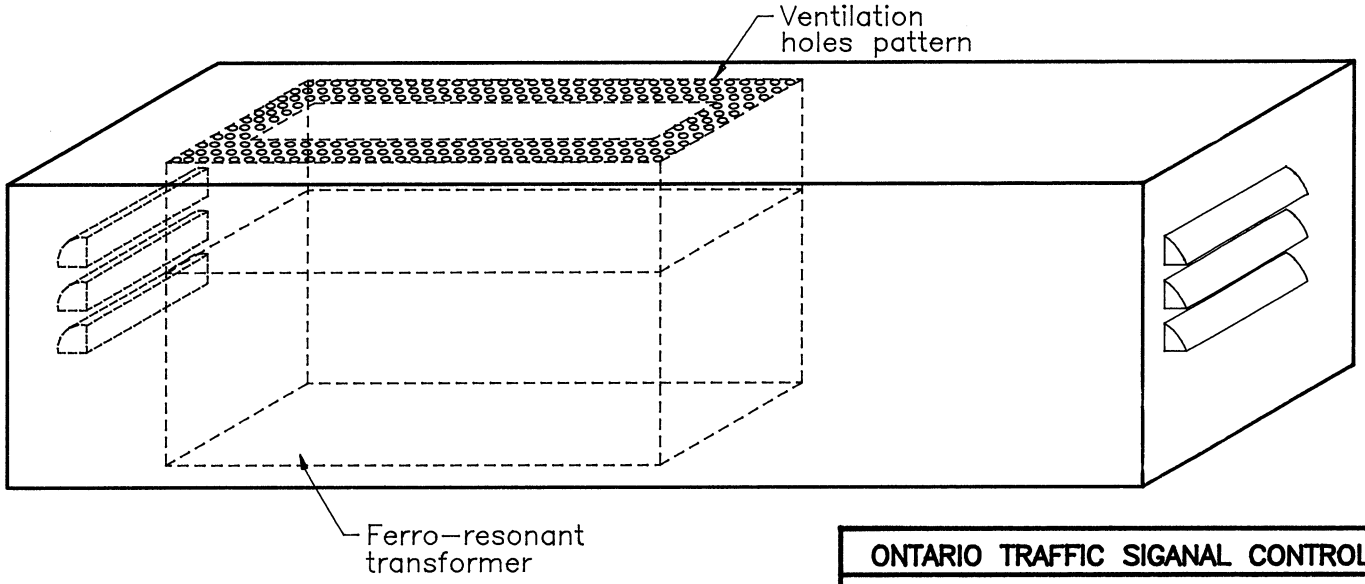
ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

POWER SUPPLY–24VDC

Date	94 11 09	Rev	1	OTSCES – 1440.01



TOP VIEW

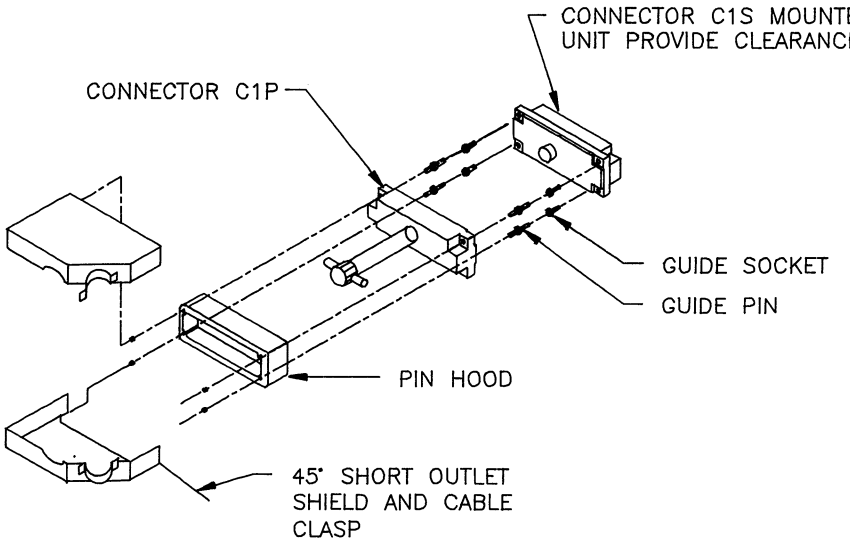


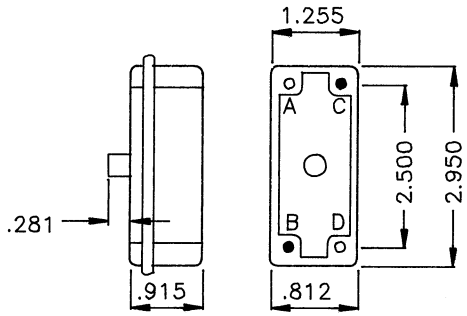
ISOMETRIC VIEW

ONTARIO TRAFFIC SIGANAL CONTROL EQUIPMENT SPECIFICATIONS

24 VDC POWER SUPPLY COVER VENTILATION

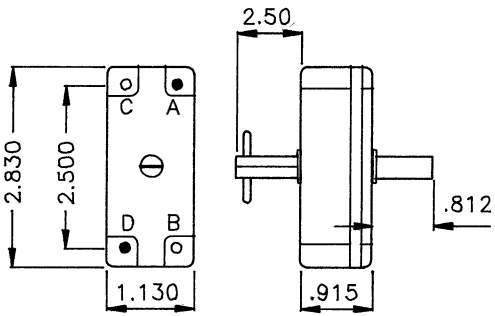
Date:	94 11 09	Rev.		OTSCES – 1440.02





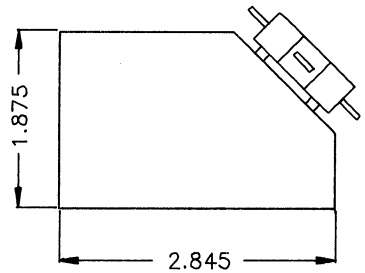
CORNER GUIDES
PIN B AND C
SOCKETS A AND D

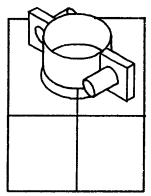
CONNECTOR C1S



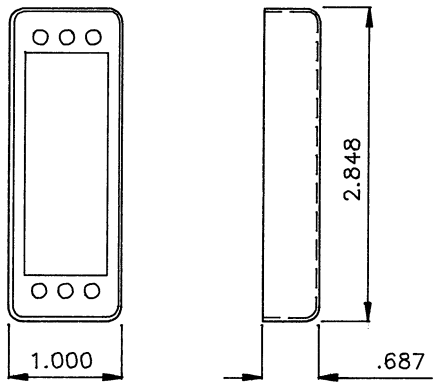
CORNER GUIDES
PINS A AND D
SOCKETS B AND C

CONNECTOR C1P





SHIELD FOR C1P



HOOD FOR C1P

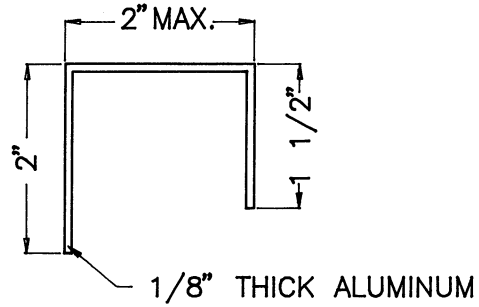
NOTES:

1. ALL DIMENSIONS SHOWN ARE IN INCHES UNLESS OTHERWISE SHOWN.
2. C1 CONNECTOR PINS 1,14,92 AND 104 SHALL BE CONNECTED TO THE CONTROLLER UNIT DC LOGIC GROUND.

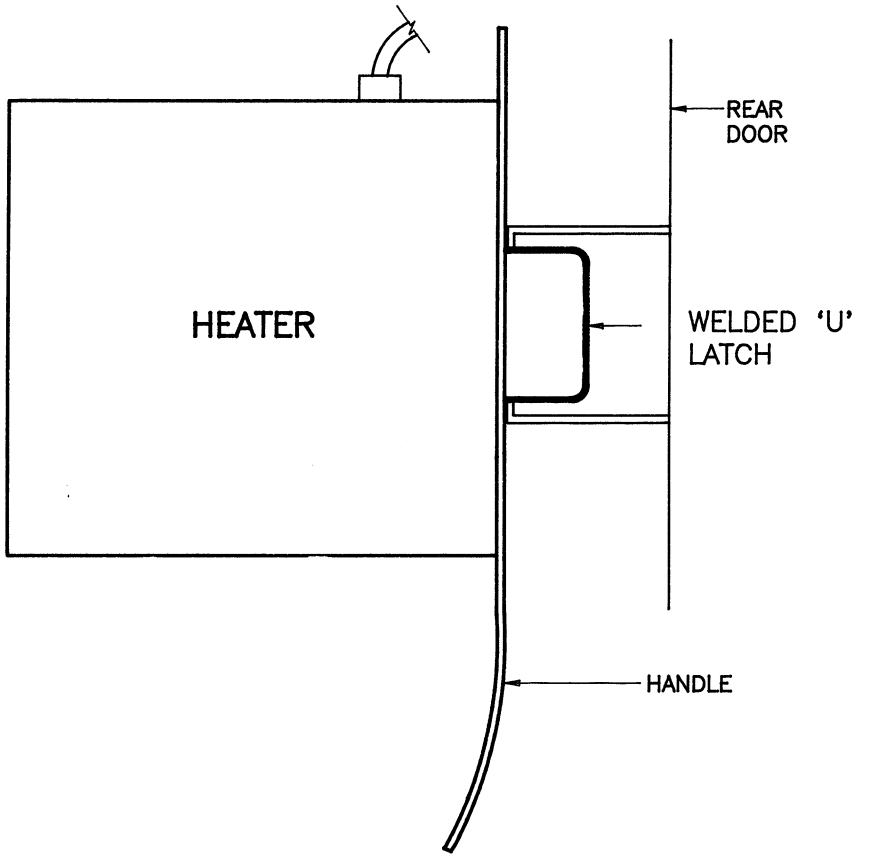
ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

C1 CONNECTORS

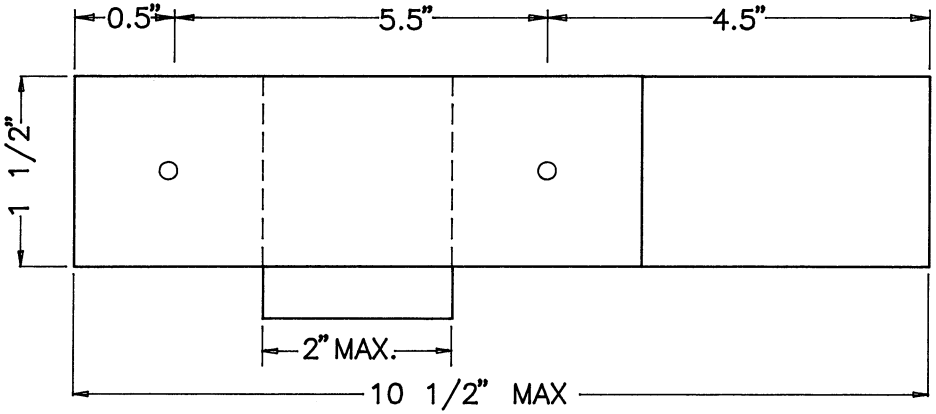
Date	92 06 01	Rev		OTSCES – 1450.01



SIDE VIEW



TOP VIEW

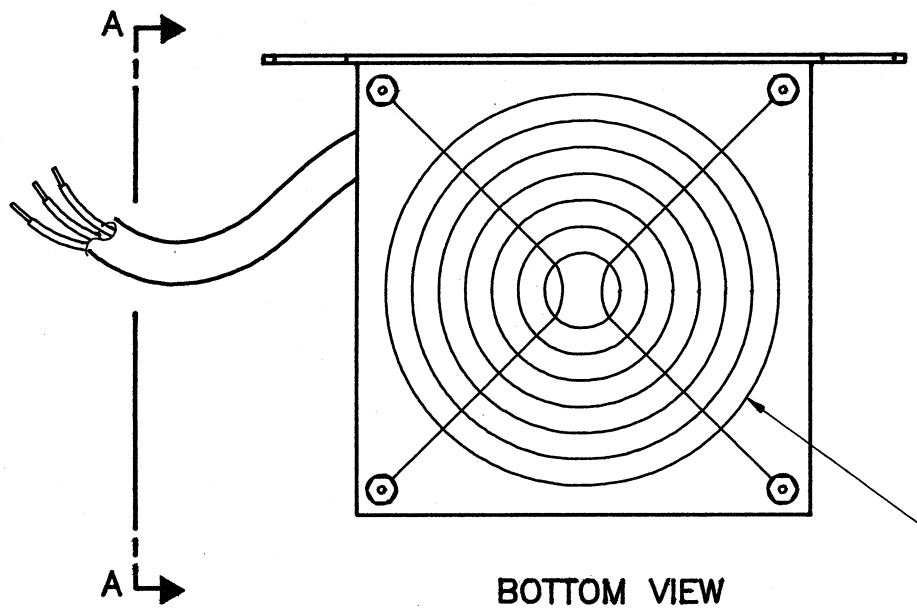


FRONT VIEW

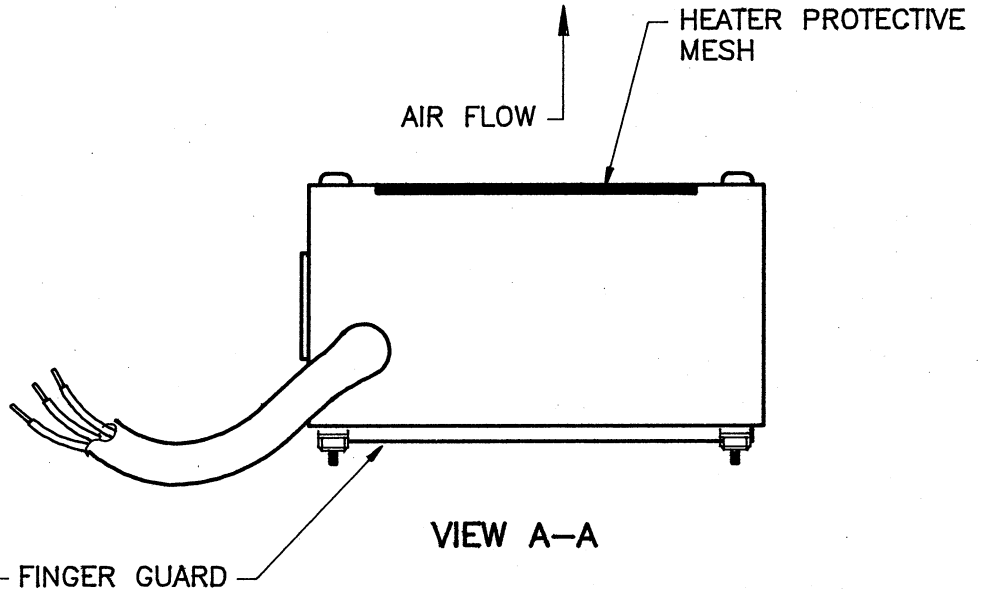
ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

HEATER MOUNTING BRACKET

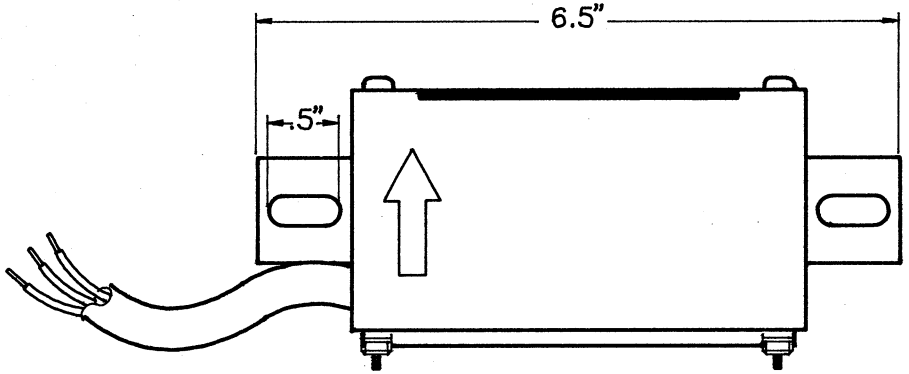
Date	94 11 09	Rev	1	OTSCES – 1460.01



BOTTOM VIEW



VIEW A–A

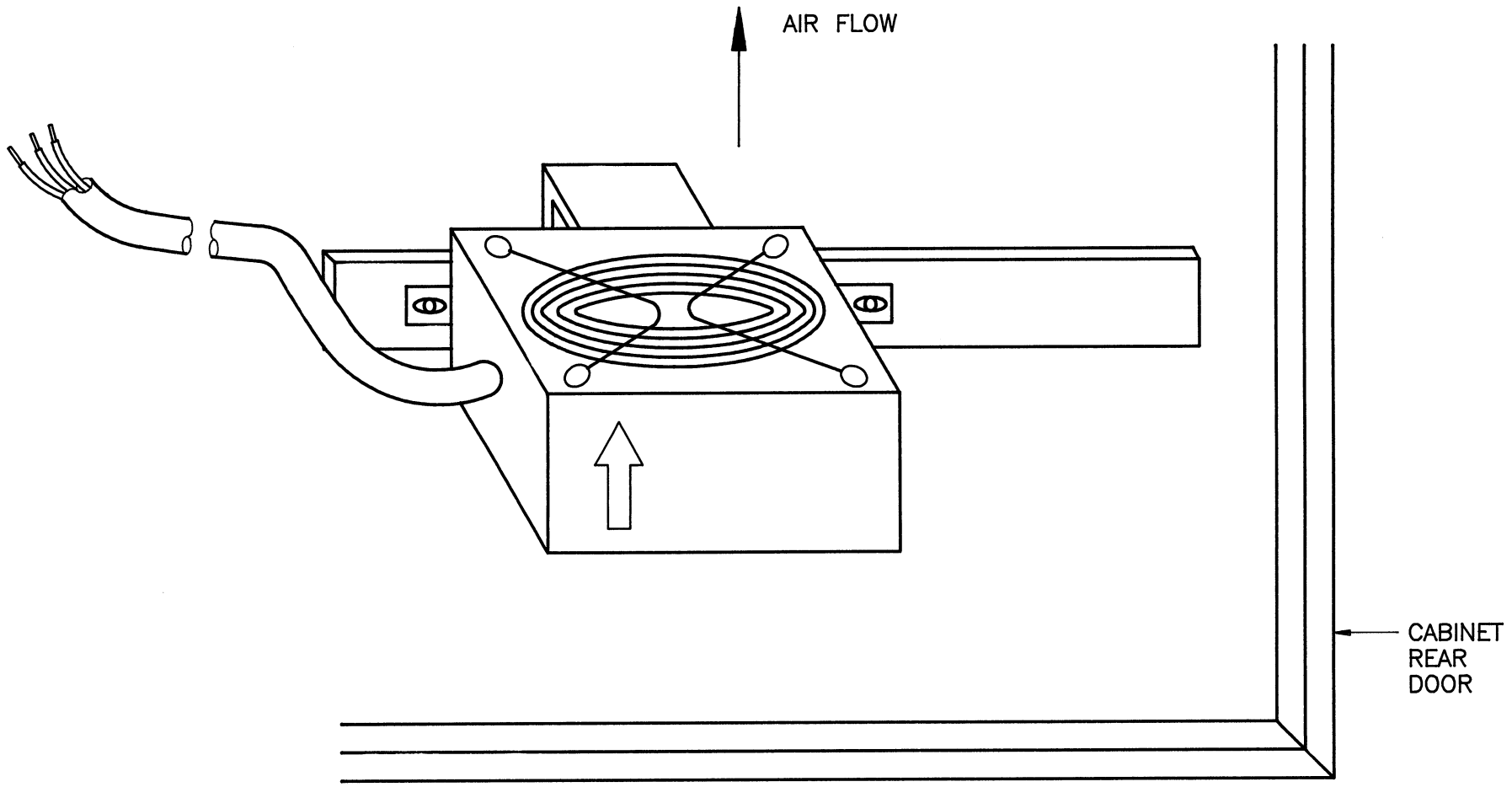


FRONT VIEW

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

HEATER

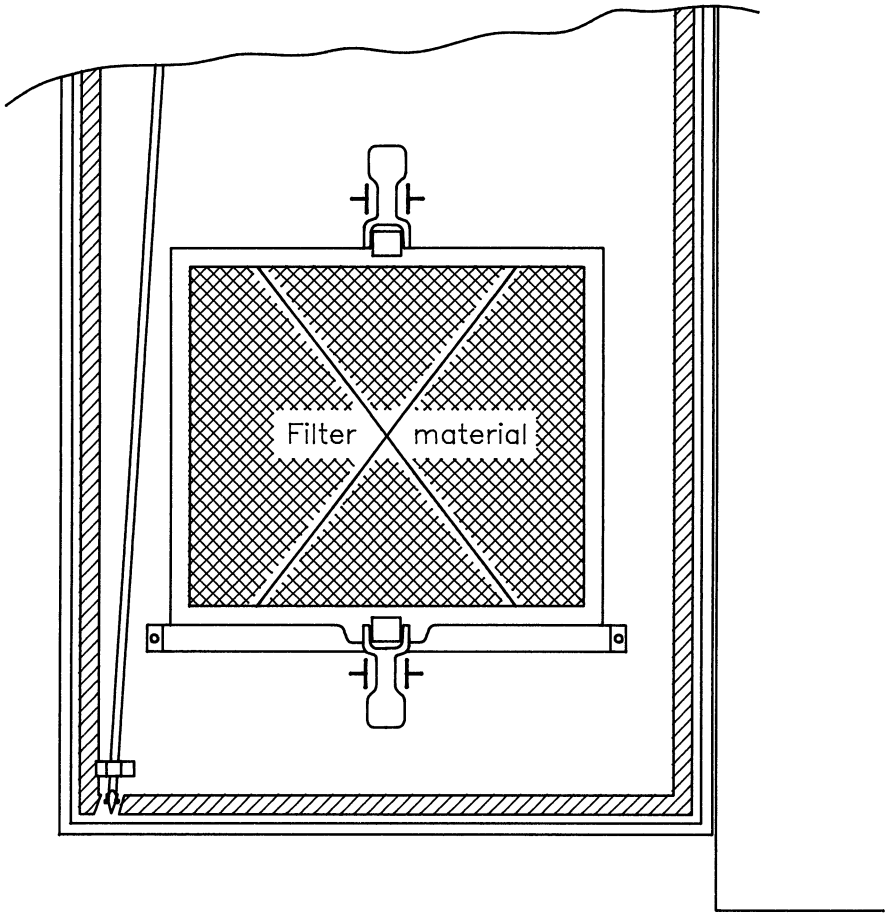
Date:	94 11 09	Rev.		OTSCES – 1460.02



ONTARIO TRAFFIC SIGANAL CONTROL EQUIPMENT SPECIFICATIONS

HEATER AND BRACKET ASSEMBLY

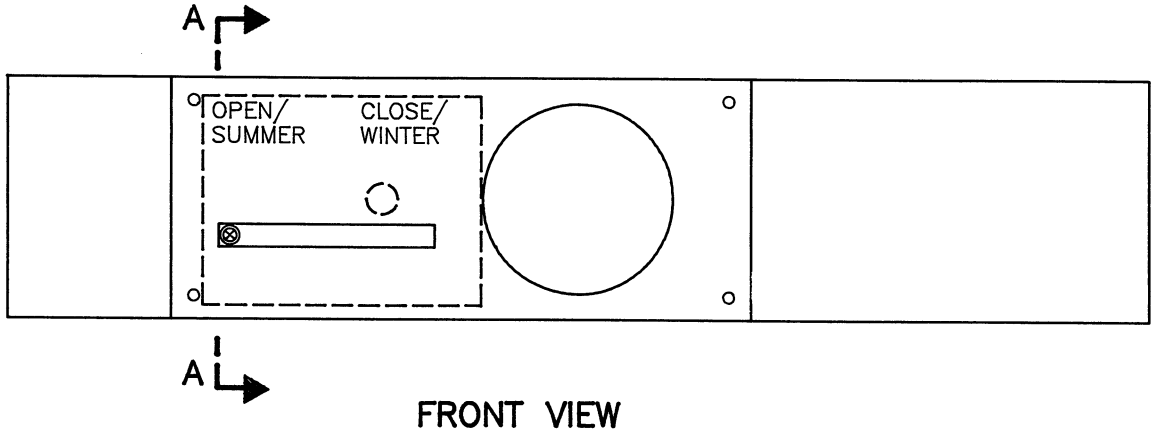
Date:	94 11 09	Rev.		OTSCES – 1460.03



ONTARIO TRAFFIC SIGANAL CONTROL EQUIPMENT SPECIFICATIONS

LOUVER VENT AND FILTER

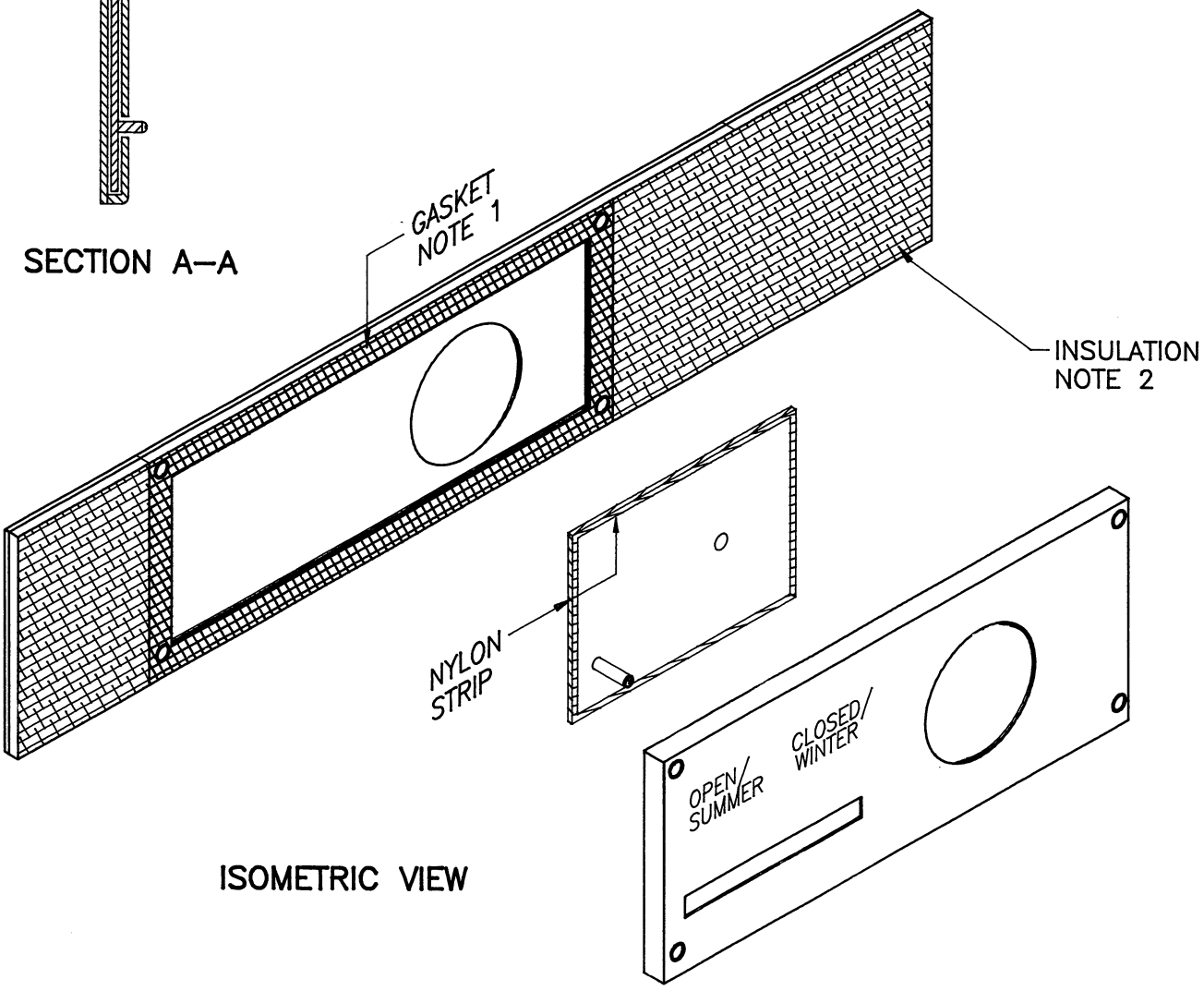
Date:	94 11 09	Rev.		OTSCES – 1470.01



FRONT VIEW



SECTION A–A



ISOMETRIC VIEW

NOTES:

1 GASKET AS IN OTSCES CHPT.14 SECTION 2.5.8 FOR MODEL 401 CABINETS ONLY

2 INSULATED AS IN OTSCES CHPT.16 PARA. 2.1.1 AND PARA. 2.1.2

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

FAN VENTILATION AREA

Date:	94 11 09	Rev		OTSCES – 1480.01

CHAPTER 15

Specifications

For

332 Series Cabinets

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2 ENVIRONMENT CONTROL ..... - 2
2.1 GENERAL ..... - 2
2.2 THERMOSTAT PANEL ..... - 2

3 CABINET ASSEMBLIES ..... - 3
3.1 GENERAL ..... - 3
3.2 POWER DISTRIBUTION ASSEMBLY (PDA) ..... - 3
3.3 OUTPUT FILE ..... - 7
3.4 FLASH TRANSFER RELAY (FTR) AND SOCKET ..... - 10
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Date	OTSCES No.	Rev	Title
June 1, 1992	1510.01	-	332 Cabinet Outline
November 9, 1994	1510.02	1	332 Cabinet - One Line Diagram
June 1, 1992	1510.03	-	332 Cabinet - Rack Assignment
November 9, 1994	1520.01	1	Service Panel - Outline
June 1, 1992	1520.02	-	7 Wire Interconnection Pin Assignment
November 9, 1994	1530.01	1	Input Panel - Outline
November 9, 1994	1540.01	1	332 PDA - Outline
June 1, 1992	1540.02	-	332 PDA - Terminal Block Assignment
June 1, 1992	1560.01	-	Output File - Outline
November 9, 1994	1560.02	1	Output File - Terminal Assignment
June 1, 1992	1560.03	-	Auxiliary Output File - Outline
November, 1994	1570.01	1	Connector C1 Wiring List
June 1, 1992	1570.02	-	Connector C4 and C5 Wiring List

1 GENERAL REQUIREMENTS

1.1 SCOPE

1.1.1 This chapter defines the specifications applicable to 332 Controller Cabinets.

1.1.2 These specifications shall supplement Chapter 1, General Specifications for Traffic Control Equipment and Chapter 14, General Specifications for Cabinets. In case of conflict the specifications of this Chapter will govern.

2 ENVIRONMENT CONTROL

2.1 GENERAL

2.1.1 The top interior side of the cabinet shall be insulated with 1/4 inch of closed cell expanded polyethylene or equivalent.

2.1.2 A vapour action corrosion inhibitor, Part #CORTEC VC1-111 EMITTER or equivalent, shall be installed inside the cabinet, on the ceiling for protecting the cabinet against corrosion.

2.2 THERMOSTAT PANEL

2.2.1 An analog thermostat, Model 500A, shall be provided and shall meet the requirements of Chapter 13.

3 CABINET ASSEMBLIES

3.1 GENERAL

3.1.1 Locks

The lock and the key shall be equivalent to Corbin lock no. 154814ARS and Corbin key no. 1R6380 Code 2. The locks shall have rectangular, spring-loaded bolts. The lock shall be left-hand on the front door and right-hand on the rear door. Keys shall be removable in the locked and unlocked positions. The lock shall be rigidly mounted with four stainless steel machine screws with the hole spacing for the machine screws approximately 2-inches apart. The screws shall not be accessible on the outside of the doors. The front portion of the lock shall extend 0.25 inch to 0.37 inch beyond the outside surface of the door. Two keys shall be furnished with each cabinet.

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

- Power Supply
- Power Distribution Assembly
- Output File
- Input File
- Fan Assembly
- Heater Assembly
- Auxiliary Output File

3.2 POWER DISTRIBUTION ASSEMBLY (PDA)

3.2.1 The power distribution assembly shall be furnished and mounted on the EIA 19-inch rack utilizing 7 inches of rack height. All equipment within the assembly shall be readily accessible for ease of replacement. The front panel of the assembly shall be removable from the front by using a robertson screwdriver. The internal wiring shall have enough slack to allow the panel to drop open to 10 degrees from the horizontal.

3.2.2 The depth of the assembly, including terminal blocks, shall not exceed 10 inches from the front cabinet rails.

3.2.3 The power distribution assembly shall be provided with marker strips to identify the Flasher Units in the assembly. The marker strip shall be of a material that can be easily and legibly written on using a pencil or ballpoint pen. Marker strips shall be located at the front immediately below the Flasher Units they are to identify.

3.2.3.1 The top and bottom of the power distribution assembly shall be covered in order to eliminate any electrical hazards.

3.2.4 Adequate ventilation holes shall be provided on the top and bottom covers of the PDA to eliminate any heat generated by the electronic components within the PDA.

3.2.5 The following equipment shall be provided with the power distribution assembly unless otherwise specified in the Purchase Order:

Quantity	Description
2	Duplex equipment receptacles (one on the front panel, another on the back panel, readily accessible from back door).
1	Controller unit receptacle
1	24V Power supply receptacle
1	Main circuit breaker
1	Five-Pole signal bus and MC coil circuit breaker
1	Two-Pole flash bus circuit breaker
2	Input file fuses
1	Equipment circuit breaker
1	AC line filter
2	12 position terminal blocks
1	Mercury contactor
1	Auto/Flash switch
1	Flash relay and socket
2	Flasher sockets
2	Model 204 flasher units
1	Flash indicator light
1	24 Volt bypass switch

3.2.6 Circuit Breakers and Fuse

3.2.6.1 The main circuit breaker labelled "MAIN" shall be rated for 50 amperes at 125 VAC.

3.2.6.2 The equipment circuit breaker labelled "EQ" shall be single pole automatic trip, and trip indicating, rated at 15 amperes at 125 VAC.

3.2.6.3 The signal bus circuit breaker labelled "SIGNAL" shall be four 15 ampere 125 VAC circuit breakers. Three switch packs shall receive power from one circuit breaker. The MC coil circuit breaker shall be one 15 Ampere 125 VAC circuit breaker with common trip to the four signal bus breakers. The breakers shall have proper trip time delay for tungsten lamp loads.

3.2.6.4 The flash bus circuit breaker labelled "FLASH" shall be two 20 ampere 125 VAC circuit breakers with common trip. Each flasher unit shall receive power from one circuit breaker. The breakers shall have proper trip time delay for tungsten lamp loads.

3.2.6.5 All circuit breakers shall have mounting requirements identical to the Potter and Brumfield "W" series with standard size for the main circuit breaker and mini-mag size for all the others. The rating of breakers shall be shown on the breaker handle or on the panel space above or below the breaker.

3.2.6.6 The input file fuses shall be 0.25" x 1.25" fast acting type rated at 2.0A.

3.2.7 Receptacles

3.2.7.1 Equipment receptacles shall be NEMA 5-15R duplex type rates for 15A at 125 VAC.

3.2.7.2 The equipment receptacles shall have ground-fault circuit interruption as defined in the CEC. GFI protection for the two equipment receptacles may use parallel wiring, as long as both receptacles are protected.

3.2.7.3 The receptacles for the controller unit and the 24 VDC power supply shall be a CSA Type 5-15R duplex type mounted on the back panel of the assembly.

3.2.8 Line Filter

3.2.8.1 One AC line filter, model Corcom #10V1 or equivalent shall be added internally to the PDA to provide filtering for the 170 Controller Unit and 24V power supply receptacles and also to the two input files. The line filter shall be placed prior to the input file fuses. Filtered AC negative output shall be connected to T2 position 1.

3.2.9 A lamp labelled "Flash Operation" shall be provided on the front panel of the assembly. The lamp shall be driven through Flash Relay circuit 1.

3.2.10 The wiring to the terminal blocks on the back panel of the assembly shall have enough slack to allow the back panel to swing fully open for service.

3.2.11 Terminal blocks shall be provided and mounted on the back panel of the assembly. The blocks shall be of type specified in Chapter 1. Two spare positions shall be provided on the terminal blocks. All conductors from the power distribution assembly routed to the cabinet wiring shall be connected to the terminal block on a common side, except for the AC+ power conductor between the secondary service terminal block and the main circuit breaker. All internal conductors terminating at the blocks shall be connected to the other side of the blocks. Terminal position assignments shall be as shown on the plans.

3.2.12 The Flash Transfer Relays shall meet the requirements for Heavy Duty Relays Model 430. Each Relay shall be labelled as to the phase it is controlling.

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

3.2.14 A 24 Volt By-Pass switch shall be installed on the front panel of the PDA (see drawings). The switch terminals shall be wired to DC terminal block T02 terminals 1 and 6 at the back of the output files. A normally open push button switch rated at 5A, 50V DC minimum shall be used. A "24 Volt By-Pass" label shall be provided above the push button.

3.3 OUTPUT FILE

3.3.1 The plastic card guides used to support the monitor and switch packs shall begin 1.0 ± 0.5 inch back from the front face of the file and they shall be the pop-in type. Special tools shall not be required to remove or insert the card guides into their designated spots. The plastic card guides shall meet the requirements of Chapter 1.

3.3.2 Minimum four spare card guide shall be supplied for each type supplied with every cabinet shipped to the Ministry. The spare card guides shall be tied and bundled and stored in one of the plastic pouches supplied with each cabinet.

3.3.3 The output files shall utilize 10.5 inches of rack height and shall be capable of containing 12 switch packs, 4 flash transfer relays, and the monitor unit. All connectors and socket connectors shall be hard wired and shall be securely mounted to endure the insertion and extraction force applied. Four flash transfer relays shall be furnished with each output file unless otherwise specified in the Purchase Order.

3.3.3.1 The top and bottom of the OUTPUT and AUX OUTPUT FILES shall be covered in order to eliminate any electrical hazards.

3.3.4 Adequate ventilation holes shall be provided on the top and bottom covers of the output file in order to eliminate any heat generated by the components within the output files.

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

3.3.6 Switch pack, monitor unit and flash transfer relay sockets and flash programming connectors shall be accessible from the back of the file without the use of tools. All wires connected to the back panel of the file shall have enough slack to allow the panel to swing fully open for servicing.

3.3.7 Field wire terminal blocks shall be mounted vertically on the back of the assembly. The 3 terminal blocks shall be the 12-position quick-clamp barrier type, Cinch-Jones 542 series with Y type solder terminal, or equivalent, with Robertson or combination Robertson and slot head screws. The terminals shall be labelled according to their phase function.

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

3.3.9 The red and yellow signal circuits of each of the switch packs 2, 4, 6 and 8 shall be available at a Molex Type 1375 receptacle which shall intermate with a Molex Type 1375 plug to allow flash programming.

3.3.10 Six plug connectors shall be furnished with each cabinet. Four connectors shall be jumpered for red flash and two connectors shall be jumped for yellow flash. The cabinet shall be shipped with switch packs 2 and 6 programmed for yellow flash and switch packs 4 and 8 for red flash. The two spare red flash connectors shall be tied to the two yellow flash connectors. Connectors shall be readily accessible without the removal of any other equipment. Plug Pins shall be crimped and soldered. The Molex receptacles and plugs shall be properly labelled with the associated switch pack number and programmed colour.

3.3.11 The Monitor Connector shall be a rigidly supported printed circuit board edge connector, having two rows of 28/56 independent double readout bifurcated contacts on 0.156 inch centres. The connector shall intermate with the Monitor Unit Model 210 and Model 212. The wiring terminals on the connector shall be individually insulated after the associated wires are soldered onto the terminals to prevent accidental shorting of two adjacent terminals and wirings.

3.3.12 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. The cabinet shall contain a conspicuous warning against operation with the monitor unit removed. It shall be possible to remove or install the monitoring device while the controller is in normal operation without causing the intersection to go into any abnormal or flashing operation.

3.3.13 The monitor unit connector shall be wired in accordance with the pin assignment shown on the plans for the Model 212 monitor unit.

3.3.14 The logic relay and the isolation relay shall be of octal based with long round pin type to avoid possible loosening of the connection due to vibration. The logic relay shall have an eight pin plug and socket. Isolation relay shall have an eleven pin plug and socket. The coil voltage for each relay shall be identified next to the relay label.

3.3.15 Field signal inputs to the monitor connector shall be connected to the same point as the field output terminals.

3.3.16 One AC line filter, model Corcom #3V1A or equivalent shall be added

internally to the back panel of the output file assembly in the adjacent area of the conflict monitor unit. Filter inputs shall be connected to terminal block unit. Filter units shall be connected to terminal blocks T01 terminals 9, 10 and 11. Filter outputs shall be connected to monitor connector pins 20, 21 and FF.

3.3.17 For protection against lightning surges and transients, metal oxide varistors (MOV) shall be installed between the switch pack field terminals and a grounding bus strip. The varistors and the ground bus strip shall be located on the inside of the back panel of the output file. The grounding bus strip shall be grounded to the output file chassis. A green coloured wire (AWG #8) shall connect the grounding bus strip to the ground bus located on the 332 service panel.

3.3.18 The varistors shall be capable of meeting the following minimum requirements:

Recurrent peak voltage 212 volts
Energy Rating minimum 20 joules
Power Dissipation, average 0.85 watts
Peak current, 2000 amperes for pulse less than 6 microseconds

3.3.19 MOV shall also be installed between each pin position of terminal block TO2 (see drawings) and a DC grounding bus strip. Both MOV and the DC grounding bus shall be located on the inside of the back panel of the output file.

3.3.20 The grounding bus shall be isolated from the chassis and connected to DC ground within the output file. These MOV shall be General Electric V33 ZA5 or equivalent.

3.3.21 MOV shall also be installed between each pin position of terminal block T01 (see drawings) pin position and a grounding bus strip. Both MOV and the grounding bus strip shall be installed on the inside of the back panel of the output file. The grounding bus shall be grounded to the chassis ground terminal bus located on the service panel and to the inside of the back panel of the output file. MOV shall have the same ratings as the MOV installed on the output file field terminals.

3.4 FLASH TRANSFER RELAY (FTR) AND SOCKET

3.4.1 Flash transfer relays shall conform to the requirements for model 430 Heavy Duty Relays.

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

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

3.4.4 The flash transfer relay shall transfer switch pack outputs to flash control. Transfer of the flash transfer relay circuit to flash control shall not prohibit the operation of the controller unit.

3.4.5 FTR1 shall be wired to transfer signals associated with switch packs 1 and 6. FTR2 shall be wired to transfer signals associated with switch packs 2 and 5. FTR3 shall be wired to switch packs 3 and 8. FTR4 shall be wired to transfer signals associated with switch packs 4 and 7. This wiring arrangement shall ensure all signal indications on any approach shall flash in unison.

3.5 POLICE PANEL

3.5.1 Police Panel Door

3.5.1.1 The police panel door shall be equipped with a lock keyed for a master police key. The police lock and key shall be equivalent to Corbin lock No. D357SG and Corbin key no. Code 1. The police panel shall be mounted on the side of the cabinet as shown on the plans. Any screws used for mounting the door hinges or lock shall not be accessible from the outside. The keyhole shall have a cover plate. The lock stopper material shall not wear down with repeated use and shall not be made of aluminum.

3.5.1.2 Two keys shall be furnished with each cabinet for the police lock. Each key shall have a shaft at least 1.750" in length.

3.5.2 A police panel shall be mounted behind the police panel door. The panel shall contain one DPDT, and one 3PDT toggle switch. The 3PDT switch shall be labelled "ON/OFF" and the DPDT shall be labelled "FLASH/AUTO". The "ON/OFF" switch shall be positioned so that the

"ON" position is up. The "FLASH/AUTO" switch shall be positioned so that the "AUTO" position is up.

3.5.3 The switches shall have contacts rates for 15 amperes at 125 volts AC.

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

3.6 SIDE PANELS

3.6.1 Two panels shall be provided and mounted on the EIA rack parallel to the cabinet sides as shown on the drawings. The panels shall be fabricated from 5052-H32 sheet aluminum with a thickness of 0.125 inches. All edges shall be filed to a radius of 0.03125 inch minimum. The panels shall be free of dents, scratches and abrasions harmful to the strength and general appearance. The panels shall not have any finishing applied such as paint or anodizing.

3.6.2 Inhibitor shall be applied between the metal contacting surfaces wherever electrical contacts are required. In viewing from the back door, the left side panel shall be designated the "Input Panel" and the right side panel shall be designated the "Service Panel".

3.6.3 Input Panel

3.6.3.1 The terminal block and the C5 connector shall be installed according to plans. A wiring duct shall be installed below the input panel according to the plans.

3.6.4 Service Panel

3.6.4.1 Two service terminal blocks rated 50A and 600V AC shall be provided on the service panel. The primary terminal block shall be installed at the service entrance point at the bottom of the service panel. The secondary terminal block shall be installed in the area next to the power distribution assembly back panel.

3.6.4.2 Two one metre long No. 8 conductors shall be connected between the Primary and Secondary terminal blocks, one for AC+ (L1) connection and the other for AC- connection.

3.6.4.3 The chassic ground connections from the equipment ground bus to secondary terminal block and from the primary to the secondary terminal block shall be kept as short as possible.

3.6.4.4 Power Line Surge Protectors

3.6.4.4.1 Power Line surge protectors shall be provided and installed at the service terminal blocks.

3.6.4.4.2 The primary surge protector shall be a three-electrode Gas Tube Type and shall be provided between both AC+ (L1) and AC- line conductors and chassis ground. The Gas Tube shall have the following ratings:

a) Impulse Breakdown: less than 1000 V in less than 0.1 microseconds at 10 kilovolts/microsecond.
b) Standby Current: less than one milliampere
c) Striking Voltage: greater than 212 V DC
d) Capable of withstanding 15 pulses of peak current each of which will rise in eight microseconds and fall in 20 microseconds to one half the peak voltage at 3 minute intervals. Peak current rating shall be 20,000 amperes.

3.6.4.4.3 The leads of the gas discharge tube shall be 3/4" maximun for mounting onto the primary service terminal.

3.6.4.4.4 The secondary protectors shall be three Metal Oxide Varistors (MOV) mounted on the 332 service panel, near the secondary terminal blocks. The varistors shall be General Electric #V150PA20A or equivalent. Only one varistor shall have its base plate electrically isolated from the chassis wall and shall be installed between AC+ (L1) and AC- terminals. The other two varistors shall have their base plates mounted directly on the service panel to provide good electrical contact to chassis ground. One MOV shall be installed between AC- and chassis ground and the other MOV between AC+ (L1) and chassis ground. All connections shall be made by AWG #14 stranded copper wires, less than two inches in length.

3.6.4.5 Two terminal blocks labelled TBO and TBOO shall be provided on the service panel. The terminal blocks shall be 12 position barrier type and shall be mounted vertically in parallel separated by 5 inches of space (centre to centre). The centre of TBOO shall be 2.5 inches from the inside of the rear equipment rack rail. TBOO and TBO shall have double screw terminals and shall not have feed through pins.

3.6.4.6 The AC- copper terminal bus shall not be grounded to the cabinet or connected to logic ground and shall provide a minimum of 10 terminals for the connection of field conductors. Minimum 1/4" nylon screws shall be used for securing the bus to the service panel. Metal screws may be used with nylon spacers to provide insulation. A minimum gap of 3/8 inch shall be provided between the screws.

3.6.4.7 An equipment grounding (earth ground) bus with a minimum of 10 terminals shall be provided. The bus shall be copper and grounded to the cabinet chassis.

3.6.4.8 A conductive corrosion inhibitor for aluminum shall be applied to the surface of the service panel in the areas where the equipment ground bus and the MOV base are grounded through the panel.

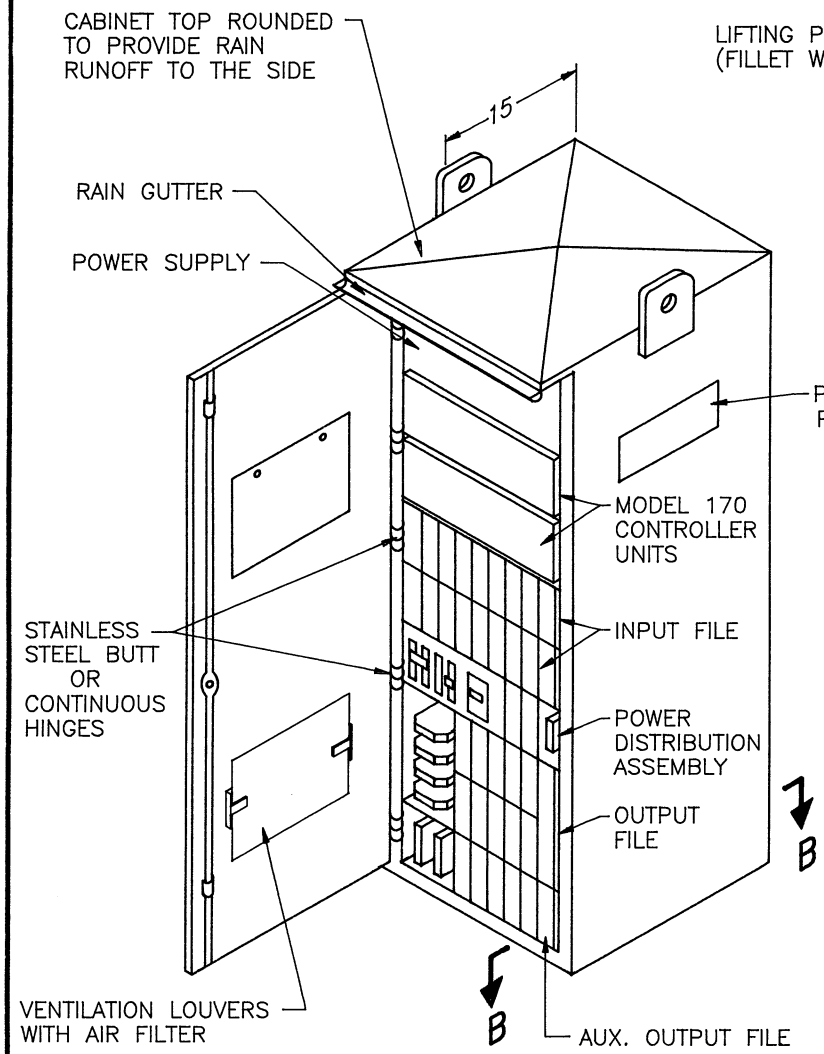
3.6.4.9 A wiring duct shall be installed between the back door and the service panel rear edge. The duct shall be 4 inches wide x 2 inches deep x 21 inches long and shall be located 9 inches above the cabinet base.

3.6.4.10 A 60 Amp disconnect switch, Bryant #60002 or equivalent in a 6.5" x 5" x 2" deep box shall be installed on the Service Panel for termination of incoming power supply cables. The box cover shall provide protection of switch handle from accidental operation. The cover shall be painted with gloss polyester thermosetting powder paint, color yellow, with silk screened lettering as shown in OTSCES Drawing 1520.01.

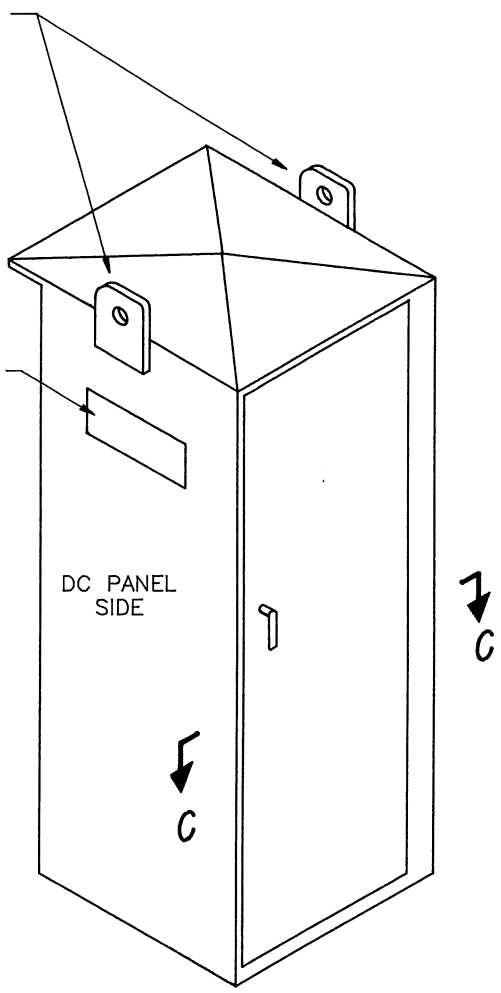
3.7 CONTROLLER PROVISIONS

3.7.1 Two plated controller unit supporting angles extending from the front to the back rails shall be supplied to support the local 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 three inches. The angles shall be mounted 20.5 inches from the top of the rack and shall be continuously adjustable vertically for 0.5 inches.

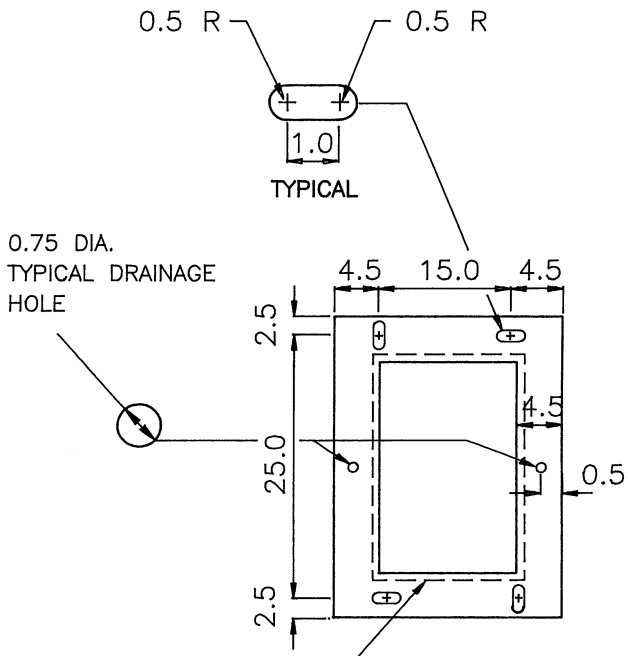
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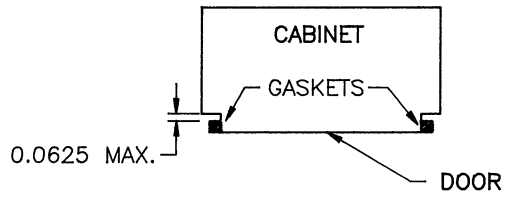
FRONT VIEW



REAR VIEW



SECTION B–B

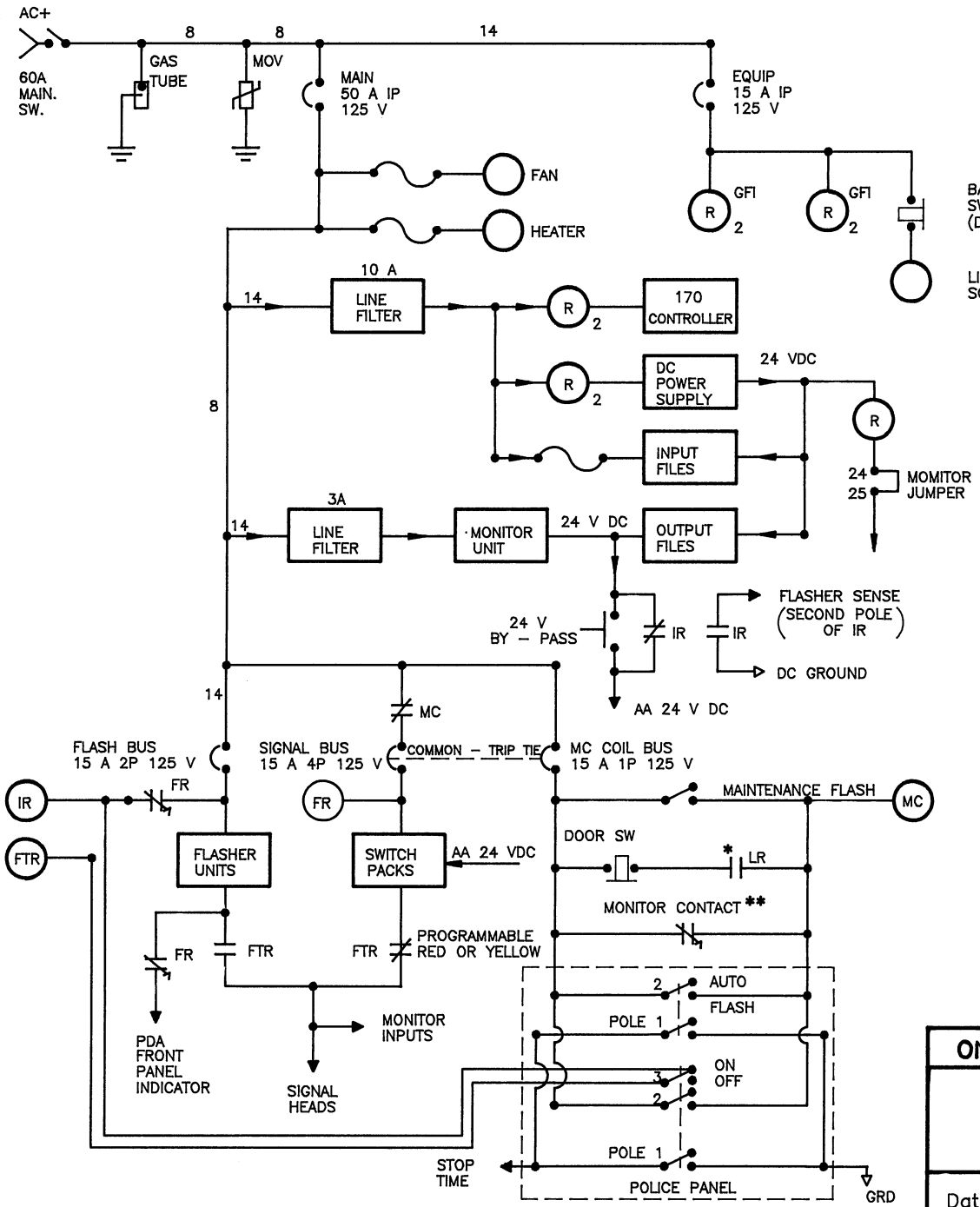


SECTION C–C
TYPICAL

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

332 CABINET OUTLINE

Date	92 06 01	Rev		OTSCES – 1510.01



LEGEND

- SURGE PROTECTOR
- FUSE
- CIRCUIT BREAKER
- RECEPTACLE, DUPLEX, GROUND FAULT INTERRUPTER
- RECEPTACLE, DUPLEX
- RC — RELAY COIL
- MC — MC COIL
- FR — FLASH RELAY COIL
- RELAY CONTACT N.O.
- RELAY CONTACT N.C.
- MC — MERCURY CONTACT
- FR — FLASH RELAY
- FTR — FLASH TRANSFER RELAY
- 8 — WIRE SIZE, IF NOT INDICATED SHALL BE No. 14 AWG
- LR — LOGIC RELAY, OUTPUT FILE
- A.C. GROUND
- IR — ISOLATION RELAY, OUTPUT FILE
- RELAY CONTACT OPEN WHEN COIL ARE ENERGIZED

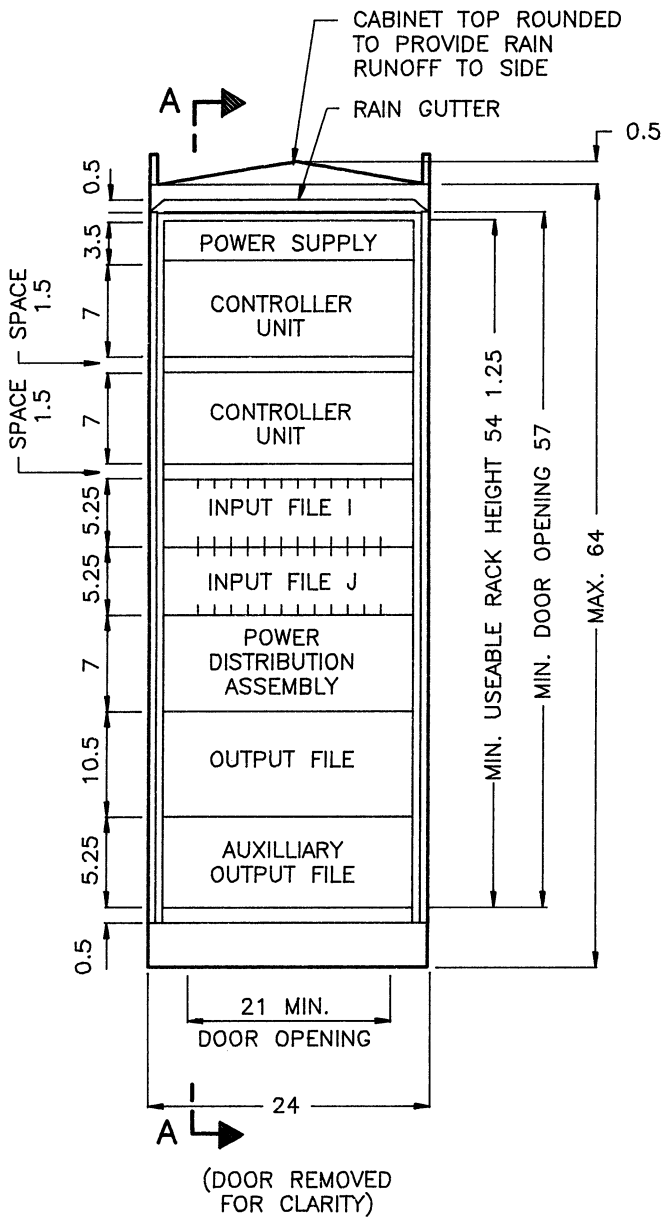
* RELAY CONTACT OPEN WITH COIL NORMALLY ENERGIZED WHILE MONITOR PLUGGED IN.

** MONITOR TRIGGERED INTO FLASH MODE AND DEENERGIZED THE COIL

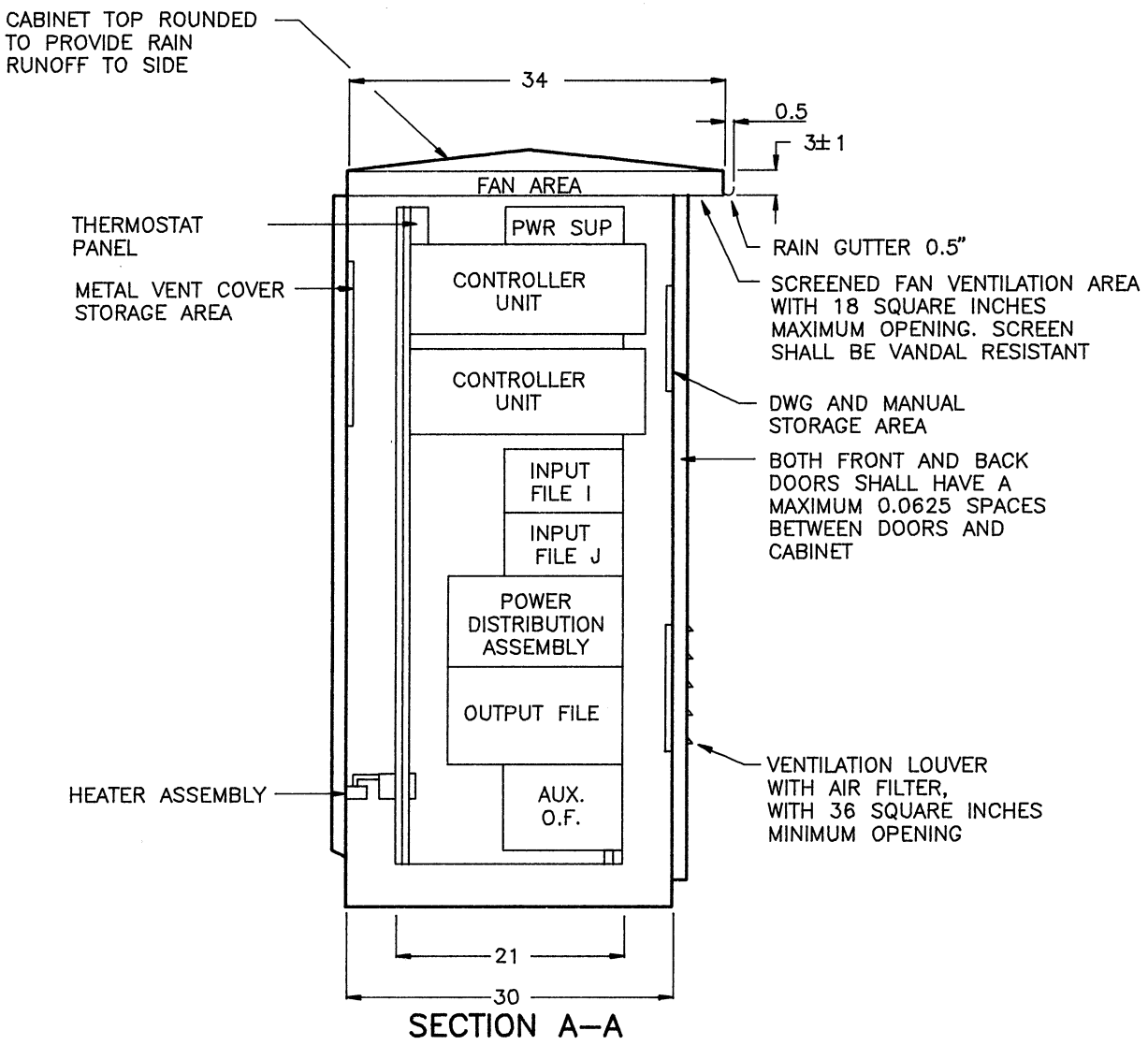
ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

332 CABINET–ONE LINE DIAGRAM

Date	94 11 09	Rev	1	OTSCES – 1510.02



FRONT VIEW



SECTION A–A

NOTE:

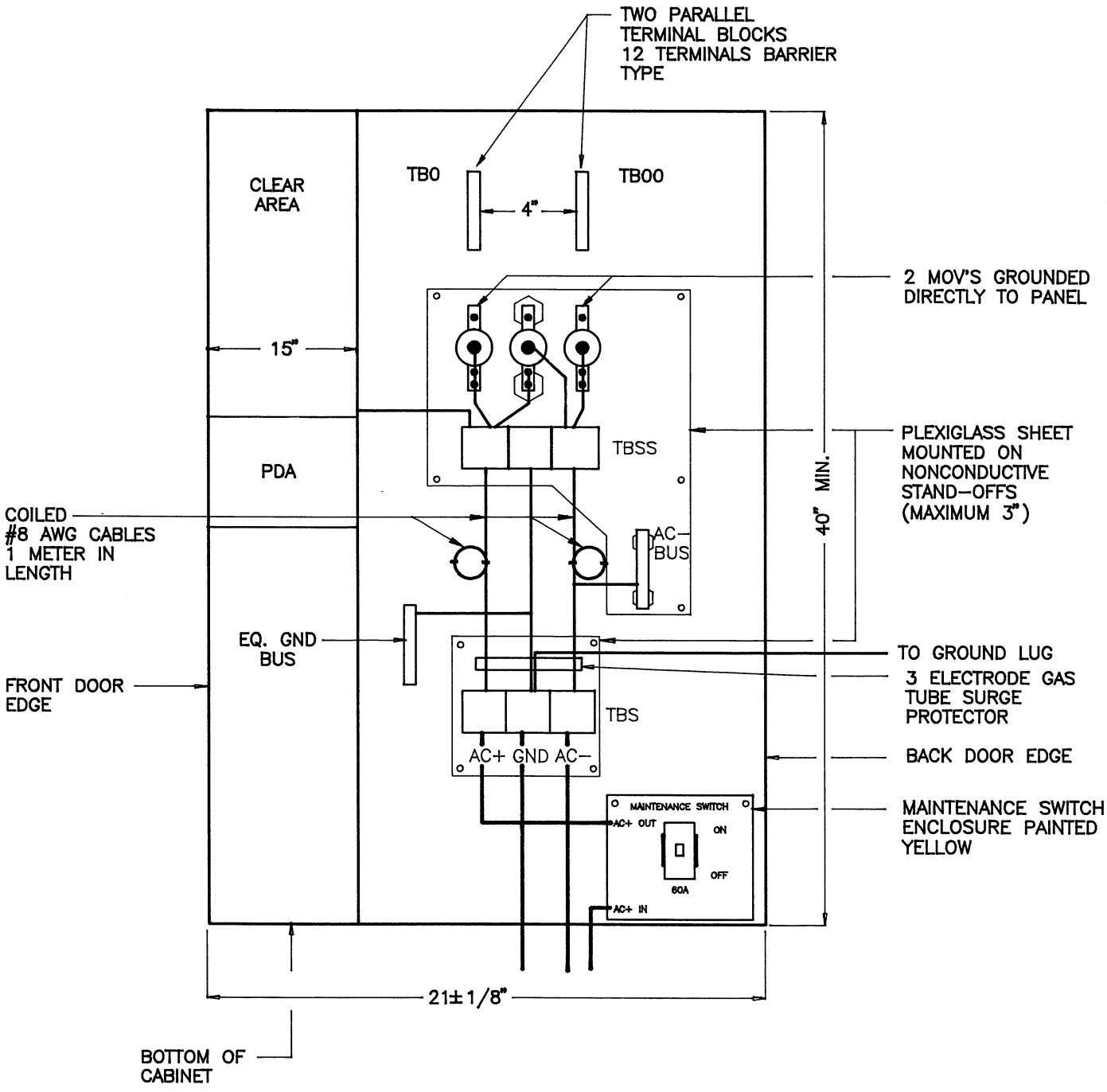
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SHOWN.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

332 CABINET–RACK ASSIGNMENT

Date	92 06 01	Rev		OTSCES – 1510.03

SERVICE PANEL SIDE



NOTE:

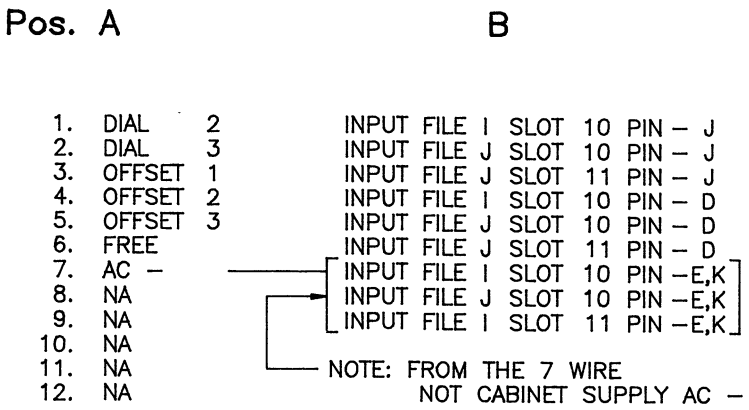
CENTER MOV IS MOUNTED ON SERVICE PANEL AND IS ELECTRICALLY ISOLATED FROM SERVICE PANEL.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

SERVICE PANEL-OUTLINE

Date:	94 11 09	Rev	1	OTSCES – 1520.01

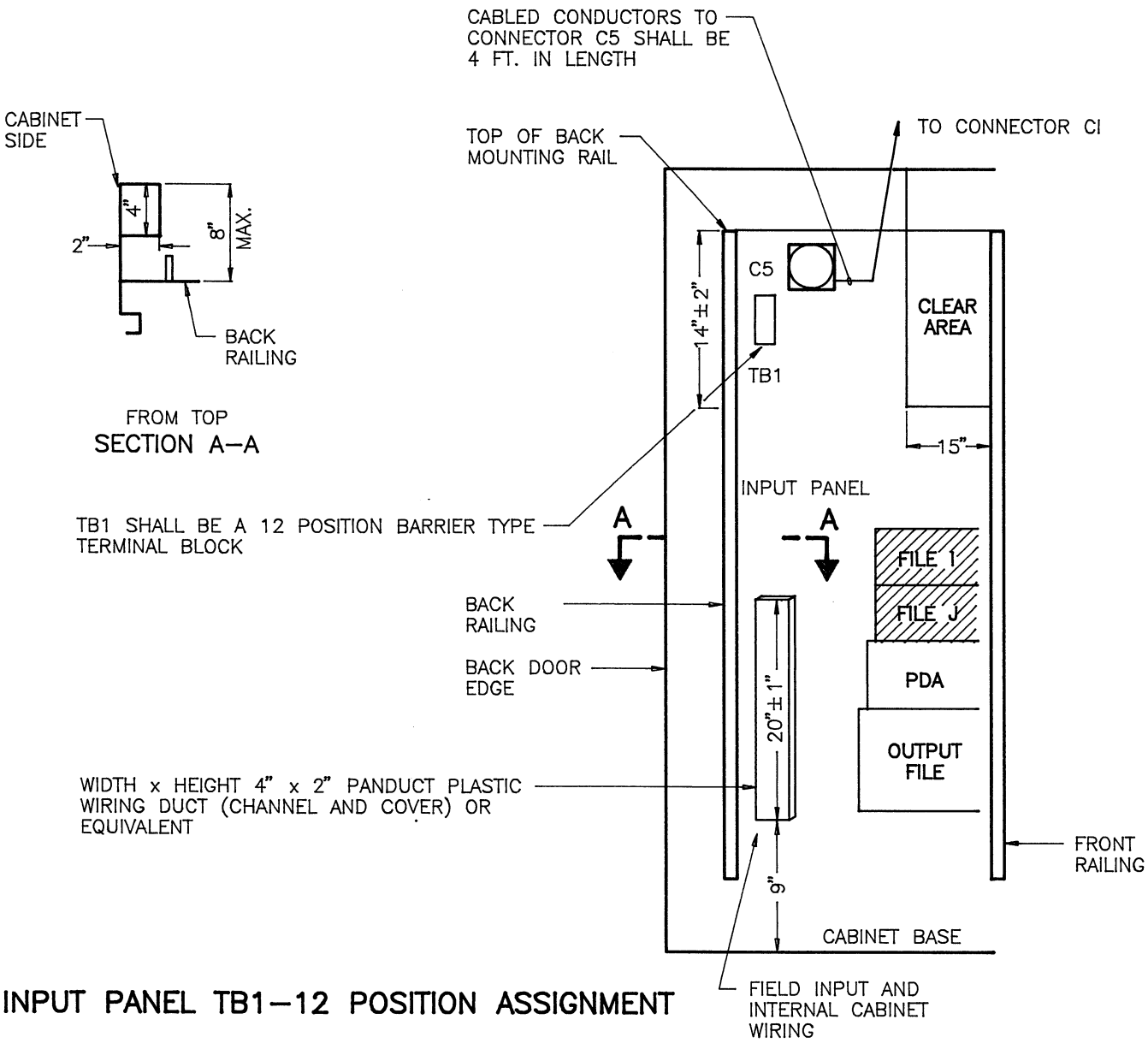
SERVICE PANEL TBO TERMINAL BLOCK
(12 POSITION BARRIER TYPE)



ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

7 WIRE INTERCONNECTION PIN ASSIGNMENT

Date	92 06 01	Rev		OTSCES – 1520.02



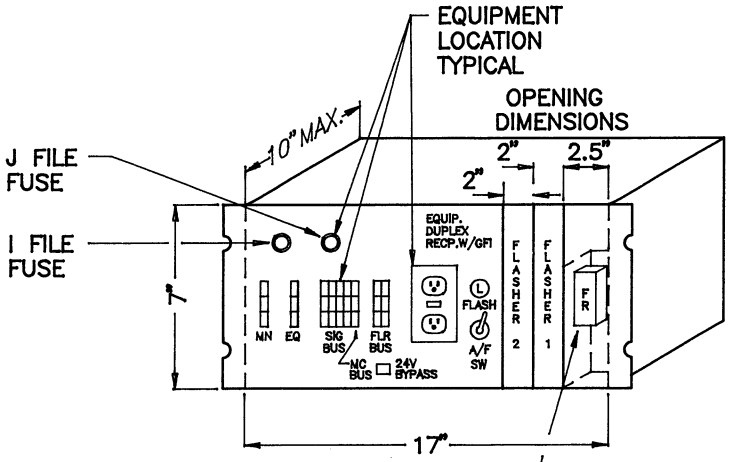
INPUT PANEL TB1–12 POSITION ASSIGNMENT

	A	B
1	+ 24V DC	OUTPUT FILES INPUT FILES MONITOR UNIT
2	NA	
3		MONITOR UNIT
4		TEST RESET
5	POSITIONS NOT ASSIGNED	
6		
7		
8		
9	POSITION 9 –12 RESERVED FOR COMMUNICATIONS	
10		
11		
12		

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

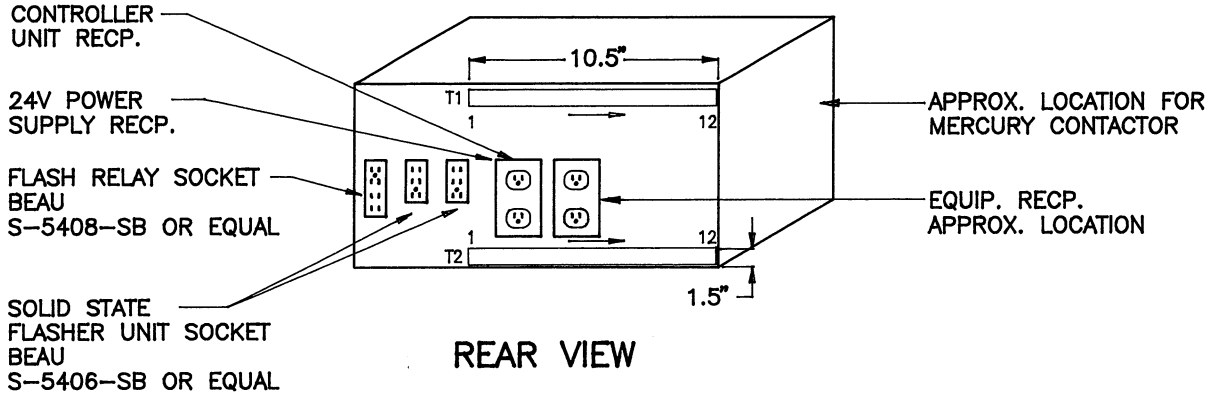
INPUT PANEL–OUTLINE

Date	94 11 09	Rev	1	OTSCES – 1530.01



FRONT VIEW

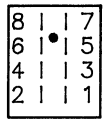
TOP OF RELAY SHALL BE FLUSH WITH FACE OF ASSEMBLY



REAR VIEW

PIN No.	CIRCUIT	PIN No.	CIRCUIT
1	COIL	5	COM CKT #1
2	COIL	6	COM CKT #2
3	NC CKT #1	7	NO CKT #1
4	NC CKT #2	8	NO CKT #2

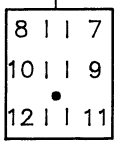
CONTACTS SHALL BE RATED 15 AMPERES MINIMUM



(REAR VIEW)

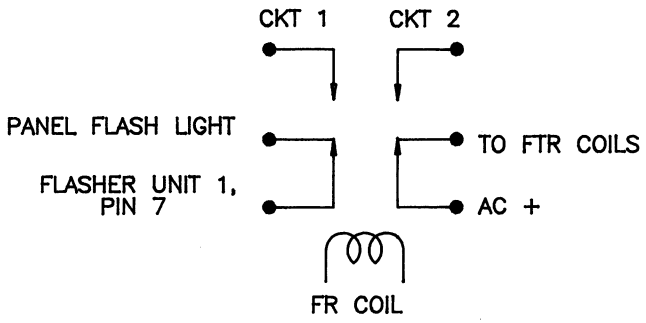
CONNECTOR SOCKET FLASH RELAY

PIN No.	CIRCUIT	PIN No.	CIRCUIT
7	LD CKT #1	10	AC-
8	LD CKT #2	11	AC+
9	EQ GND	12	NA



(REAR VIEW)

CONNECTOR SOCKET FLASHER



FLASH RELAY WIRING DIAGRAM

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

332 PDA-OUTLINE

Date:	94 11 09	Rev	1	OTSCES - 1540.01

POWER DISTRIBUTION ASSEMBLY T1 AND T2
TERMINAL BLOCK ASSIGNMENT DETAIL

T1 AND T2 SHALL BE 12 POSITION BARRIER TYPE

T1

	POS. A (Int)	B (Ext.)
1.	EQU. GND.	EQU. GND. BUS
2.	AC – RECP. GF.	AC – BUS
3.	AC – COILS & MISC.	AC – BUS
4.	AC – FLASHER UNITS	AC – BUS
5.	MAIN CB (Secondary)	HEATER, FAN
6.	MAIN CB (Secondary)	T01 – 11
7.	MC COIL	T01 – 12
8.	MC COIL CB (Secondary)	POL. PANEL, F. DOOR SW. 01 – 15
9.	SPARE	MAINT. SW.
10.	AC + EQT. RECEPTABLE	BACK DOOR SW.
11.	FILTERED FUSED AC +	UPPER INPUT FILE I
12.	FILTERED FUSED AC +	UPPER INPUT FILE J

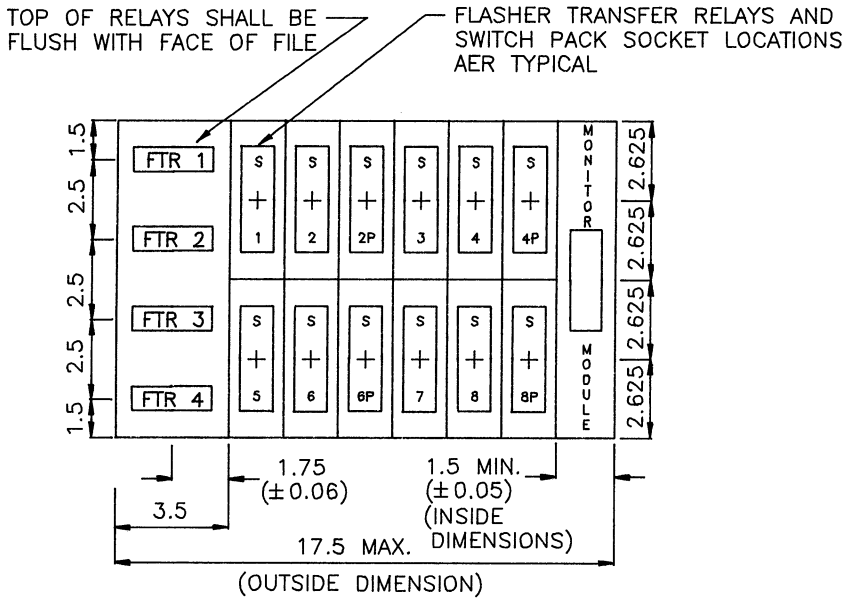
T2

	POS. A (Ext.)	B (Int.)
1.	INPUT FILES AC (–)	FILTERED AC
2.	T01 – 05	FLH UNIT 1 CH. 1 PIN 7
3.	T01 – 06	FLH UNIT 1 CH. 2 PIN 8
4.	T01 – 07	FLH UNIT 2 CH. 1 PIN 7
5.	T01 – 08	FLH UNIT 2 CH. 2 PIN 8
6.	T01 – 14, POL. PANEL	AC PWR FROM FR CONTACT
7.	T01 – 01	SIG CB, CKT 1
8.	T01 – 02	SIG CB, CKT 2
9.	T01 – 03	SIG CB, CKT 3
10.	T01 – 04	SIG CB, CKT 4
11.	SPARE	SPARE
12.	SPARE	SPARE

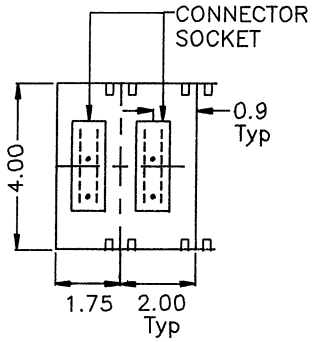
ONTARIO TRAFFIC SIGANAL CONTROL EQUIPMENT SPECIFICATIONS

332 PDA – TERMINAL BLOCK ASSIGNMENT

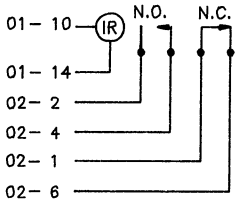
Date	92 06 01	Rev		OTSCES – 1540.02



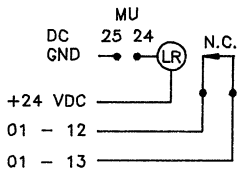
FRONT VIEW



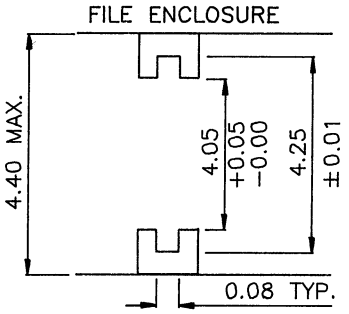
SWITCH PACK MOUNTING DETAIL



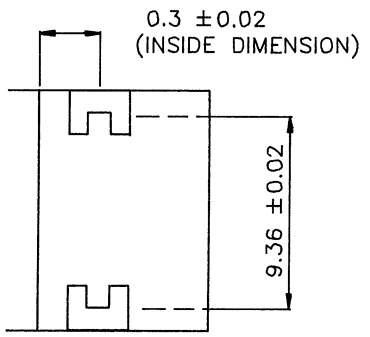
ISOLATION RELAY DETAIL



LOGIC RELAY DETAIL

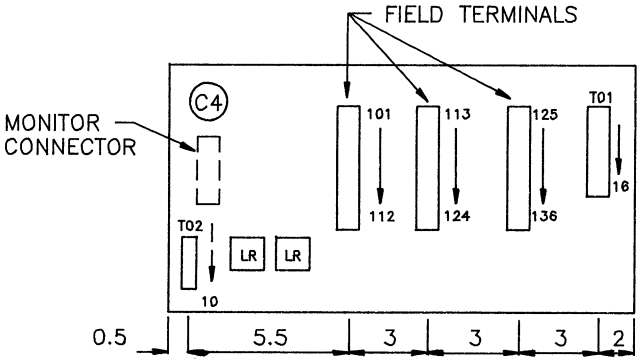


SWITCH PACK ENCLOSURE AND EDGE GUIDE



FRONT VIEW

MONITOR UNIT ENCLOSURE AND EDGE GUIDE



REAR PLANE

NOTE:

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SHOWN.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

OUTPUT FILE–OUTLINE

Date	92 06 01	Rev		OTSCES – 1560.01

OUTPUT FILE AC TERMINAL BLOCK SCHEDULE T01

Pos.	A (Int.)	B (Ext.)	
1.	SW. PK. 1, 2, 2P	T2 – 7	SIG BUS 1
2.	SW. PK. 3, 4, 4P	T2 – 8	SIG BUS 2
3.	SW. PK. 5, 6, 6P	T2 – 9	SIG BUS 3
4.	SW. PK. 7, 8, 8P	T2 – 10	SIG BUS 4
5.	FTR 1	T2 – 2	FLH 1 CH 1
6.	FTR 2	T2 – 3	FLH 1 CH 2
7.	FTR 3	T2 – 4	FLH 2 CH 1
8.	FTR 4	T2 – 5	FLH 2 CH 2
9.	EQU. GND. BUS	EQU. GND. BUS	
10.	AC –	AC –	
11.	AC + TO FILTER	T1 – 6	MAIN BKR SEC
12.	LR SIDE 1 & MONITOR RLY. Cont. Output	T1 – 7	MC COIL
13.	LR SIDE 2	FRONT DR. SW.	
14.	AC + TO ISOLATION RELAY COIL	T2 – 6	AC + Output from FLH RLY. CNTCT.
15.	MONITOR RLY. CONTACT INPUT	T1 – 8	MC CO
16.	AC + TO FTR RLY. COILS	POL. ON/OFF SW. Pole 3	

OUTPUT FILE DC TERMINAL BLOCK SCHEDULE T02

Pos.	A (Int.)	B (Ext.)
1.	24 V TO MONITOR, IR CONTACT	24 V SUPPLY TBI – INPUT PANEL
2.	DC GND	DC GND. BUS INPUT PANEL
3.	STOP TIME	INPUT FILE I SLOT 14 PIN F(2), Police Panel
4.	FLASH SENSE – IR CONTACT	INPUT FILE I SLOT 14 PIN W(3)
5.	EXT. RST. MONITOR UNIT	UNASSIGNED
6.	+24 V THROUGH IR CONTACT to LD. SW.	+ 24 V FROM 24 V PUSH BUTTON
7.	COMMUNICATION – MONITOR UNIT	INPUT FILE I SLOT 11 PIN F(2)
8.	UNDELAYED CONFLICT – MONITOR UNIT	UNASSIGNED
9.	MODE SELECT – MONITOR UNIT	PIN 4 FLASH SENSE
10.	SPARE	UNASSIGNED

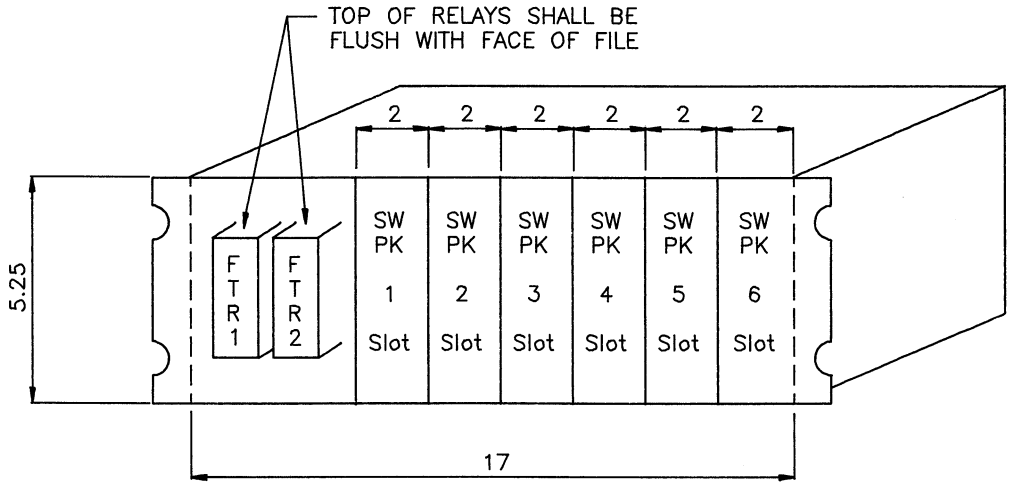
SWITCHPACK OUTPUTS FROM THE OUTPUT FILE SHALL CONNECT TO THE FOLLOWING FIELD TERMINALS.

FIELD TERM	FUNCTION	FIELD TERM	FUNCTION	FIELD TERM	FUNCTION
4R	SWPK 4 – RED	2PR	SWPK 2P – RED	1R	SWPK 1 – RED
4Y	SWPK 4 – YEL	2PY	SWPK 2P – YEL	1Y	SWPK 1 – YEL
4G	SWPK 4 – GRN	2PG	SWPK 2P – GRN	1G	SWPK 1 – GRN
4PR	SWPK 4P – RED	3R	SWPK 3 – RED	2R	SWPK 2 – RED
4PY	SWPK 4P – YEL	3Y	SWPK 3 – YEL	2Y	SWPK 2 – YEL
4PG	SWPK 4P – GRN	3G	SWPK 3 – GRN	2G	SWPK 2 – GRN
8R	SWPK 8 – RED	6PR	SWPK 6P – RED	5R	SWPK 5 – RED
8Y	SWPK 8 – YEL	6PY	SWPK 6P – YEL	5Y	SWPK 5 – YEL
8G	SWPK 8 – GRN	6PG	SWPK 6P – GRN	5G	SWPK 5 – GRN
8PR	SWPK 8P – RED	7R	SWPK 7 – RED	6R	SWPK 6 – RED
8PY	SWPK 8P – YEL	7Y	SWPK 7 – YEL	6Y	SWPK 6 – YEL
8PR	SWPK 8P – GRN	7G	SWPK 7 – GRN	6G	SWPK 6 – GRN

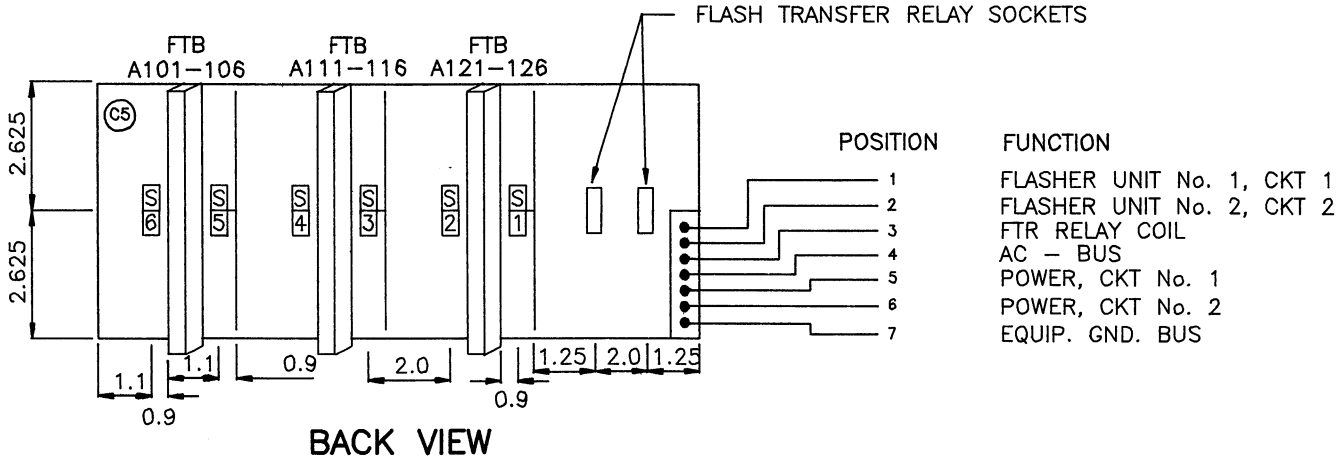
ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

OUTPUT FILE– TERMINAL ASSIGNMENT

Date	94 11 09	Rev	1	OTSCES – 1560.02



FRONT VIEW



BACK VIEW

SWITCHPACK OUTPUTS FROM THE AUXILIARY OUTPUT FILE SHALL CONNECT TO THE FOLLOWING FIELD TERMINALS.

FIELD TERM.	FUNCTION		FIELD TERM.	FUNCTION		FIELD TERM.	FUNCTION	
A101	SWPK	5 – RED	A111	SWPK	3 – RED	A121	SWPK	1 – RED
A102	SWPK	5 – YEL	A112	SWPK	3 – YEL	A122	SWPK	1 – YEL
A103	SWPK	5 – GRN	A113	SWPK	3 – GRN	A123	SWPK	1 – GRN
A104	SWPK	6 – RED	A114	SWPK	4 – RED	A124	SWPK	2 – RED
A105	SWPK	6 – YEL	A115	SWPK	4 – YEL	A125	SWPK	2 – YEL
A106	SWPK	6 – GRN	A116	SWPK	4 – GRN	A126	SWPK	2 – GRN

NOTE:

FLASH TRANSFER RELAY AND SWITCH PACK SOCKET LOCATIONS ARE TYPICAL.
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SHOWN.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

AUXILIARY OUTPUT FILE –OUTLINE

Date	92 06 01	Rev		OTSCES –1560.03

CONNECTOR – C1 WIRING LIST

PIN	SOURCE	DEST.	FUNCTION
1	DC GROUND		LOGIC GROUND
2	01 – 1	C4 – 1	4P DONT WALK
3	01 – 2	C4 – 2	4P WALK
4	01 – 3	C4 – 3	4 RED
5	01 – 4	C4 – 4	4 YELLOW
6	01 – 5	C4 – 5	4 GREEN
7	01 – 6	C4 – 6	3 RED
8	01 – 7	C4 – 7	3 YELLOW
9	01 – 8	C4 – 8	3 GREEN
10	02 – 1	C4 – 9	2P DONT WALK
11	02 – 2	C4 – 10	2P WALK
12	02 – 3	C4 – 11	2 RED
13	02 – 4	C4 – 12	2 YELLOW
14	DC GROUND		LOGIC GROUND
15	02 – 5	C4 – 13	2 GREEN
16	02 – 6	C4 – 14	1 RED
17	02 – 7	C4 – 15	1 YELLOW
18	02 – 8	C4 – 16	1 GREEN
19	03 – 1	C4 – 17	8P DONT WALK
20	03 – 2	C4 – 18	8P WALK
21	03 – 3	C4 – 19	8 RED
22	03 – 4	C4 – 20	8 YELLOW
23	03 – 5	C4 – 21	8 GREEN
24	03 – 6	C4 – 22	7 RED
25	03 – 7	C4 – 23	7 YELLOW
26	03 – 8	C4 – 24	7 GREEN
27	04 – 1	C4 – 25	6P DONT WALK
28	04 – 2	C4 – 26	6P WALK
29	04 – 3	C4 – 27	6 RED
30	04 – 4	C4 – 28	6 YELLOW
31	04 – 5	C4 – 29	6 GREEN
32	04 – 6	C4 – 30	5 RED
33	04 – 7	C4 – 31	5 YELLOW
34	04 – 8	C4 – 32	5 GREEN
35	05 – 1	C4 – 33	OVERLAP A RT GRN ARROW
36	05 – 2	C4 – 34	OVERLAP B RT GRN ARROW
37	05 – 3	C4 – 35	OVERLAP A RT YEL ARROW
38	05 – 4	C4 – 36	OVERLAP B RT YEL ARROW
39	I1 – 1	IFI – 2U	2 EXTENSION & COUNT
40	I1 – 2	IFJ – 2U	6 EXTENSION & COUNT
41	I1 – 3	IFI – 6U	4 EXTENSION & COUNT
42	I1 – 4	IFJ – 6U	8 EXTENSION & COUNT
43	I1 – 5	IFI – 2L	2 EXTENSION & COUNT
44	I1 – 6	IFJ – 2L	6 EXTENSION & COUNT
45	I1 – 7	IFI – 6L	4 EXTENSION & COUNT
46	I1 – 8	IFJ – 6L	8 EXTENSION & COUNT
47	I2 – 1	IFI – 4U & L	2 CALL DETECTOR
48	I2 – 2	IFJ – 4U & L	6 CALL DETECTOR
49	I2 – 3	IFI – 8U & L	4 CALL DETECTOR
50	I2 – 4	IFJ – 8U & L	8 CALL DETECTOR
51	I2 – 5	IFJ – 14U	RR1 (CLR 2 & 5 – FLASH)
52	I2 – 6	IFJ – 14L	RR2 (CLR 4 & 7 – LMTD SERV)
53	I2 – 7	IFI – 11L	UNDELAYED CONFLICT
54	I2 – 8	IFJ – 11U	FREE / INTERCONNECT
55	I3 – 1	IFJ – 1U & L	5 EXTENSION & COUNT
56	I3 – 2	IFI – 1U & L	1 EXTENSION & COUNT
57	I3 – 3	IFJ – 5U & L	7 EXTENSION & COUNT
58	I3 – 4	IFI – 5U & L	3 EXTENSION & COUNT
59	I3 – 5	IFJ – 9U	5 EXTENSION & COUNT
60	I3 – 6	IFI – 9U	1 EXTENSION & COUNT
61	I7 – 7	IFJ – 9L	7 EXTENSION & COUNT
62	I3 – 8	IFI – 9L	3 EXTENSION & COUNT
63	I4 – 5	IFI – 3U	2 EXTENSION & COUNT
64	I4 – 6	IFJ – 3U	6 EXTENSION & COUNT
65	I4 – 7	IFI – 7U	4 EXTENSION & COUNT
66	I4 – 8	IFJ – 7U	8 EXTENSION & COUNT
67	I5 – 1	IFI – 12U	2 PEDESTRIAN PB
68	I5 – 2	IFI – 13U	6 PEDESTRIAN PB
69	I5 – 3	IFI – 12L	4 PEDESTRIAN PB
70	I5 – 4	IFI – 13L	8 PEDESTRIAN PB
71	I5 – 5	IFJ – 12U	EVA 2 & 5 PREEMPT
72	I5 – 6	IFJ – 13U	EVB 4 & 7 PREEMPT
73	I6 – 7	IFJ – 12L	EVC 6 & 1 PREEMPT
74	I6 – 8	IFJ – 13L	EVD 8 & 3 PREEMPT
75	I6 – 1	IFJ – 11L	OFFSET 1 / FORCE A
76	I6 – 2	IFI – 3L	OFFSET 2 / FORCE B
77	I6 – 3	IFJ – 3L	OFFSET 3 / SPEC FUNCT
78	I6 – 4	IFI – 7L	DIAL 2 / HOLE – ON – LINE
79	I6 – 5	IFJ – 7L	DIAL 3 / YELD
80	I6 – 6	IFI – 11U	COMMUNICATIONS
81	I6 – 7	IFI – 14U	FLASH SENSE
82	I6 – 8	IFI – 14L	STOP TIME
83	06 – 1	C5 – 1	OVERLAP A RED
84	06 – 2	C5 – 2	OVERLAP B RED
85	06 – 3	C5 – 3	RING A SST DWELL
86	06 – 4	C5 – 4	RING B SST DWELL
87	06 – 5	C5 – 5	EXTERNAL RESET
88	06 – 6	C5 – 6	RESERVED
89	06 – 7	C5 – 7	RESERVED
90	06 – 8	C5 – 8	RESERVED
91	07 – 1	C5 – 9	TIME OF DAY
92	DC GROUND		LOGIC GROUND
93	07 – 2	C5 – 10	TIME OF DAY
94	07 – 3	C5 – 11	TIME OF DAY
95	07 – 4	C5 – 12	TIME OF DAY
96	07 – 5	C5 – 13	TIME OF DAY
97	07 – 6	C5 – 14	TIME OF DAY
98	07 – 7	C5 – 15	TIME OF DAY
99	07 – 8	C5 – 16	TIME OF DAY
100	05 – 5	C5 – 17	RESERVED
101	05 – 6	C5 – 18	CABINET FLASH
102	05 – 7	IFI&J – 15–3	DETECTOR RESET
103	05 – 8	C4 – 37	WATCHDOG
104	DC GROUND	IFT	LOGIC GROUND

NOTES:

SOURCE 01–2=170 CONTROLLER OUTPUT PORT ADDRESS 5001 BIT 2
I2–3=170 CONTROLLER INPUT PORT ADDRESS 5002 BIT 3

DEST. IFI–6U=INPUT FILE I, SLOT 6, UPPER CHANNEL (CHANNEL 1)
IFJ–14L=INPUT FILE J, SLOT 14, LOWER CHANNEL (CHANNEL 2)

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

CONNECTOR C1 WIRING LIST

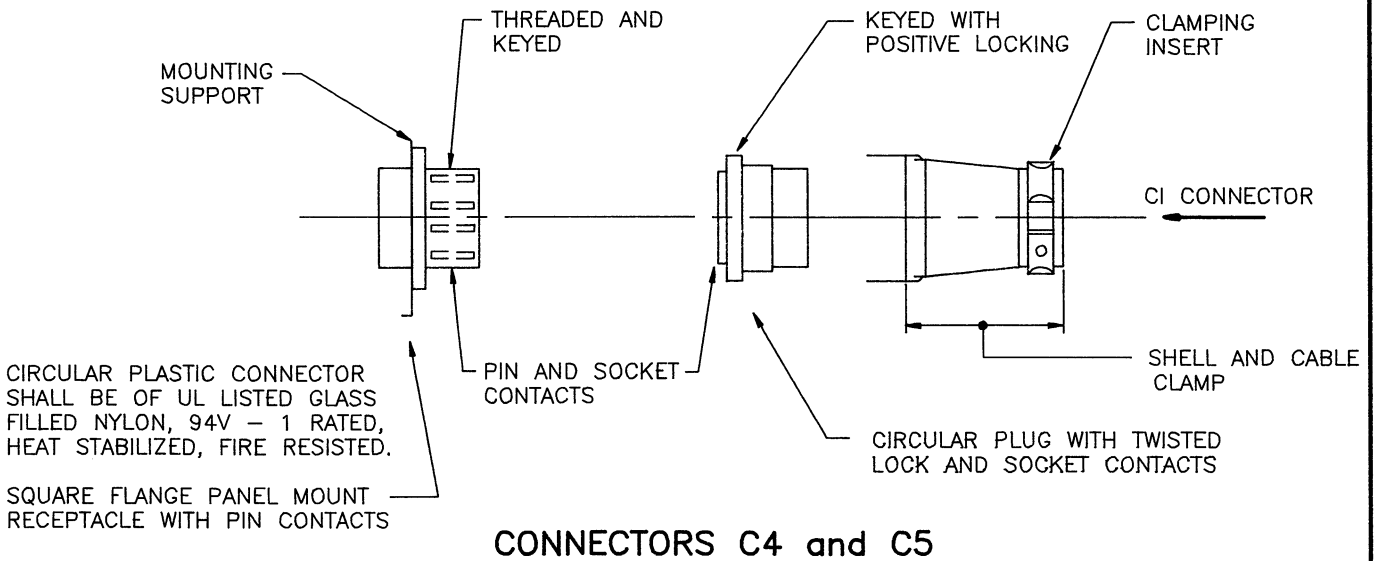
Date:	94 11 09	Rev	1	OTSCES – 1570.01

CONNECTOR – C4 WIRING LIST

PIN	SOURCE (SOCKET)	DEST. (PLUG)	
1	CI – 2	SWPK	4P – 6
2	CI – 3	SWPK	4P – 10
3	CI – 4	SWPK	4 – 6
4	CI – 5	SWPK	4 – 8
5	CI – 6	SWPK	4 – 10
6	CI – 7	SWPK	3 – 6
7	CI – 8	SWPK	3 – 8
8	CI – 9	SWPK	3 – 10
9	CI – 10	SWPK	2P – 6
10	CI – 11	SWPK	2P – 10
11	CI – 12	SWPK	2 – 6
12	CI – 13	SWPK	2 – 8
13	CI – 15	SWPK	2 – 10
14	CI – 16	SWPK	1 – 6
15	CI – 17	SWPK	1 – 8
16	CI – 18	SWPK	1 – 10
17	CI – 19	SWPK	8P – 6
18	CI – 20	SWPK	8P – 10
19	CI – 21	SWPK	8 – 6
20	CI – 22	SWPK	8 – 8
21	CI – 23	SWPK	8 – 10
22	CI – 24	SWPK	7 – 6
23	CI – 25	SWPK	7 – 8
24	CI – 26	SWPK	7 – 10
25	CI – 27	SWPK	6P – 6
26	CI – 28	SWPK	6P – 10
27	CI – 29	SWPK	6 – 6
28	CI – 30	SWPK	6 – 8
29	CI – 31	SWPK	6 – 10
30	CI – 32	SWPK	5 – 6
31	CI – 33	SWPK	5 – 8
32	CI – 34	SWPK	5 – 10
33	CI – 35	SWPK	2P – 8
34	CI – 36	SWPK	6P – 8
35	CI – 37	SWPK	4P – 8
36	CI – 38	SWPK	8P – 8
37	CI – 103	WD TIMER – MU 22	

CONNECTOR – C5 WIRING LIST

PIN	SOURCE (SOCKET)	DEST. (PLUG)
1	CI – 83	NC
2	CI – 84	NC
3	CI – 85	NC
4	CI – 86	NC
5	CI – 87	NC
6	CI – 88	NC
7	CI – 89	NC
8	CI – 90	NC
9	CI – 91	NC
10	CI – 93	NC
11	CI – 94	NC
12	CI – 95	NC
13	CI – 96	NC
14	CI – 97	NC
15	CI – 98	NC
16	CI – 99	NC
17	CI – 100	NC
18	NC	NC
19	NC	NC
20	NC	NC
21	NC	NC
22	NC	NC
23	NC	NC
24	+ 24 VDC	NC



CONNECTORS C4 and C5

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

CONNECTOR C4 AND C5 WIRING LIST

Date	92 06 01	Rev		OTSCES – 1570.02

CHAPTER 16

Specifications
For
401 Series Cabinet

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Date	OTSCES No.	Rev	Title
June 1992	1610.01	0	401 Series Cabinet Outline
November 2002	1610.03	1	401-C Cabinet - Rack Assignment
November 2002	1610.04	1	401-D Cabinet - Rack Assignment
November 2002	1610.05	1	401-S Cabinet - Rack Assignment
November 2002	1610.06	1	401-R Cabinet - Rack Assignment
November 2002	1610.10	2	401 C, D & S Cabinet - One Line Wiring Diagram
December 15, 1999	1610.11	2	401 R Cabinet - One Line Wiring Diagram
November 2002	1620.01	3	401 Service Panel - Output
November 2002	1620.02	1	401 Service Panel - Wiring Diagram
November 2002	1630.01	1	401 Input Panel - Outline
November 9, 1994	1640.01	1	401 PDA - Outline
December 15, 1999	1640.02	1	401 PDA - Wiring Diagram
December 15, 1999	1660.01	2	401 Output File - Outline
November 2002	1660.02	2	401 Output File - Terminal Assignment
November 2002	1670.01	1	401 Series - Connector C1 Wiring List (Page 1/2)
November 2002	1670.02	1	401 Series - Connector C1 Wiring List (Page 2/2)
November 2002	1670.03	1	401 Series - Connector C4 Wiring List

1. GENERAL REQUIREMENTS

1.1. This chapter defines the specifications applicable to the Model 401-series Cabinets.

1.2. These specifications shall supplement Chapter 1: General Specifications for Traffic Control Equipment and Chapter 14: General Specifications for Cabinets. In case of conflict, the specifications of this Chapter will govern.

1.3. Each cabinet shall as a minimum, bear a marking label which provides proof of electrical approval and/or electrical certification for the intended use, and shall meet the Electrical Safety Authority (ESA) Code requirements for the Province of Ontario.

1.4. The front and rear doors shall each bear a marking label for the electrical approval or certification. Each label shall be permanently affixed to the exterior of each of the doors, in the top left corner (hinge side).

1.5. In addition to the electrical approval or certification labels, a secondary label shall be affixed directly below the electrical approval or certification label and shall be provided with the following information as applicable:

- Manufacturers name.
- Cabinet model number.
- Cabinet serial number.
- Operating voltage.
- Maximum Wattage.
- Operating Frequency.

1.6. The electrical approval or certification label and the secondary details label can be produced together on one label provided the original cabinet manufacturer has global panel certification on their products.

1.7. The identification labels, shall be permanent and shall not fade due to sunlight and/or other weather conditions.

2. ENVIRONMENT CONTROL

2.1. GENERAL

2.1.1. The interior cabinet walls (ceiling, walls and doors) shall be insulated with 1/2 inch of expanded polystyrene insulation or equivalent, capable of providing an insulation "R" value of 2.0.

2.1.2. All interior horizontal and vertical surfaces directly opposite the outside air shall be insulated to within 0.125 inches of all edges, flanges or other attachments. The insulation shall be permanently bonded to the metal.

2.1.3. The insulation material for the front & rear doors and the ceiling shall be fabricated from one-piece. The insulation for the interior vertical sidewall panels can be fabricated from a singular or two panels, provided the seams are glued to prevent separation of the insulating panels.

2.1.4. A vapour action corrosion inhibitor or emitter, CORTEC part # VCI-111 or equivalent, shall be installed inside the cabinet as close as possible to the ceiling.

2.2. THERMOSTAT PANEL

2.2.1. One Model 500D digital thermostat panel shall be provided and shall meet the requirements of Chapter 13.

2.2.2. The AC supply for the thermostat panel, the fan and the heater shall originate at the Power Distribution Assembly.

2.3. HEATER REQUIREMENTS

2.3.1. A cabinet heater and mounting bracket assembly shall be provided and shall meet the requirements of Chapter 14, Section 2.5.9.

2.3.2. The cabinet heater shall terminate at the rear of the Model 500D digital thermostat panel.

2.4. FAN REQUIREMENTS

2.4.1. A fan shall be provided and shall meet the requirements of Chapter 14, Section 2.5.5.

2.4.2. The cabinet fan shall terminate at the rear of the Model 500D digital thermostat panel.

3. ASSEMBLIES - 401 SERIES

3.1. GENERAL

3.1.1. The 401-series cabinets shall be fabricated to the general dimensions as indicated in the OTSCES drawings.

3.1.2. The following assemblies, when supplied with the cabinet, shall be completely removable from the cabinet without removal of any other equipment.

- Fan Assembly
- Heater Assembly
- Trouble Lamp Assembly
- Model 500D Thermostat Panel
- 401 Power Distribution Assembly (PDA)
- 24 Volt DC Cabinet Power Supply
- Input Files
- Output File (401R Cabinet)

3.1.3. Unless otherwise indicated, all equipment rack-mounting screws shall be Robertson #10-32 stainless steel. The fan shall be mounted with Robertson #6-32 stainless steel screws.

3.2. Locks

3.2.1. The front and rear doors shall be provided with locks. The lock and the key shall be equivalent to CORBIN No. 15481RS lock and CORBIN No. 5R7325 key. The locks shall have rectangular, spring-loaded bolts.

3.2.2. The front door lock shall be left-hand and right-hand on the rear door. Key shall be removable in the locked and unlocked positions. The locks shall be rigidly mounted with four stainless steel machine screws with the hole spacing for the machine screws approximately 2 inches apart. The screws shall not be accessible from the outside of the doors.

3.2.3. The locks shall be provided with an integral retractable cover. The front portion of the locks shall extend 0.25 inch to 0.37 beyond the outside surface of the doors.

3.3. Front & Rear Door Keys

3.3.1. Each key shall be CORBIN No. 5R7325 and stamped with "MTO401".

3.3.2. Two (2) keys shall be supplied for each 401-series cabinet. The keys shall not be shipped with the cabinets. The keys shall be shipped separately to:

Superintendent of Electrical / ATMS
1927 Kipling Avenue
Toronto, Ontario M9W 4J4

3.4. Police Access Door Key

3.4.1. The type 401R cabinet is provided with a Police Access door. One Police Access key shall be supplied for each cabinet. This key shall be inserted into the type 401R drawing storage pouch.

3.5. Pedestal

3.5.1. Each 401 cabinet shall be provided with a pedestal. The pedestal shall meet the specifications as defined in Chapter 14, section 2.5.11 (Cabinet pedestal).

3.5.2. A mat shall be shipped with the pedestal. The mat shall be fabricated of same material as the gasket as defined in Chapter 14, Section 2.5.8. The mat shall have the following dimensions 21 by 15 by ¼ (inches).

3.6. TYPE 401 POWER DISTRIBUTION ASSEMBLY (PDA)

3.6.1. The Power Distribution Assembly shall be furnished and mounted on the EIA 19-inch equipment rack. Refer to OTSCES 1610.03 (401C), 1610.04 (401D), 1610.05 (401S) or 1610.06 (401R) for details.

3.6.2. The Power Distribution Assembly shall utilize 7.0 inches of rack height. The depth shall not exceed 6.5 inches from the front cabinet rails. All equipment within the assembly shall be readily accessible for ease of replacement.

3.6.3. The front panel shall be removable with the aid of Robertson screws. The internal wiring shall have enough slack to allow the front panel to drop open to approximately 10 degrees off the horizontal.

3.6.4. The back panel shall be capable of being dropped open by the removal of two-thumb screw(s). The internal wiring shall have enough slack to allow the back panel to drop open to approximately 10 degrees off the horizontal.

3.6.5. The top and bottom surfaces shall be covered in order to eliminate any electrical hazards. Ventilation holes shall be provided on the sides and bottom surface to eliminate any heat generated by the electronic components within the Power Distribution Assembly.

3.6.6. The following equipment shall be provided with the Power Distribution Assembly:

Quantity	Description
1	Main Circuit Breaker
1	Service Circuit Breaker
1	Environment Circuit Breaker
1	Critical Circuit Breaker
1	Non-Critical Circuit Breaker
1	Output File Ramp 1 Circuit Breaker
1	Output File Ramp 2 Circuit Breaker
1	Duplex Service Receptacle, GFI (White)
1	Duplex Service Receptacle (White)
3	Duplex Critical Equipment Receptacle (Red)
2	Duplex Non-Critical Equipment Receptacle (Yellow)
2	Line Filters, 20-Ampere @ 125VAC

2	Fuse holders & fuses for Input Files (IFI & IFJ)
2	Indicators for Input File (IFI & IFJ) Fuses
1	Terminal Block, 8-position “TAC”
1	Terminal Block, 6-position “TN”
1	Terminal Block, 4-position “TCG”

3.6.7. Circuit Breakers, Fuses and Indicators

3.6.7.1. Each circuit breaker shall be rated per the following table:

Circuit Breakers	Amperes	Volts AC
Main	50	125
Service	15	125
Environment	15	125
Critical Equipment	15	125
Non-Critical Equipment	15	125
Output File Ramp 1	15	125
Output File Ramp 2	15	125

3.6.7.2. All circuit breakers shall have mounting requirements identical to the Potter and Brumfield "W" series, with standard size for the main circuit breaker and mini-mag size for all others.

3.6.7.3. All circuit breakers shall have the proper delay for tungsten lamp loads.

3.6.7.4. The rating for the circuit breakers shall be shown on the circuit breaker handle, and/or on the panel space beneath the circuit breaker.

3.6.7.5. The background of the circuit breakers shall be colour coded red or yellow by one of the following methods:

a) Appropriate coloured silk-screening of the front panel.
b) Using "3M Scotchlite coloured labels of high intensity grade reflective sheeting, series 5800 with low temperature, pressure-sensitive adhesive". These labels shall be adhered to the front panel.
c) Using painted flat plates of approximately 0.02" thick, which are mounted on the front panel and held, in place using the circuit breakers mounting screws.

3.6.8 Terminal Blocks

3.6.8.1 The Power Distribution Assembly shall be provided with three terminal blocks, mounted on the rear panel.

3.6.8.2. Terminal blocks shall be rated 30A @ 600V RMS (minimum). The terminal blocks shall be the barrier type and shall be provided with 10-32 x 5/16 inch nickel-plated brass binder Robertson head screws and inserts.

3.6.8.3 The wiring to the terminal blocks on the back panel or the Power Distribution Assembly shall have enough slack to allow the back panel to swing fully open for service.

3.6.8.4 The wires from the Service Panel secondary terminal block (TBSS) shall directly enter and

terminate within the PDA through a grommet hole in the PDA rear panel.

3.6.8.5 The Power Distribution Assembly chassis shall connect directly to earth ground on the Service panel at TBSS.

3.6.8.6 All Terminal Blocks with AC powered circuits shall be protected with covers to provide protection against accidental contact.

3.6.8.7 The AC supply to the trouble lamp, the fan and the heater shall originate at the Power Distribution Assembly.

3.7. Fuses

3.7.1. The 115VAC feed to each Input File shall be protected by a fuse and shall use 0.25" X 1.25" fast acting type rated at 2.0A. The rating of the fuses shall be marked immediately adjacent to each fuseholder.

3.7.2. The upper fuse will be identified as being IFI for the "I" Input File.

3.7.3. The lower fuse will be identified as being IFJ for the "J" Input File.

3.8. Fuse Indicators

3.8.1. Each Input File fuse shall have one RED 115 Volt AC neon indicator in close proximity to each fuse. Under normal operating conditions and when the fuses are functional, the neon indicators shall be on.

3.8.2. The upper indicator shall be identified as being IFI for the upper Input File.

3.8.3. The lower indicator will be identified as being IFJ for the lower Input File.

3.9. Receptacles

3.9.1. Service Receptacles (Front & Rear)

3.9.1.1. The Power Distribution Assembly shall be provided with one front panel Ground Fault Circuit Interrupter (GFCI) duplex Service Receptacle and one rear panel duplex Service receptacle.

3.9.1.2. The GFCI receptacle shall be CSA #5015R, rated for 15A at 125VAC. Circuit interruption shall occur on 6 milliamperes of ground-fault current and shall not occur on less than 4 milliamperes of ground-fault current.

3.9.1.3. The GFCI receptacle shall be wired to provide protection for the rear-mounted Service duplex receptacle and shall use parallel wiring provided both receptacles are GFCI protected.

3.9.1.4. These receptacles shall be colour coded as detailed in OTSCES 1640.01.

3.9.2. Critical Equipment

3.9.2.1. The rear panel of the Power Distribution Assembly shall be provided with three (3) duplex receptacles and shall be CSA type 5-15R duplex type. These receptacles shall be identified as “CRITICAL EQUIPMENT”.

3.9.2.2. These receptacles shall be colour coded as detailed in OTSCES 1640.01.

3.9.3. Non-Critical Equipment

3.9.3.1. The rear panel of the Power Distribution Assembly shall be provided with two (2) duplex receptacles and shall be CSA type 5-15R duplex type. These receptacles shall be identified as “NON-CRITICAL EQUIPMENT”.

3.9.3.2. These receptacles shall be colour coded as detailed in OTSCES 1640.01.

3.10. Line Filters

3.10.1. Two Line Filters, CORCOM #20V1 or equivalent shall be provided within the Power Distribution Assembly to provide filtering for the Critical and Non-Critical Equipment receptacles.

3.10.2. One Line Filter shall provide filtering for the Critical Equipment receptacles. The line filter shall be wired prior to the Critical Equipment receptacles.

3.10.3. A second Line Filter, shall provide filtering for the Non-Critical Equipment receptacles and Input Files. The line filter shall be wired prior to the Non-Critical Equipment receptacles and Input File fuses.

3.11. Terminal Blocks

3.11.1. Unless otherwise indicated herein, terminal blocks shall meet the requirements of Chapter 14, Section 3.5.

3.12. Side Panels

3.12.1. Two panels each 20" high shall be provided and mounted on the inside of the EIA rack parallel to the cabinet sidewalls as detailed in OTSCES 1620.01 and 1630.01.

3.12.2. The panels shall be fabricated from 5052-H32 sheet aluminum with a thickness of 0.125 inches. All edges shall be filed to radius of 0.03125-inch minimum.

3.12.3. The panels shall be free of dents, scratches and abrasions that could be harmful to the strength and general appearance.

3.12.4. The panels shall not be finished, such as clear coat, paint or anodizing.

3.12.5. On the INPUT PANEL, a ½-inch (minimum) opening shall be provided between the panel bottom lip and the bottom bar of the rack. Refer to OTSCES 1630.01.

3.12.6. In viewing from the back door, the left side panel shall be designated the “INPUT PANEL” and the right side panel shall be designated the “SERVICE PANEL”.

3.12.7. Input Panel

3.12.7.1. A wiring duct and cover, 4-inch by 2-inch by 20-inch, shall be installed on the Input Panel according to OTSCES 1630.01.

3.12.8. Service Panel

3.12.8.1. Two 3-terminal service terminal blocks rated 50A and 600V AC shall be provided on the Service Panel. Refer to OTSCES 1620.01.

3.12.8.2. The primary terminal block (TBS) shall be installed at the service entrance point at the bottom of the service panel. The secondary terminal block (TBSS) shall be installed in the area next to the power distribution assembly.

3.12.8.3. Two 1-metre long, # 8 conductors shall be connected between the Primary terminal block (TBS) and Secondary terminal block (TBSS). One # 8 conductor for AC+ (black wire) and one # 8 conductor for AC- (white wire).

3.12.8.4. The area of the terminal blocks, wiring and MOV devices shall be protected by a sheet of Plexiglas installed on stand-offs as shown on OTSCES 1620.01.

3.13. Surge Protection

3.13.1. The primary line surge arrestor (Lightning Arrestor) shall provide protection between line to ground and neutral to ground. The primary line surge arrestor shall be installed on the primary terminal block (TBS) mounted on the Service Panel. The arrestor shall be installed as shown on OTSCES 1620.01 and 1620.02.

3.13.2. The primary line surge arrestor shall have the following ratings:

a) Impulse Breakdown: 900 V in less than 0.1 microsecond at 10kilovolts / microsecond.
b) Standby current: less than one milli-ampere.
c) Striking Voltage: greater than 212 V DC.
d) Capable of withstanding 20 pulses of peak current, each of which will rise in eight microseconds and fall in 20 microseconds to one half the peak voltage at 3-minute intervals. Peak current rating shall be 20,000 amperes neutral to ground and 15,000 amperes line to neutral.

3.13.2.1. The leads of the primary line surge arrestor shall be 3/4" maximum for mounting onto the terminals. The top of the terminal block to the bottom of the arrestor shall not be more than 1/4".

3.13.2.2. The secondary surge protectors shall be three Metal Oxide Varistors (MOV) devices mounted on the Service Panel near the secondary terminal block (TBSS).

3.13.2.3. The MOV devices shall be General Electric # V150PA20A or equivalent. Each MOV device shall be wired with AWG # 14 wire, colours as appropriate for wiring into the TBSS terminations. These wires shall be kept as short as possible.

3.13.2.4. One MOV device shall have its base plate electrically isolated from the Service Panel and shall be installed between AC+ and AC- as shown on the drawings. A minimum of ½-inch stand-offs shall be used to provide isolation.

3.13.2.5. The other two MOV devices shall have their base plates mounted directly on the Service Panel surface and to provide good electrical contact to the chassis ground.

3.13.2.6. One MOV device shall be installed between AC+ and the chassis ground.

3.13.2.7. One MOV device shall be installed between AC- and the chassis ground.

3.13.2.8. A conductive corrosion inhibitor for aluminium shall be applied to the surface of the service panel in the areas where the equipment chassis ground bus and the MOV devices base plates are grounded through the service panel.

3.13.2.9. The area of the terminal blocks, wiring and MOV devices shall be protected by a sheet of Plexiglas installed on stand-offs as shown on OTSCES 1620.01.

3.14. Maintenance Disconnect Switch

3.14.1. The Service Panel shall be provided with a 60-ampere Maintenance disconnect switch. The Maintenance Switch provides termination of the AC+ line of the incoming power supply wiring.

3.14.2. This switch shall be a Bryant #60002 or equivalent.

3.14.3. The Maintenance Disconnect Switch shall be housed in a 6.5-inch by 5-inch by 2-inch metal enclosure. The metal enclosure cover shall provide protection against accidental tripping of the switch handle.

3.14.4. The enclosure and cover shall be painted with gloss polyester thermosetting powder paint, colour yellow. The cover shall be silk screened as shown on OTSCES 1620.01.

3.15.Trouble Lamp

3.15.1. A trouble lamp with basket protection shall be mounted near the top of the rear door.

3.15.2. The AC supply to the trouble lamp shall originate at the Power Distribution Assembly.

3.15.3. The trouble lamp shall meet the requirements of Chapter 14, Section 2.5.16.

3.16.Operation & Maintenance Manual

3.16.1. One Operations and Maintenance manual shall be supplied with each 401-series cabinet.

3.16.2. The Operations and Maintenance manual shall meet the requirements of Chapter 1, Section 1.8.

3.17.Delivery

3.17.1. Each cabinet is to be delivered per the requirements of Chapter 1, Section 1.9.

4. 401C CABINET ASSEMBLIES

4.1. GENERAL

4.1.1. The model **401C** cabinet is a 401-series cabinet for housing electronic communication equipment and microprocessor based controllers, which controls and monitors various items or equipment. The model **401C** cabinet shall be complete with the following rack mounted units:

a)	Type 401 PDA	1 unit
b)	Model 500D Thermostat	1 unit
c)	Input Panel without wiring duct	1 unit
d)	Service Panel	1 unit

4.1.2. The above modules shall be completely assembled, mounted and wired as shown on OTSCES 1610.03.

5. 401D CABINET ASSEMBLIES

5.1. GENERAL

5.1.1. The model **401D** cabinet is a 401-series cabinet for housing vehicle detector station equipment. The model **401D** cabinet shall be complete with the following rack mounted units:

a)	Type 401 PDA	1 unit
b)	Model 500D Thermostat	1 unit
c)	Input Panel with wiring duct	1 unit
d)	Service Panel	1 unit
e)	24 VDC Power Supply	1 unit
f)	Input files	2 units
g)	170 controller support angle	2 units
h)	C1 connector and 401D type harness	1 unit

5.1.2. The above modules shall be completely assembled, mounted and wired as shown on OTSCES 1610.04.

5.2. 24VDC POWER SUPPLY

5.2.1. One 24VDC Power Supply shall be provided in the 401D configuration.

5.2.2. The 24 VDC Power Supply shall meet the requirements of Chapter 14, Section 2.5.15. The 24VDC Power Supply shall be installed in the rack location as detailed on OTSCES 1610.04.

5.3. INPUT FILES

5.3.1. Two Input Files shall be provided in the 401D configuration.

5.3.2. The Input files shall meet the requirements to the requirements of Chapter 14, Section 2.5.14. The Input Files shall be installed in the rack location as detailed on OTSCES 1610.04.

5.4. CONTROLLER SUPPORT PROVISIONS

5.4.1. Two steel plated controller unit supporting angles shall be supplied and installed according to the plans. These supporting angles extend from the front rails to the rear rails and shall be supplied to support one controller unit.

5.4.2. The controller unit supporting angles shall be designed to support a minimum of 50 pounds each. The horizontal side of each angle shall be a minimum of three inches.

5.4.3. The controller unit supporting angles shall be mounted 35 inches from the top of the rack and shall be continuously adjustable vertically for 0.5 inches.

6. 401S CABINET ASSEMBLIES

6.1. GENERAL

6.1.1. The model **401S** cabinet is a 401-series cabinet with shelves. The model **401S** cabinet shall be complete with the following rack mounted units:

a)	Type 401 PDA	1 unit
b)	Model 500D Thermostat	1 unit
c)	Input Panel with wiring duct	1 unit
d)	Service Panel	1 unit
e)	Shelves	3 units

6.1.2. The above modules shall be completely assembled, mounted and wired as shown on OTSCES 1610.05.

6.2. SHELVING BRACKETS

6.2.1. Three shelves, 16 inches in depth and same width as the rack shall be supplied and secured to mounting brackets. Each shelf shall be designed to support 100 pounds of weight without undue flexing.

6.2.2. Two mounting brackets shall be provided per shelf. The design of the mounting brackets shall support a minimum of 100 pounds without causing damage or undue flexing to the bracket.

6.2.3. The mounting brackets shall be suitable for mounting across the front or the rear rails using 10-32 thread holes and the bracket position shall be continuously adjustable for 3/8".

6.2.4. The shelves shall be made of the same material as the cabinet and shall have the same finish as the cabinet walls.

6.2.5. All edges on the brackets and shelves shall be rounded off for safety.

6.2.6. The three shelves shall be positioned as follows:

6.2.6.1. The first shelf will be positioned 10" from the top of the rack.
6.2.6.2. The second shelf will be positioned 10" ± 0.625" from the bottom of the first shelf.
6.2.6.3. The third shelf will be positioned 10" ± 0.625" from the bottom of the second shelf.

6.2.7. Two spare mounting brackets, one spare shelf and suitable quantity of mounting hardware shall be supplied with each cabinet. These items shall be taped to the bottom shelf.

7. 401R CABINET ASSEMBLIES

7.1. GENERAL

7.1.1. The model **401R** cabinet is a 401-series cabinet for housing ramp metering and vehicle detector station equipment. The model **401R** cabinet shall be complete with the following rack mounted units:

a)	Type 401 PDA	1 unit
b)	Model 500D Thermostat	1 unit
c)	Input Panel with wiring duct	1 unit
d)	Service Panel	1 unit
e)	24 VDC Power Supply	1 unit
f)	Input files	2 units
g)	170 controller support angle	2 units
h)	C1 connector and type 401R harness	1 unit
j)	Type 401R Output File	1 unit
k)	Police Panel	1 unit

7.1.2. The above modules shall be completely assembled, mounted and wired as shown on OTSCES 1610.06.

7.2. CABINET 24VDC POWER SUPPLY

7.2.1. One 24VDC Power Supply shall be provided in the 401R configuration.

7.2.2. The 24 VDC Power Supply shall meet the requirements of Chapter 14, Section 2.5.15. The 24VDC Power Supply shall be installed in the rack location as detailed on OTSCES 1610.04.

7.3. INPUT FILES

7.3.1. Two Input Files shall be provided in the 401R configuration.

7.3.2. The Input files shall meet the requirements to the requirements of Chapter 14, Section 2.5.14. The Input Files shall be installed in the rack location as detailed on OTSCES 1610.04.

7.4. TYPE 401R OUTPUT FILE

7.4.1. The model 401R Output File shall utilize 10.5 inches of rack height and shall be capable of containing 6 switch packs, 2 transfer relays, 2 line filters, C4-connector and terminal blocks.

7.4.2. All connectors and sockets shall be hard wired and shall be securely mounted to endure the insertion and extraction forces applied to the switch packs, transfer relays and terminals.

7.4.3. Adequate ventilation holes shall be provided on the Output File in order to eliminate any heat generated by the components within the Output File.

7.4.4. The plastic card guides used to support the switch packs shall begin 1.0 ± 0.5 inch back from the front face of the Output File and shall be the pop-in type. Special tools shall not be required to remove or insert the card guides into their designated spots.

7.4.5. The Output File shall be provided with marker strips to identify the switch pack usage. The marker strips shall be made of a material that can be easily and legibly written on using a pencil or ballpoint pen. Marker strips shall be located at the front immediately below the item they are to identify.

7.4.6. Switch pack and transfer relay sockets shall be accessible from the back of the file without the use of tools. All wires connected to the back panel of the file shall have enough slack to allow the panel to swing open for servicing.

7.4.7. Unless otherwise indicated herein, terminal blocks shall meet the requirements of Chapter 14, Section 3.5.

7.4.8. Two (2) Field Terminal blocks shall be mounted vertically on the back panel. These terminal blocks shall be rated at 30A, 600V RMS (minimum). Refer to OTSCES 1660.02 for wiring and identification.

7.4.9. The Field Terminal blocks shall be 12-position quick-connect barrier type, Cinch-Jones 542-series with Y-type solder terminals, supplied with Robertson or combination of Robertson and slot-head screws.

7.4.10. The Field Terminals shall be provided with 8-32 nickel plated brass inserts and 8-32 x 5/16-inch nickel-plated brass binder head Robertson screws.

7.4.11. The rear of the Output File shall have one 16-position terminal block, labelled TO1. Refer to OTSCES 1660.02 for wiring and identification.

7.4.12. Terminal block TO1 shall be barrier type and shall be provided with 10-32 nickel plated brass inserts and 10-32 x 5/16-inch nickel-plated brass binder-head Robertson screws.

7.4.13. The rear of the Output File shall have one 10-position terminal block, labelled TO2. Refer to OTSCES 1660.02 for wiring and identification.

7.4.14. Terminal block TO2 shall be barrier type and shall be provided with 6-32 nickel plated brass inserts and 6-32 x 1/4-inch nickel-plated brass pan-head Robertson screws.

7.4.15. Each terminal block shall be provided with Robertson screws, or a combination Robertson and slot head screws.

7.4.16. All Terminal Blocks with AC powered circuits shall be protected with covers to provide protection against accidental contact.

7.4.17. The controller unit outputs to the switch pack sockets shall be connected through Connector C4. Refer to OTSCES 1670.01, 1670.02 and 1670.03.

7.4.18. Line Filters

7.4.18.1. One AC line filter, model CORCOM #20V1 or equivalent shall be added internally to the Output File to provide filtering for switch packs 1, 3 and 4. The line filter shall be placed prior to TR1 contacts.

7.4.18.2. Filter inputs for RFI #1 shall be connected to terminal block TO1 terminals 1 and 3, for switch packs 1, 3 and 4.

7.4.18.3. One AC line filter, model CORCOM #20V1 or equivalent shall be added internally to the Output File to provide filtering for switch packs 2, 5 and 6. The line filter shall be placed prior to TR2 contacts.

7.4.18.4. Filter inputs for RFI #2 shall be connected to terminal block TO1 terminals 2 and 3, for switch packs 2, 5 and 6.

7.4.19. Metal Oxide Varistors

7.4.19.1. Metal Oxide Varistor (MOV) devices shall be installed within the Output File for protection against lightning, power line surges and transients.

7.4.19.2. Metal Oxide Varistor (MOV) devices for use on all terminals with AC power applied, shall be capable of meeting the following minimum requirements:

- Recurrent peak voltage 212 volts
- Energy rating (minimum) 20 joules
- Power Dissipation, average 0.85 watts
- Peak current for pulses, 2000 amperes for less than 6 ms

7.4.19.3. The MOV devices for the AC application shall be installed between the switch pack outputs at the field terminals and an internal copper grounding bus strip. The MOV devices and the ground bus strip shall be located on the inside of the fold-down rear panel of the Output File.

7.4.19.4. The MOV devices for the AC application shall also be installed between each terminal position of terminal block T01 and a grounding bus strip. Both MOV devices and the grounding bus strip shall be installed on the inside of the back panel of the output file.

7.4.19.5. The copper grounding bus strips for the MOV devices shall be grounded to the Output File chassis. A green coloured wire (AWG #8) shall connect the copper grounding bus strips together and to the ground terminal of the TBSS on the Service Panel.

7.4.19.6. One MOV device for the DC application shall be General Electric V33ZA5 or equivalent, and shall be installed across terminal positions 1 and 2 of terminal block TO2. This MOV shall be located on the inside of the back panel of the output file.

7.4.19.7. A grounding bus strip is not required for terminal block T02.

7.4.19.8. MOV devices shall not be installed on empty terminal positions for the field terminals, or terminal blocks T01 and T02.

7.5. TRANSFER RELAYS AND SOCKETS

7.5.1. Transfer relays shall conform to the requirements for model 430 Heavy Duty Relays.

7.5.2. Unless otherwise indicated, two model 430 heavy duty Transfer Relays shall be furnished with each Output File.

7.5.3. A leakage resistor shall be installed across the terminals of the relay socket. This resistor permits a small amount of current to pass through the relay coil should the contacts remain closed after the coil circuit has opened. This is to overcome residual magnetism effects.

7.5.4. Snubber networks shall be installed across the coil terminals of the Transfer Relay sockets.

7.5.5. The Transfer Relay coils shall be energized only when the signals are in the “ON” mode as determined by the switches within the Police Door Panel.

7.5.6. The Transfer Relays shall transfer the switch pack outputs. Movement of the Police Panel switches to "OFF" shall prohibit the operation of the signals and shall not prohibit the operation of the controller unit.

7.5.7. Transfer Relay TR1 shall be wired to control signals associated with switch packs 1, 3 and 4. This wiring arrangement shall ensure that all signal indications on these approaches shall be turned “OFF”.

7.5.8. Transfer Relay TR2 shall be wired to control signals associated with switch packs 2, 5 and 6. This wiring arrangement shall ensure that all signal indications on these approaches shall be turned “OFF”.

7.6. CONTROLLER SUPPORT PROVISIONS

7.6.1. Two steel plated controller unit-supporting angles shall be supplied and installed according to the plans. These supporting angles extend from the front rails to the rear rails and shall be supplied to support one controller unit.

7.6.2. The controller unit-supporting angles shall be designed to support a minimum of 50 pounds each. The horizontal side of each angle shall be a minimum of three inches.

7.6.3. The controller unit-supporting angles shall be mounted 29.75 inches from the top of the rack and shall be continuously adjustable vertically for 0.5 inches.

7.7. POLICE PANEL

7.7.1. Police Panel Door

7.7.1.1. The Police Panel door shall be equipped with a lock keyed for a master police key. The police lock and key shall be equivalent to CORBIN No. D357SG lock and CORBIN No. Code 1 key.

7.7.1.2. The Police Panel shall be flush mounted on the side of the cabinet as shown on the plans. Any screws used for mounting the door hinges and lock shall use tamper-resistant, stainless steel hardware.

7.7.1.3. The lock striker material shall be fabricated from steel and shall not wear down with repeated use. An aluminium striker plate is not acceptable.

7.7.1.4. The keyhole shall have a cover plate. This cover plate shall be fabricated of the same material as

the cabinet, or of brass. If of the same material as the cabinet, the cover shall be finished the same as the cabinet. The hardware used to hold this cover plate shall be stainless steel and tamper-resistant.

7.7.1.5. One Police Access key shall be supplied for each cabinet. This key shall be inserted into the drawing storage pouch.

7.7.2. Police Panel Access

7.7.2.1. A Police Panel shall be mounted behind the police panel door. The Police Panel shall contain two Double Pole - Double Throw (DPDT) toggle switches.

7.7.2.2. These switches shall have a minimum contact rating of 15 amperes at 125 VAC. Each switch handle shall be protected from moisture.

7.7.2.3. The LEFT switch shall operate Transfer Relay 1 (TR1) and shall be labelled "RAMP 1 ON/OFF". This switch shall be positioned so that the "ON" position is up.

7.7.2.4. The RIGHT switch shall operate Transfer Relay 2 (TR2) and shall be labelled "RAMP 2 ON/OFF". This switch shall be positioned so that the "ON" position is up.

7.7.2.5. The rear of the Police Panel shall be enclosed with a rigid metal covering to ensure that no parts having line voltage are exposed to accidental electrical contact.

7.7.2.6. For the Police Panel detail, refer to OTSCES 1610.01 and 1610.11.

7.8. Thermostat Panel

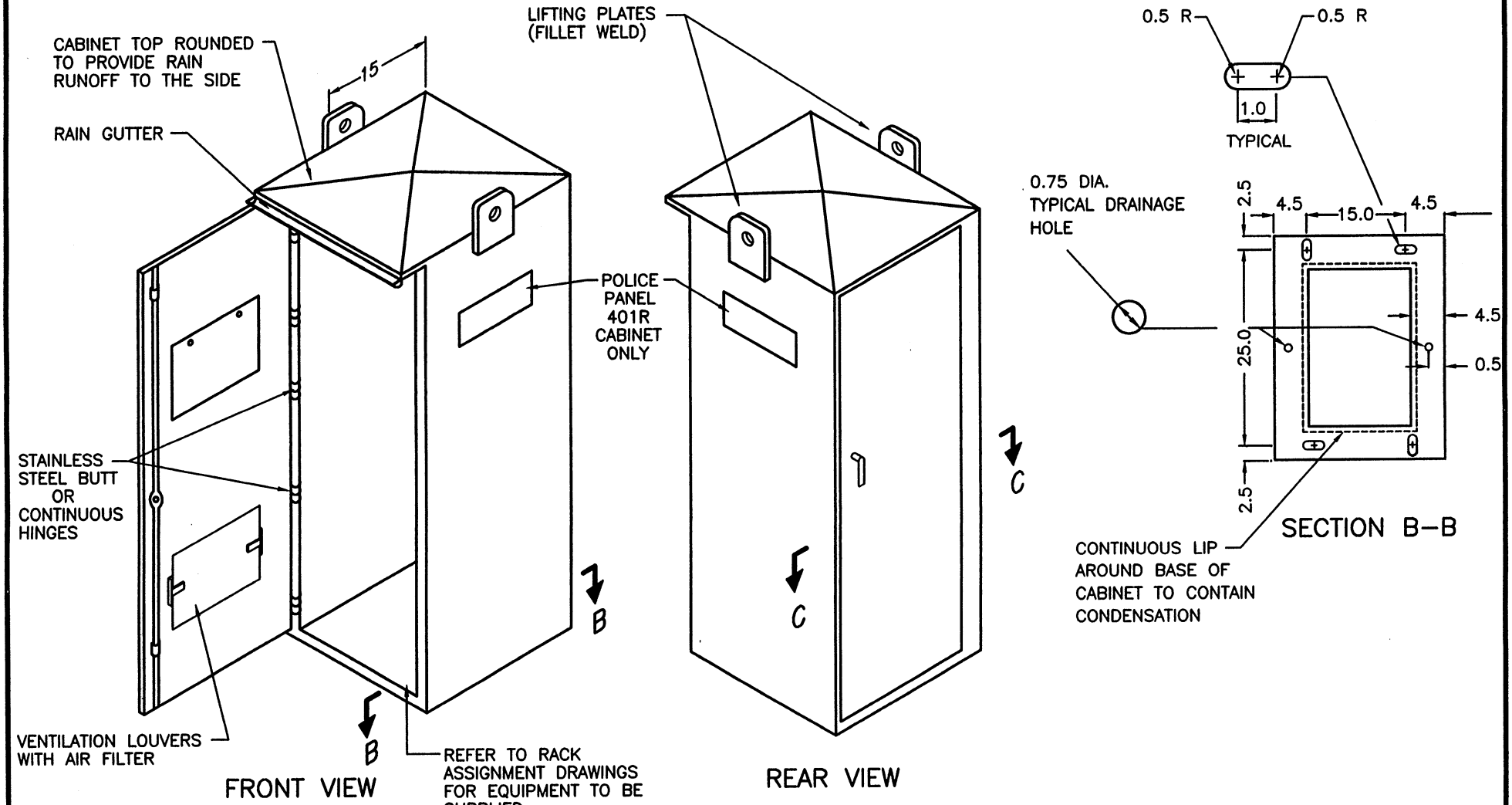
7.8.1 One model 500D Thermostat Panel shall be provided and wired per the plans and specifications.

7.8.2 For the model 500D Thermostat Panel detail, refer to Chapter 13.

7.9. DC Interface Connectors C1 & C4

7.9.1 For the C1 connector details, refer to OTSCES 1670.01, 1670.02 and 1670.03.

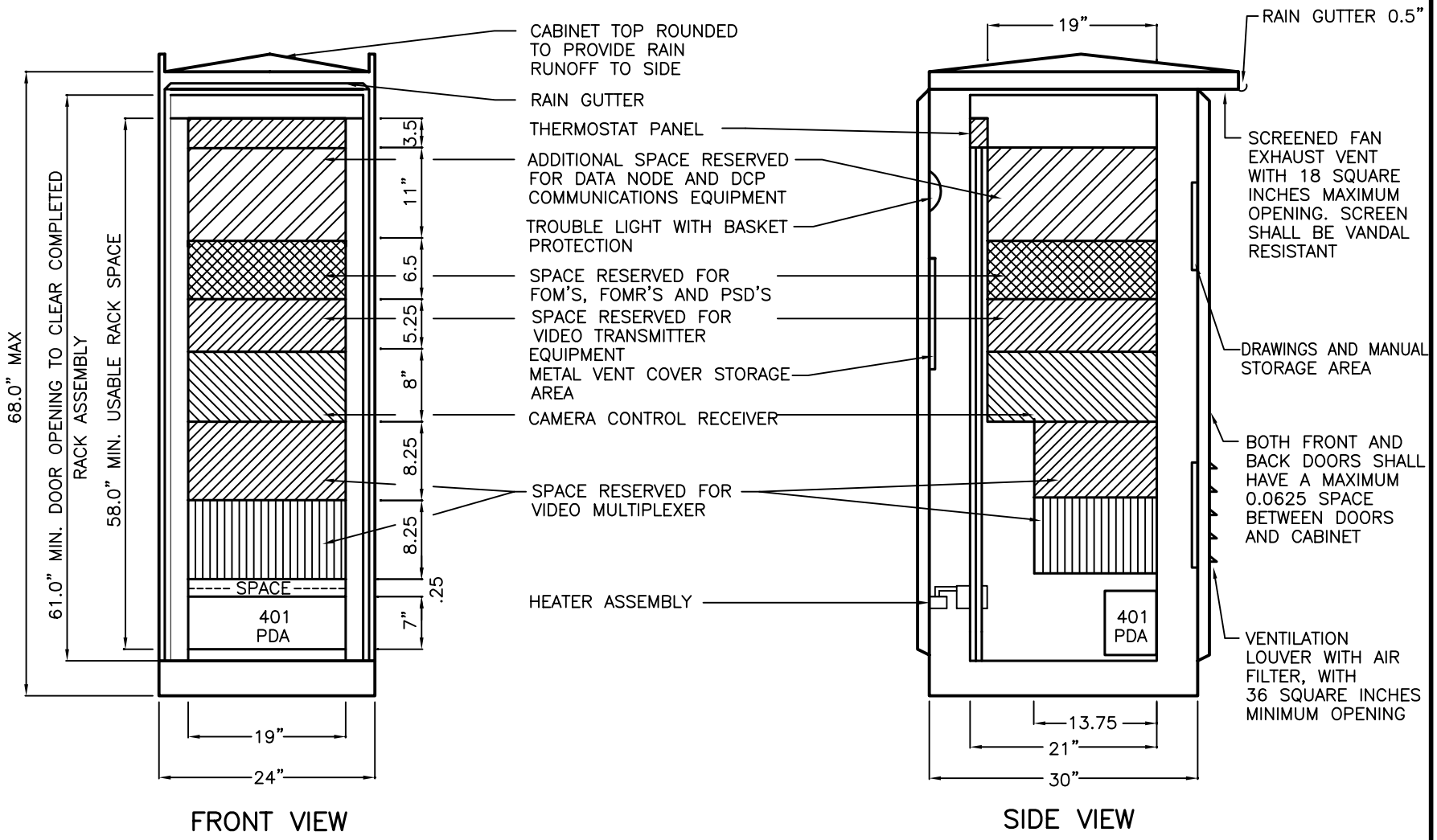
7.9.2 For the C4 connector details, refer to OTSCES 1670.01, 1670.02 and 1670.03.



ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

401 SERIES CABINET OUTLINE

Date	92 06 01	Rev		OTSCES – 1610.01



NOTES:

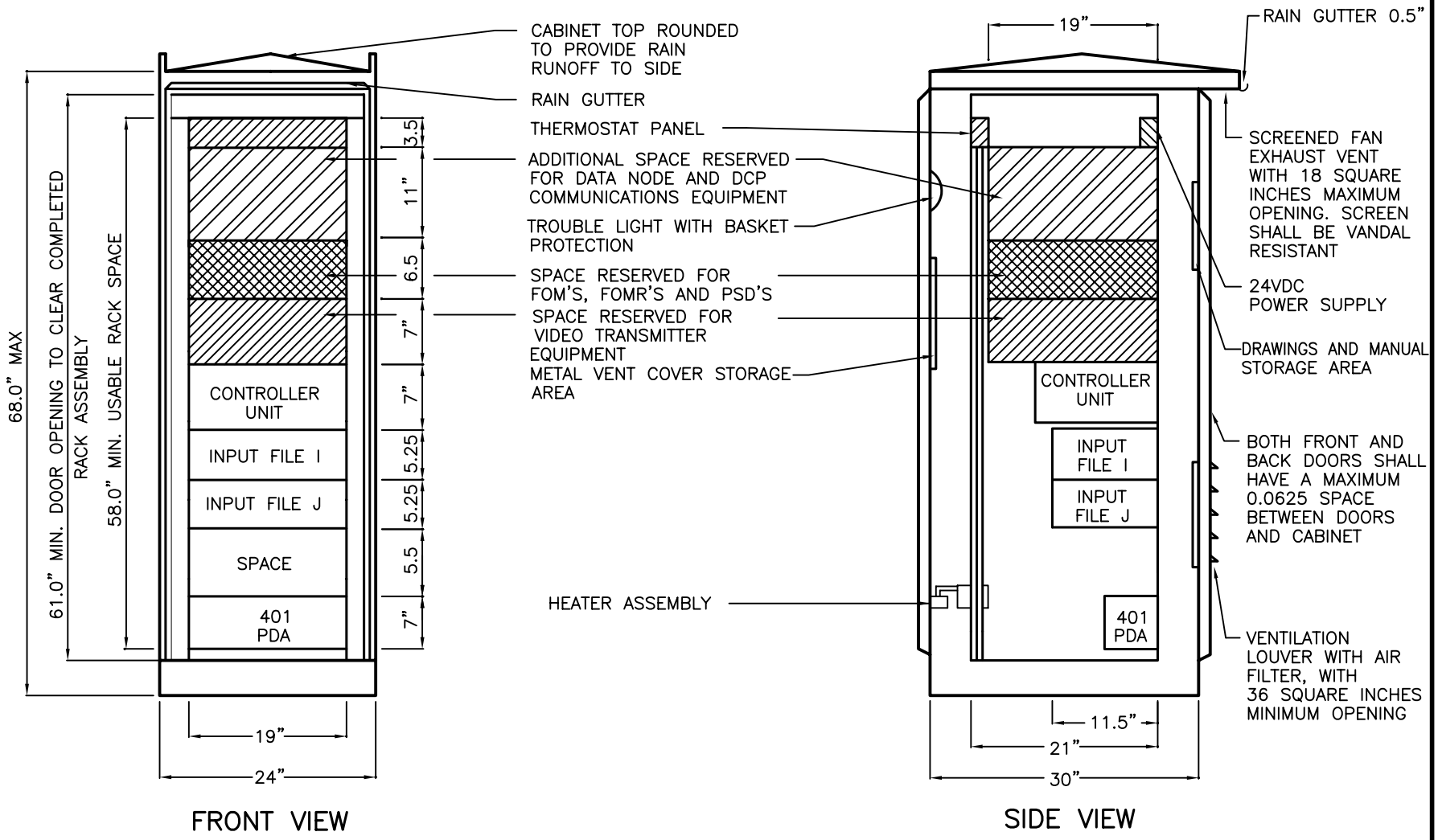
1 SPACE HAS BEEN ALLOCATED FOR A FUTURE DATA COMMUNICATIONS REQUIREMENT OF A MAXIMUM OF 4 MODEMS/MODEM REPEATERS.

2 ALL CABLES SHALL BE TRAINED AND SUPPORTED TO MINIMIZE MOVEMENT.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

401-C CABINET-RACK ASSIGNMENT

Date	Nov. 2002	Rev	1	OTSCES - 1610.03



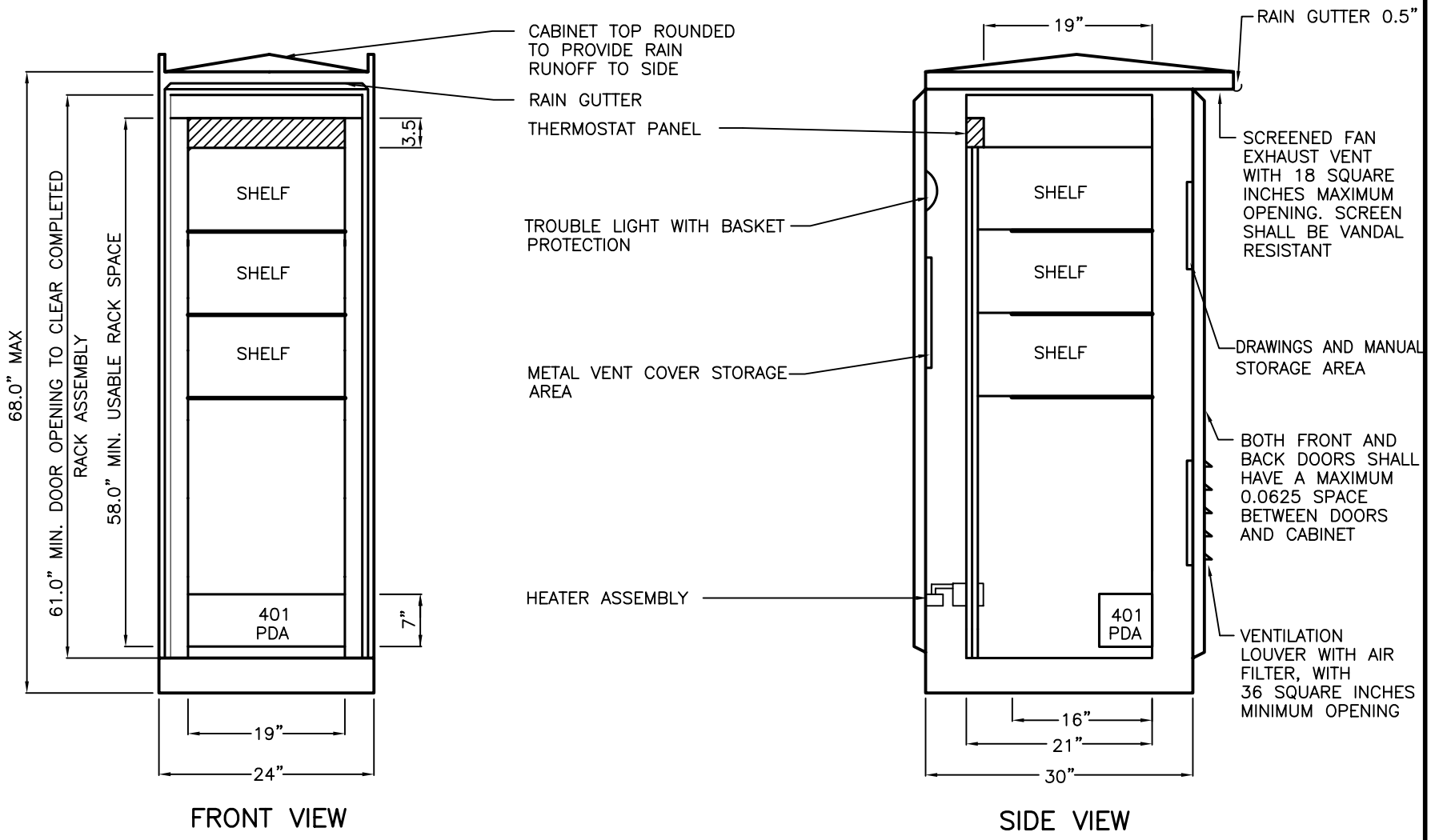
NOTES:

1 SPACE HAS BEEN ALLOCATED FOR A FUTURE DATA COMMUNICATIONS REQUIREMENT OF A MAXIMUM OF 4 MODEMS/MODEM REPEATERS.
2 ALL CABLES SHALL BE TRAINED AND SUPPORTED TO MINIMIZE MOVEMENT.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

401-D CABINET-RACK ASSIGNMENT

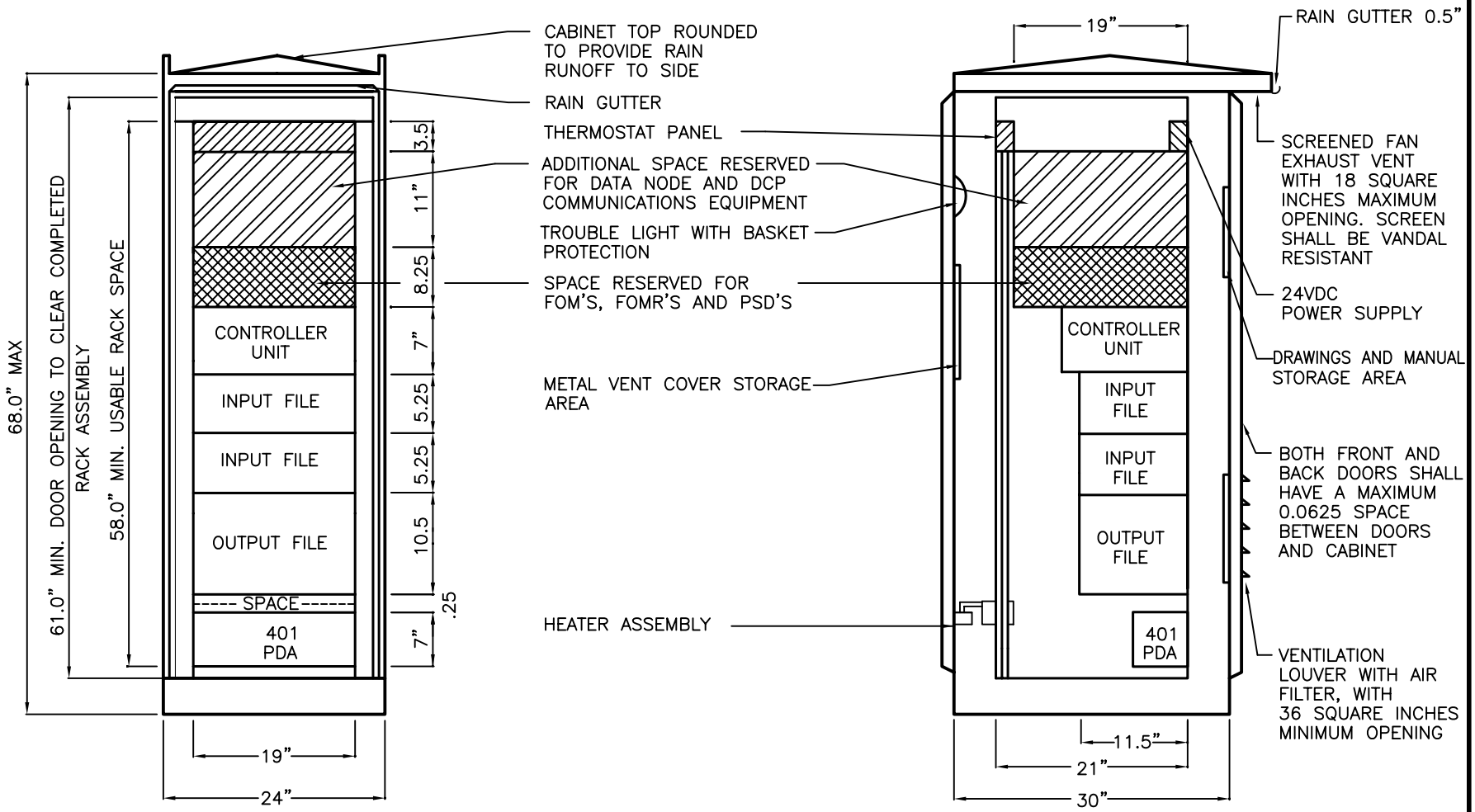
Date	Nov. 2002	Rev	1	OTSCES - 1610.04



ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

401-S CABINET-RACK ASSIGNMENT

Date	Nov. 2002	Rev	1	OTSCES - 1610.05



NOTES:

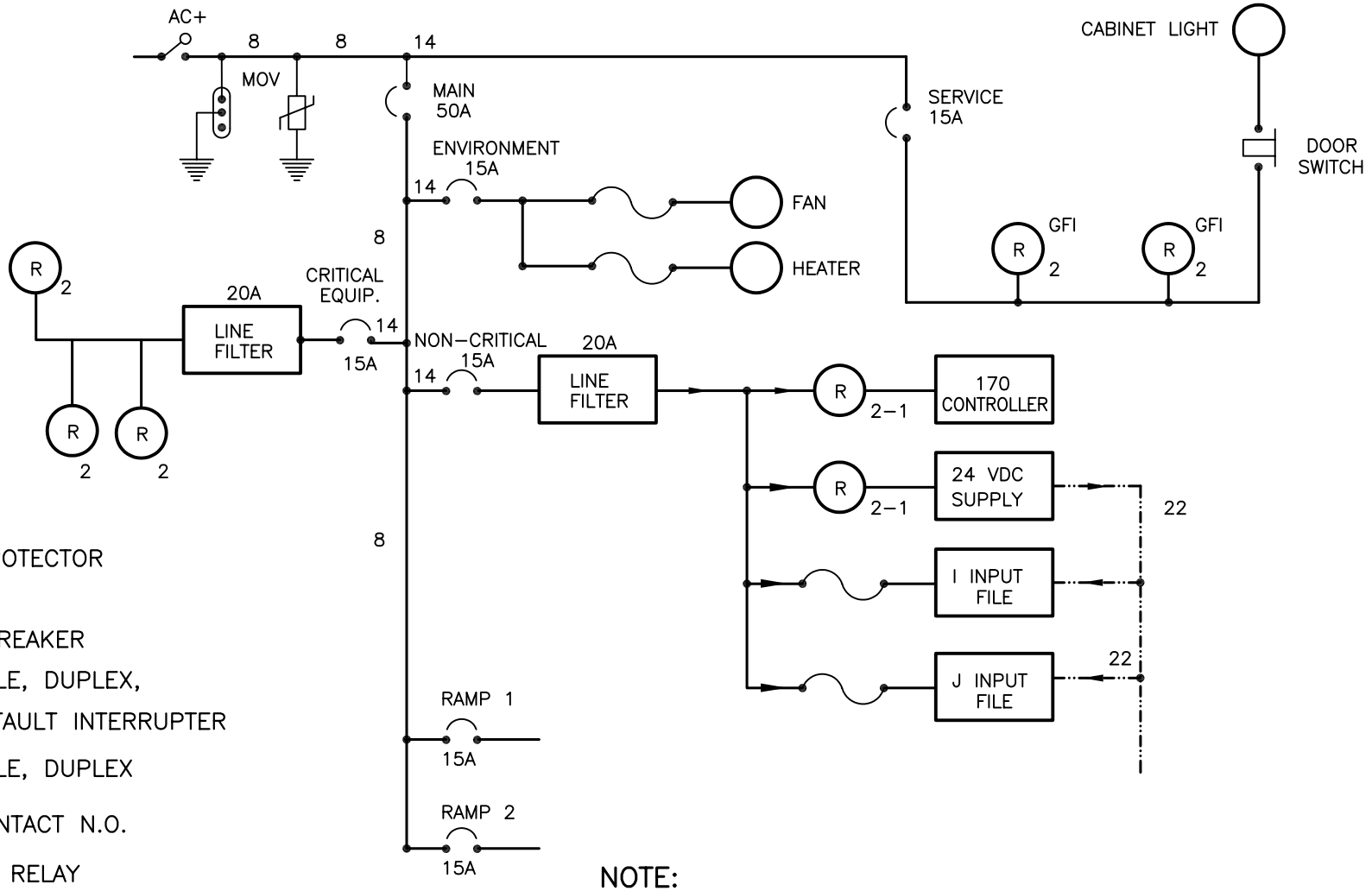
1 SPACE HAS BEEN ALLOCATED FOR A FUTURE DATA COMMUNICATIONS REQUIREMENT OF A MAXIMUM OF 4 MODEMS/MODEM REPEATERS.

2 ALL CABLES SHALL BE TRAINED AND SUPPORTED TO MINIMIZE MOVEMENT.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

401-R CABINET-RACK ASSIGNMENT

Date	Nov. 2002	Rev	1	OTSCES - 1610.06



LEGEND

- SURGE PROTECTOR
- FUSE
- CIRCUIT BREAKER
- RECEPTACLE, DUPLEX, GROUND FAULT INTERRUPTER
- RECEPTACLE, DUPLEX
- RELAY CONTACT N.O.
- TR — TRANSFER RELAY
- D.C. GROUND
- GAS DISCHARGE TUBE
- CHASSIC GROUND
- 24V DC
- 8 — WIRE SIZE. IF NOT INDICATED SHALL BE No. 14 AWG

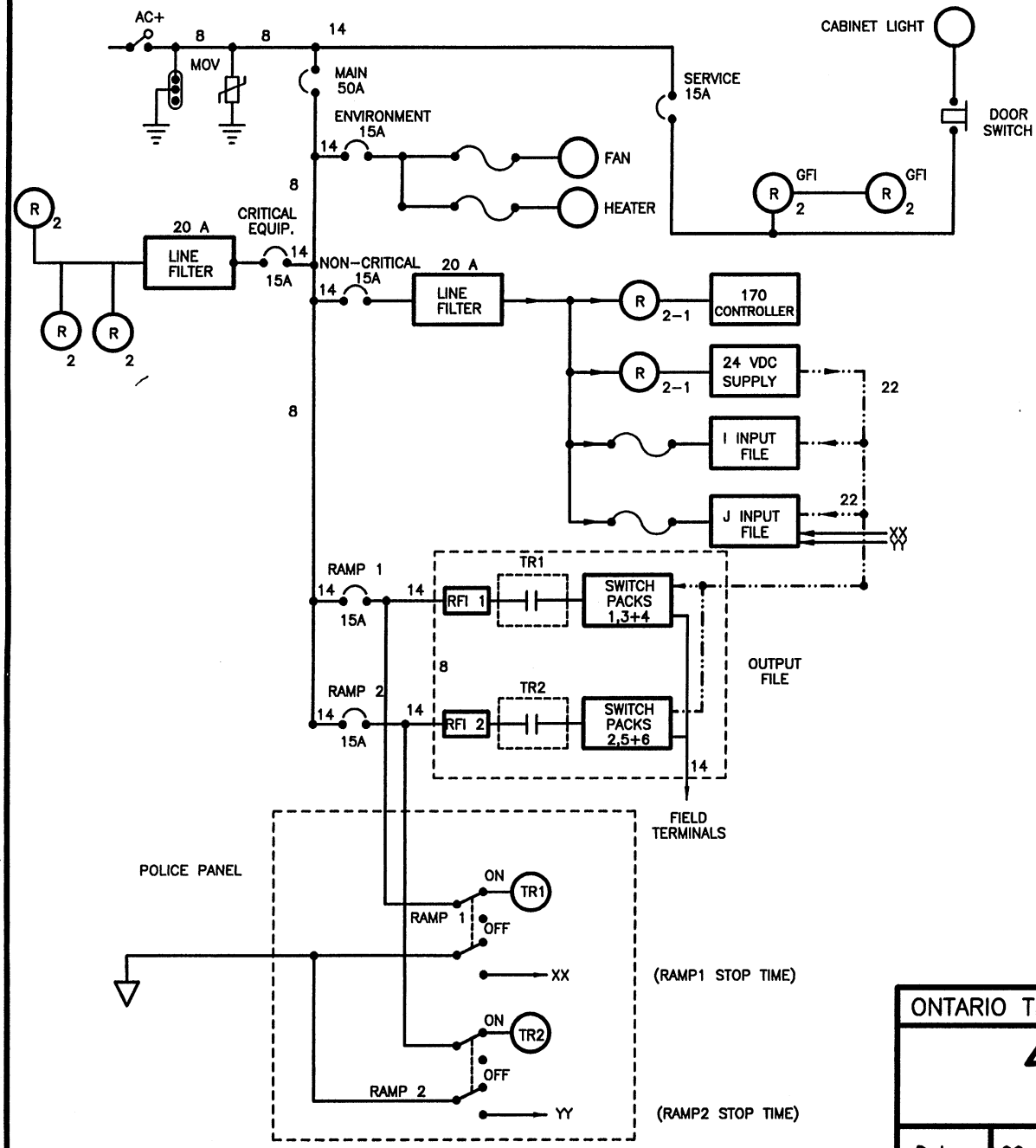
NOTE:

C AND S CABINETS DO NOT HAVE 170 CONTROLLER, 24DC POWER SUPPLY AND INPUT FILES.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

401C, D AND S CABINETS ONE LINE DIAGRAM

Date	Nov. 2002	Rev	2	OTSCES – 1610.10



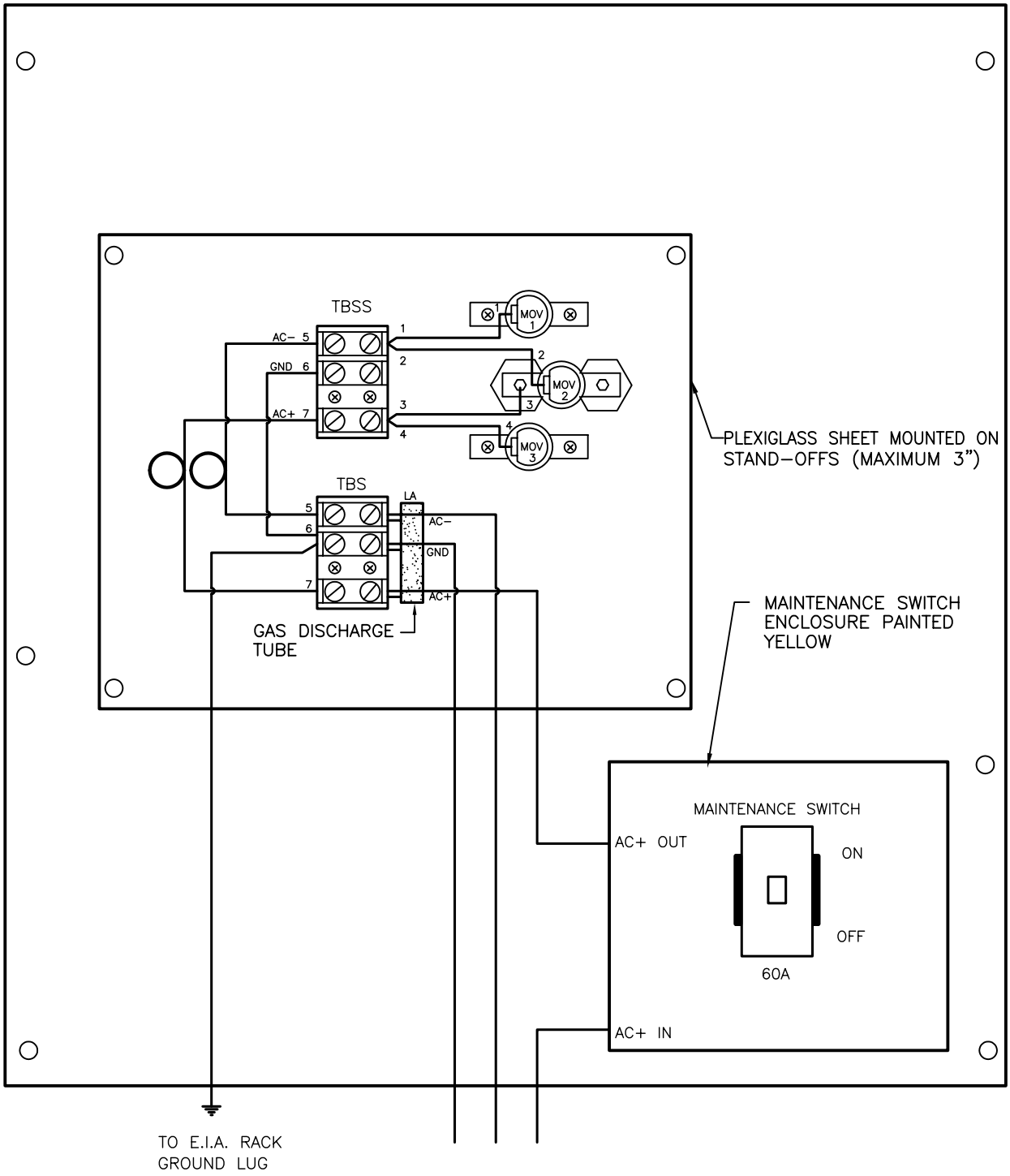
LEGEND

- SURGE PROTECTOR
- FUSE
- CIRCUIT BREAKER
- RECEPTACLE, DUPLEX, GROUND FAULT INTERRUPTER
- RECEPTACLE, DUPLEX
- RELAY CONTACT N.O.
- TR — TRANSFER RELAY
- D.C. GROUND
- RFI — RADIO FREQUENCY INTERFERENCE FILTER
- GAS DISCHARGE TUBE
- CHASSIC GROUND
- 24V DC
- 8 — WIRE SIZE, IF NOT INDICATE SHALL BE No. 14 AWG

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

401R SERIES CABINET ONE LINE DIAGRAM

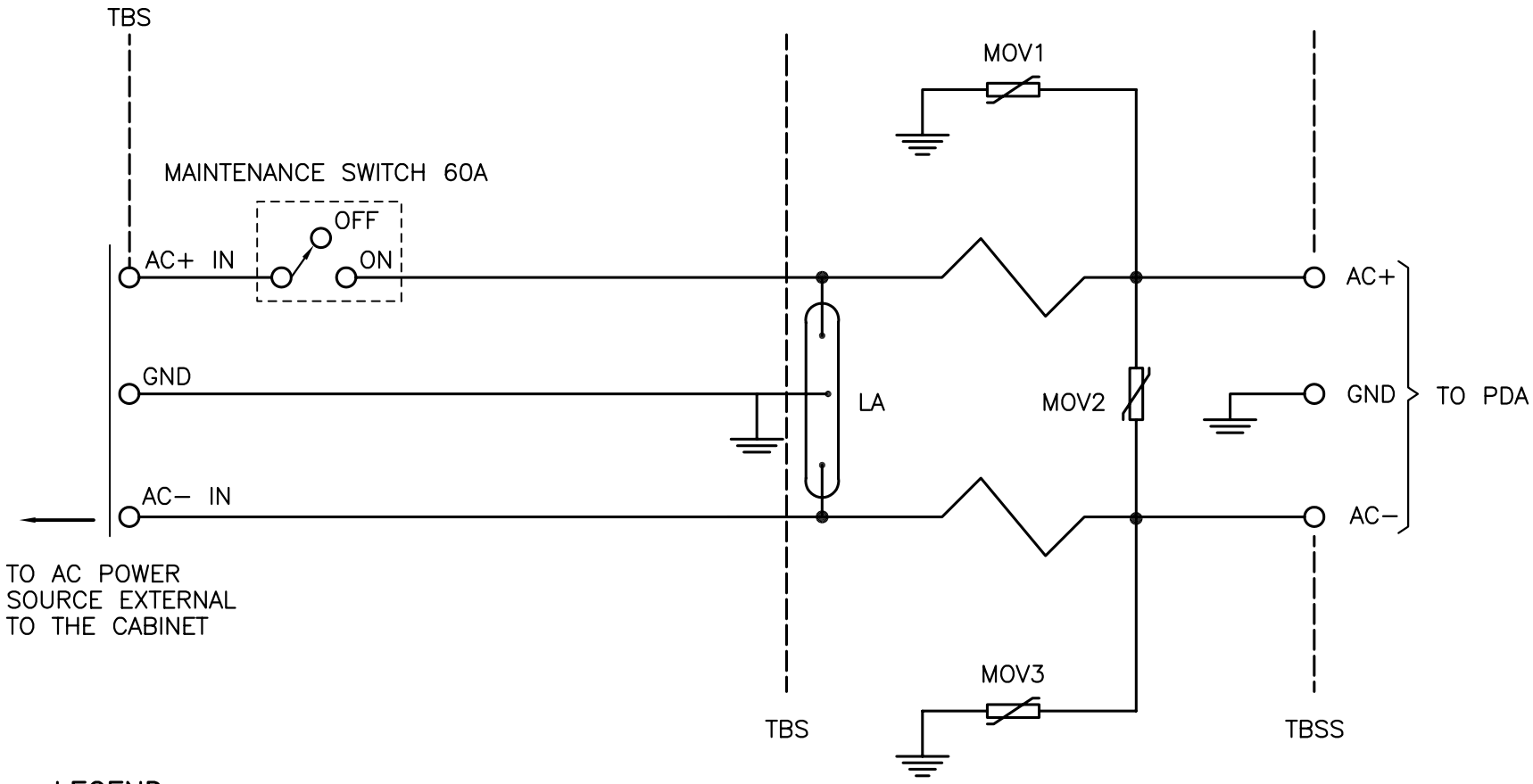
Date	99 12 15	Rev	2	OTSCES – 1610.11



NOTE:

A INHIBITOR SHALL BE APPLIED BETWEEN THE METAL CONTACTING SURFACES WHEREVER ELECTRICAL CONTACT IS REQUIRED.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS				
401 SERVICE PANEL – OUTPUT				
Date:	Nov. 2002	Rev	3	OTSCES – 1620.01



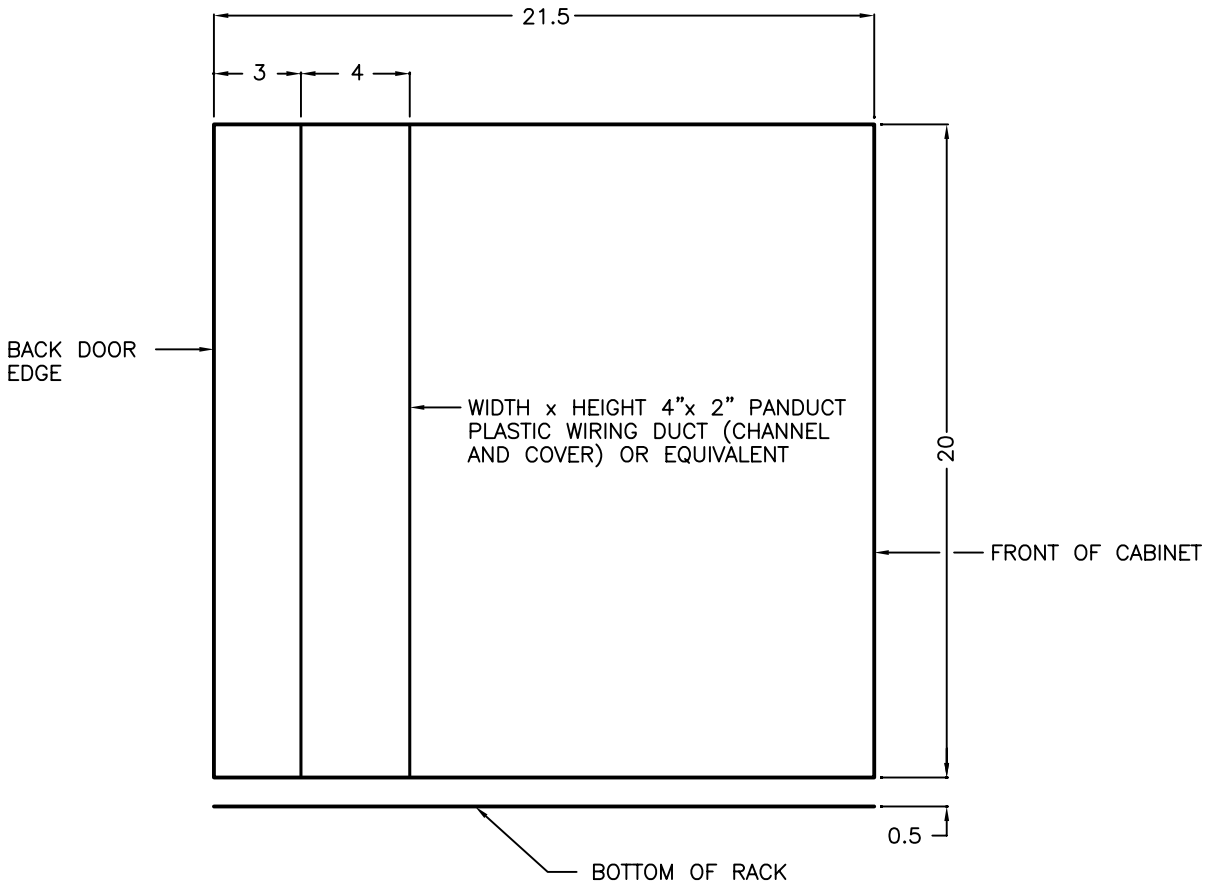
LEGEND:

- SWITCH
- GAS DISCHARGE TUBE (LIGHTNING ARRESTOR)
- MOV – METAL OXIDE VARISTOR
- COILED WIRE (1m LENGTH)

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

401 SERVICE PANEL WIRING DIAGRAM

Date	Nov. 2002	Rev	1	OTSCES – 1620.02



INPUT PANEL SIDE

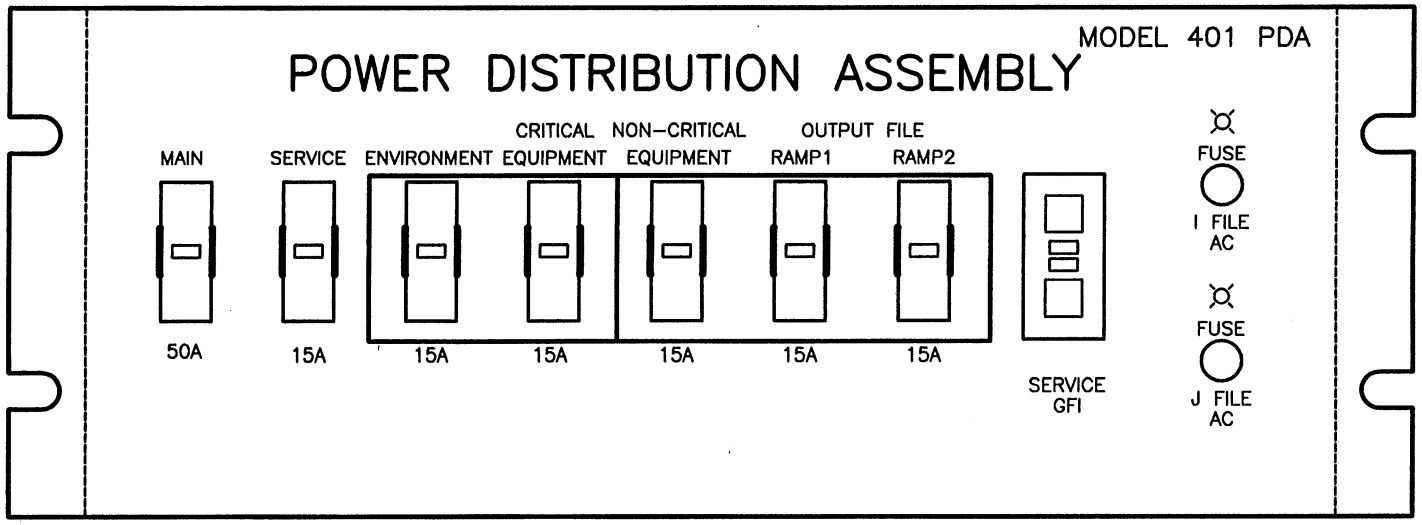
NOTES:

1 WIRING, DUCT AND COVER REQUIRED IN ALL 401 SERIES CABINETS EXCEPT 401C TYPE CABINET.

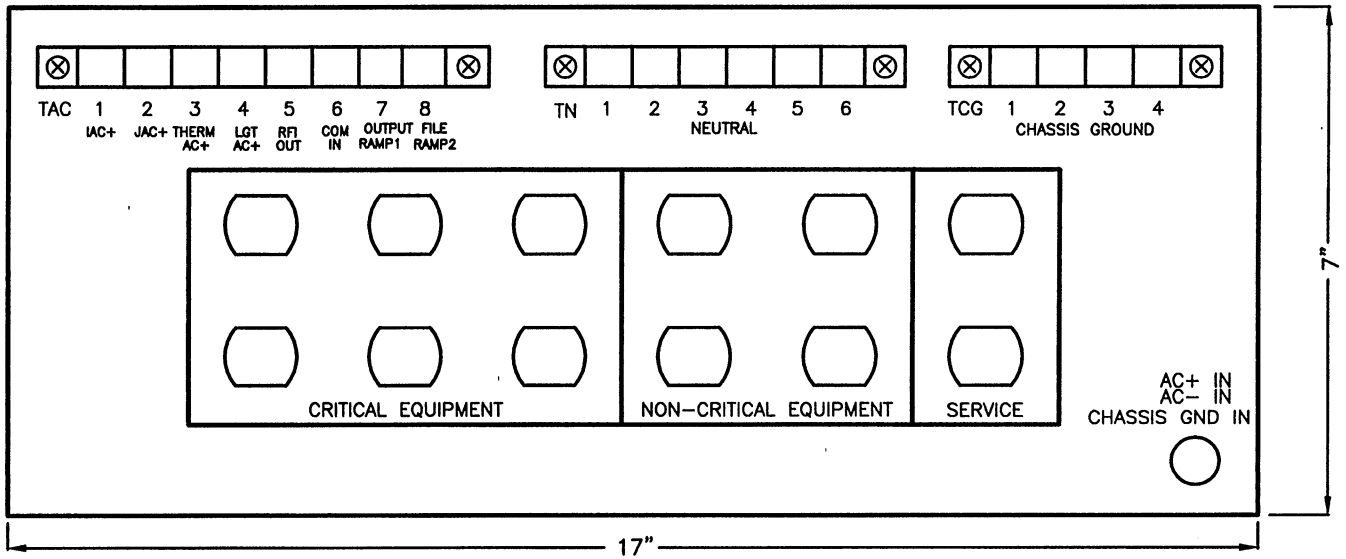
2 ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SHOWN.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS				
401 INPUT PANEL–OUTLINE				
Date	Nov. 2002	Rev	1	OTSCES – 1630.01

FRONT



REAR



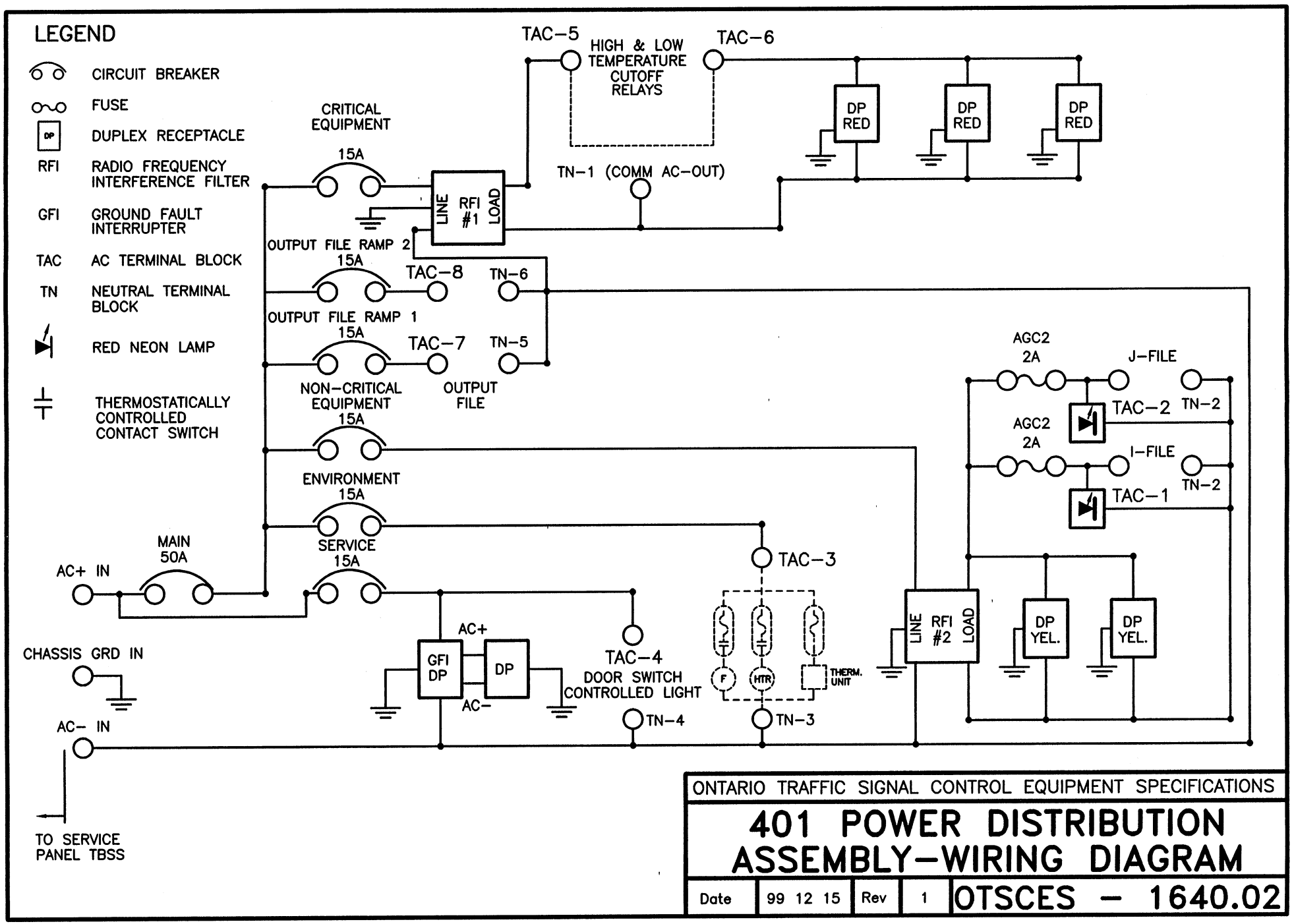
NOTES:

1. OUTLET COLOUR SCHEME
   RED: CRITICAL EQUIPMENT
   YELLOW: NON-CRITICAL EQUIPMENT
   WHITE: SERVICE AND SERVICE GFI
2. CIRCUIT BREAKER COLOUR SCHEME
   RED: ENVIRONMENT AND CRITICAL EQUIPMENT
   YELLOW: NON CRITICAL EQUIPMENT AND OUTPUT FILE
3. RED LEDS OR NEONS ABOVE THE I AND J INPUT FILE FUSES SHALL BE LIT WHEN POWER IS AVAILABLE TO THE I AND J INPUT FILES
4. PDA 6.5" DEEP MAX.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

401 POWER DISTRIBUTION ASSEMBLY-OUTLINE

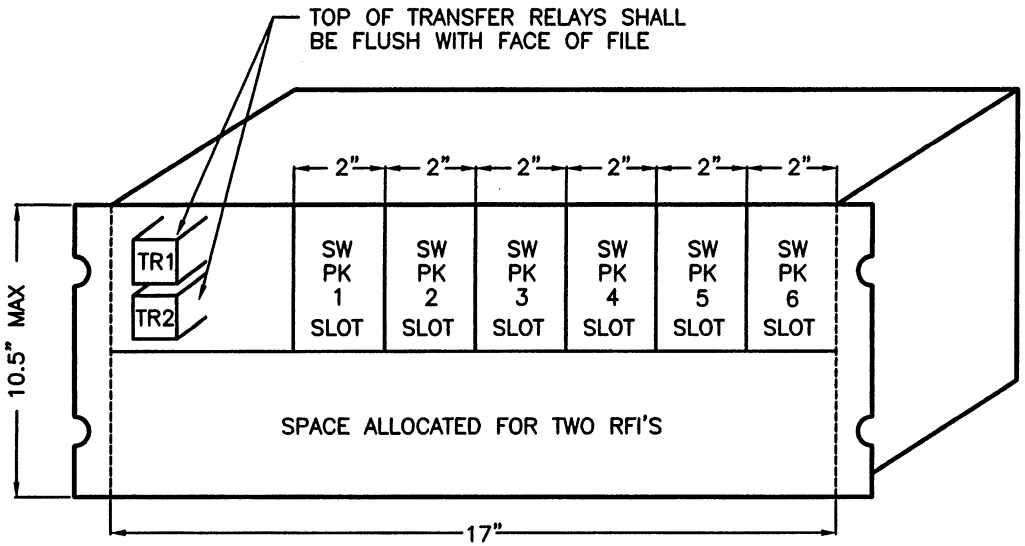
Date	94 11 09	Rev	1	OTSCES - 1640.01



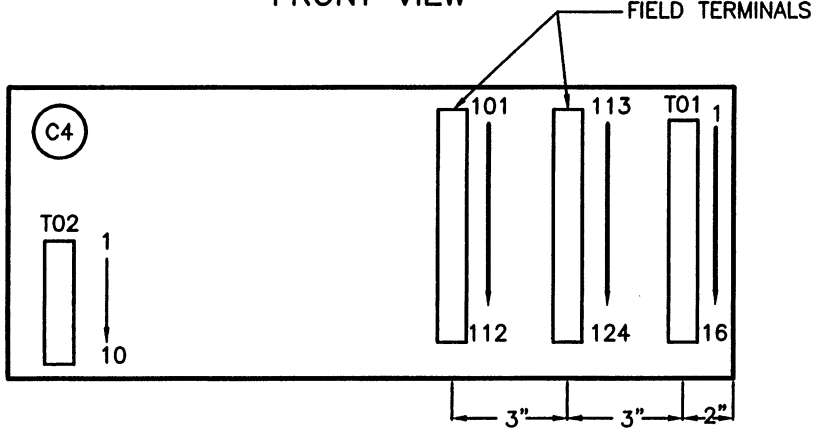
ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

401 POWER DISTRIBUTION ASSEMBLY-WIRING DIAGRAM

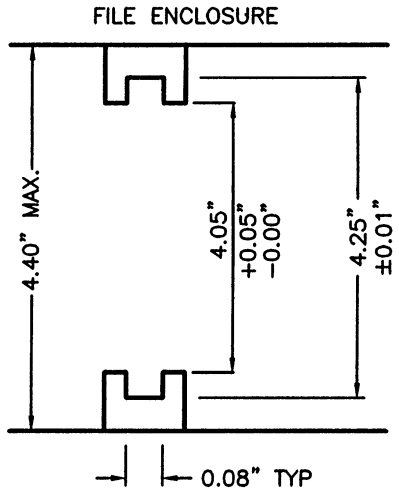
Date	99 12 15	Rev	1	OTSCES - 1640.02



FRONT VIEW



REAR VIEW



SWITCHPACK
ENCLOSURE EDGE GUIDE

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

401 OUTPUT FILE–OUTLINE

Date	99 12 15	Rev	2	OTSCES – 1660.01

SWITCHPACK OUTPUTS FROM THE OUTPUT FILE SHALL CONNECT TO THE FOLLOWING FIELD TERMINALS

FIELD TERM	FUNCTION	FIELD TERM	FUNCTION
101	SWPK 3 – RED	113	SWPK 1 – RED
102	SWPK 3 – YEL	114	SWPK 1 – YEL
103	SWPK 3 – GRN	115	SWPK 1 – GRN
104	SWPK 4 – RED	116	SWPK 2 – RED
105	SWPK 4 – YEL	117	SWPK 2 – YEL
106	SWPK 4 – GRN	118	SWPK 2 – GRN
107	SWPK 5 – RED	119	SPARE
108	SWPK 5 – YEL	120	SPARE
109	SWPK 5 – GRN	121	FIELD AC– SWITCH PACK
110	SWPK 6 – RED	122	FIELD AC– SWITCH PACK
111	SWPK 6 – YEL	123	FIELD AC– SWITCH PACK
112	SWPK 6 – GRN	124	FIELD AC– SWITCH PACK

OUTPUT FILE AC TERMINAL BLOCK T01

POS –	A (INTERNAL)	B (EXTERNIAL)
1	SWPK 1,3,4 (VIA RFI) UNIT #1	PDA TAC – 7
2	SWPK 2,5,6 (VIA RFI) UNIT #2	PDA TAC – 8
3	AC– FOR RFI 1,2 AC– INPUT	PDA TN – 6
4	AC+ TO TR1 RELAY COIL	POL. ON/OFF SW1
5	AC+ TO TR2 RELAY COIL	POL. ON/OFF SW2
6	EQU. GND. BUS	PDA TCG–2
7	AC– FOR RELAY 1,2 COIL COMMON	PDA TN – 5
8	SPARE	SPARE
9	SPARE	SPARE
10	SPARE	SPARE
11	SPARE	SPARE
12	SPARE	SPARE
13	SPARE	SPARE
14	SPARE	SPARE
15	SPARE	SPARE
16	SPARE	SPARE

OUTPUT FILE DC TERMINAL BLOCK T02

POS.	A (INTERNAL)	POS. B (EXTERNAL)
1	24 V	24 V SUPPLY
2	DC GROUND	DC GROUND
3	SPARE	SPARE
4	SPARE	SPARE
5	SPARE	SPARE
6	SPARE	SPARE
7	SPARE	SPARE
8	SPARE	SPARE
9	SPARE	SPARE
10	SPARE	SPARE

CONNECTOR – C1 WIRING LIST
Page 1 of 2

PIN	401 D CABINET DESTINATION	401 D CABINET FUNCTION	401 R CABINET DESTINATION	401 R CABINET FUNCTION
1		DC GROUND		DC GROUND
2	T+B	–	C4 – 1	Ramp 2 Flasher 1
3	T+B	–	C4 – 2	N/C
4	T+B	–	C4 – 3	Ramp 2 Flasher 2
5	T+B	–	C4 – 4	Ramp 2 Red
6	T+B	–	C4 – 5	Ramp 2 Yellow
7	T+B	–	C4 – 6	Ramp 2 Green
8	T+B	–	C4 – 7	Ramp 1 Flasher 1
9	T+B	–	C4 – 8	N/C
10	T+B	–	C4 – 9	Ramp 1 Flasher 2
11	T+B	–	C4 – 10	Ramp 1 Red
12	T+B	–	C4 – 11	Ramp 1 Yellow
13	T+B	–	C4 – 12	Ramp 1 Green
14	IFI T15–4	LOGIC GROUND	IFI T15–4	
15	T+B	–	C4 – 13	Ramp 3 Flasher 1
16	T+B	–	C4 – 14	N/C
17	T+B	–	C4 – 15	Ramp 3 Flasher 2
18	T+B	–	C4 – 16	Ramp 3 Red
19	T+B	–	C4 – 17	Ramp 3 Yellow
20	T+B	–	C4 – 18	Ramp 3 Green
21	T+B	–	C4 – 19	NOT ASSIGNED
22	T+B	–	C4 – 20	NOT ASSIGNED
23	T+B	–	C4 – 21	NOT ASSIGNED
24	T+B	–	C4 – 22	NOT ASSIGNED
25	T+B	–	C4 – 23	NOT ASSIGNED
26	T+B	–	C4 – 24	NOT ASSIGNED
27	T+B	–	C4 – 25	NOT ASSIGNED
28	T+B	–	C4 – 26	NOT ASSIGNED
29	T+B	–	C4 – 27	NOT ASSIGNED
30	T+B	–	C4 – 28	NOT ASSIGNED
31	T+B	–	C4 – 29	NOT ASSIGNED
32	T+B	–	C4 – 30	NOT ASSIGNED
33	T+B	–	C4 – 31	NOT ASSIGNED
34	T+B	–	C4 – 32	NOT ASSIGNED
35	T+B	–	C4 – 33	NOT ASSIGNED
36	T+B	–	C4 – 34	NOT ASSIGNED
37	T+B	–	C4 – 35	NOT ASSIGNED
38	T+B	–	C4 – 36	NOT ASSIGNED
39	IFI T1–2	EXP. LOOP 1	IFI T1 – 2	EXP. LOOP 1
40	IFI T2–2	EXP. LOOP 3	IFI T2 – 2	EXP. LOOP 3
41	IFI T3–2	EXP. LOOP 5	IFI T3 – 2	EXP. LOOP 5
42	IFI T4–2	EXP. LOOP 7	IFI T4 – 2	EXP. LOOP 7
43	IFI T5–2	EXP. LOOP 9	IFI T5 – 2	EXP. LOOP 9
44	IFI T6–2	EXP. LOOP A	IFI T6 – 2	EXP. LOOP A
45	IFI T2–3	EXP. LOOP 2	IFI T2 – 2	EXP. LOOP 2
46	IFI T1–3	EXP. LOOP 4	IFI T1 – 3	EXP. LOOP 4
47	IFI T4–3	EXP. LOOP 6	IFI T4 – 3	EXP. LOOP 6
48	IFI T3–3	EXP. LOOP 8	IFI T3 – 3	EXP. LOOP 8
49	IFI T6–3	EXP. LOOP 0	IFI T6 – 3	EXP. LOOP 0
50	IFI T5–3	EXP. LOOP B	IFI T5 – 3	EXP. LOOP B
51	IFI T8–2	COL. LOOP 1	IFI T8 – 2	COL. LOOP 1
52	IFI T9–2	COL. LOOP 3	IFI T9 – 2	COL. LOOP 3

NOTES:

A This drawing to be read in conjunction with OTSCES–1670.02

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

401 SERIES–CONNECTOR C1 WIRING LIST

Date	Nov. 2002	Rev	1	OTSCES – 1670.01

CONNECTOR – C1 WIRING LIST
Page 2 of 2

PIN	401 D CABINET DESTINATION	401 D CABINET FUNCTION	401 R CABINET DESTINATION	401 R CABINET FUNCTION
53	IFI T10 – 2	COL. LOOP 5	IFI T10 – 2	COL. LOOP 5
54	IFI T11 – 2	COL. LOOP 7	IFI T11 – 2	COL. LOOP 7
55	IFI T12 – 2	COL. LOOP 9	IFI T12 – 2	COL. LOOP 9
56	IFI T13 – 2	COL. LOOP A	IFI T13 – 2	COL. LOOP A
57	IFI T9 – 3	COL. LOOP 2	IFI T9 – 3	COL. LOOP 2
58	IFI T8 – 3	COL. LOOP 4	IFI T8 – 3	COL. LOOP 4
59	IFI T11 – 3	COL. LOOP 6	IFI T11 – 3	COL. LOOP 6
60	IFI T10 – 3	COL. LOOP 8	IFI T10 – 3	COL. LOOP 8
61	IFI T13 – 3	COL. LOOP 0	IFI T13 – 3	COL. LOOP 0
62	IFI T12 – 3	COL. LOOP B	IFI T12 – 3	COL. LOOP B
63	IFJ T1 – 2	MISC. LOOP	IFJ T1 – 2	RAMP 1 PRES.
64	IFJ T2 – 2	MISC. LOOP	IFJ T2 – 2	RAMP 2 PRES.
65	IFJ T3 – 2	MISC. LOOP	IFJ T3 – 2	RAMP 1 QUEUE LOOP 1
66	IFJ T4 – 2	MISC. LOOP	IFJ T4 – 2	RAMP 2 QUEUE LOOP 1
67	IFJ T5 – 2	MISC. LOOP	IFJ T5 – 2	HOV 1 PRES.
68	IFJ T6 – 2	MISC. LOOP	IFJ T6 – 2	HOV 2 PRES.
69	IFJ T7 – 2	MISC. LOOP	IFJ T7 – 2	RAMP 1 STOP TIME
70	IFJ T8 – 2	MISC. LOOP	IFJ T8 – 2	MISC. LOOP
71	IFJ T9 – 2	MISC. LOOP	IFJ T9 – 2	MISC. LOOP
72	IFJ T10–2/THER. T3–3	THER.STATE/MISC.LOOP	IFJ T10–2/THER. T3–3	THER.STATE/MISC.LOOP
73	IFJ T2 – 3	MISC. LOOP	IFJ T2 – 3	RAMP 1 PASS.
74	IFJ T1 – 3	MISC. LOOP	IFJ T1 – 3	RAMP 2 PASS.
75	IFJ T4 – 3	MISC. LOOP	IFJ T4 – 3	RAMP 1 QUEUE LOOP 2
76	IFJ T3 – 3	MISC. LOOP	IFJ T3 – 3	RAMP 2 QUEUE LOOP 2
77	IFJ T6 – 3	MISC. LOOP	IFJ T6 – 3	HOV 1 PASS.
78	IFJ T5 – 3	MISC. LOOP	IFJ T5 – 3	HOV 2 PASS.
79	IFJ T8 – 3	MISC. LOOP	IFJ T8 – 3	MISC. LOOP
80	IFJ T7 – 3	MISC. LOOP	IFJ T7 – 3	RAMP 2 STOP TIME
81	IFJ T10 – 3	MISC. LOOP	IFJ T10 – 3	MISC. LOOP
82	IFJ T9 – 3	MISC. LOOP	IFJ T9 – 3	MISC. LOOP
83	T+B	–	T+B	–
84	T+B	–	T+B	–
85	T+B	–	T+B	–
86	T+B	–	T+B	–
87	T+B	–	T+B	–
88	T+B	–	T+B	–
89	T+B	–	T+B	–
90	T+B	–	T+B	–
91	T+B	–	T+B	–
92		DC GROUND		DC GROUND
93	T+B	–	T+B	–
94	T+B	–	T+B	–
95	T+B	–	T+B	–
96	T+B	–	T+B	–
97	T+B	–	T+B	–
98	T+B	–	T+B	–
99	T+B	–	T+B	–
100	T+B	–	T+B	–
101	T+B	–	T+B	–
102	IFI T15–3	DETECTOR RESET	IFI T15–3	DETECTOR RESET
103	T+B	–	T+B	–
104	IFJ T15 – 4	LOGIC GROUND	IFJ T15–4	LOGIC GROUND

NOTES:

A This drawing to be read in conjunction with OTSCES–1670.01.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

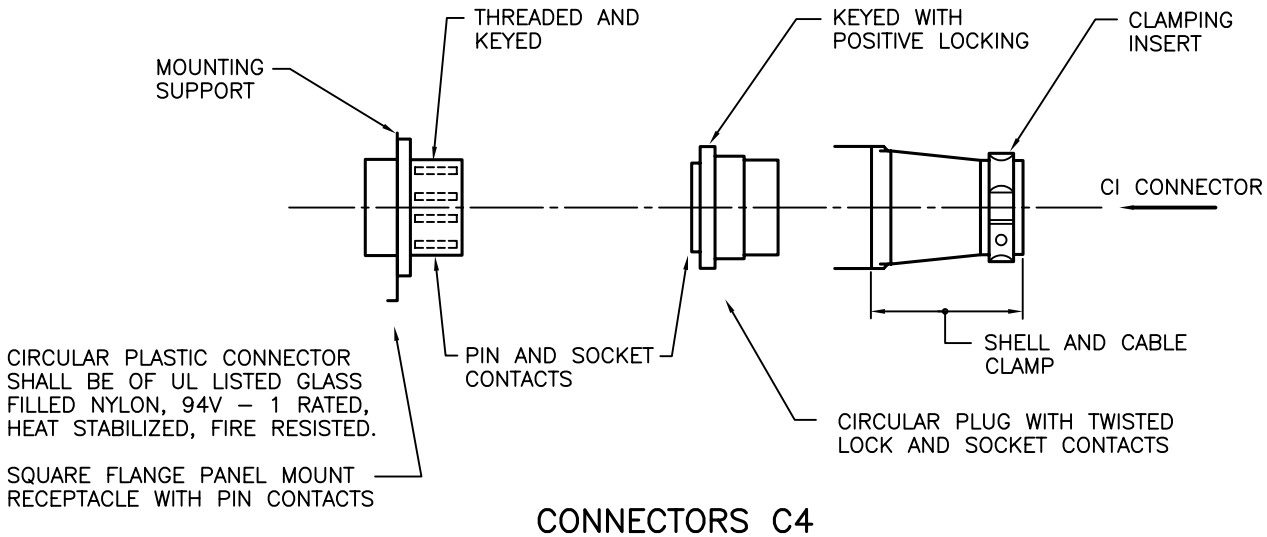
401 SERIES–CONNECTOR C1 WIRING LIST

Date	Nov. 2002	Rev	1	OTSCES – 1670.02

CONNECTOR – C4 WIRING LIST

PIN	SOURCE (SOCKET)	DEST. (PLUG)	
1	CI – 2	SWPK	3 – 6
2	CI – 3	SWPK	3 – 8
3	CI – 4	SWPK	3 – 10
4	CI – 5	SWPK	4 – 6
5	CI – 6	SWPK	4 – 8
6	CI – 7	SWPK	4 – 10
7	CI – 8	SWPK	5 – 6
8	CI – 9	SWPK	5 – 8
9	CI – 10	SWPK	5 – 10
10	CI – 11	SWPK	6 – 6
11	CI – 12	SWPK	6 – 8
12	CI – 13	SWPK	6 – 10
13	CI – 15	SWPK	1 – 6
14	CI – 16	SWPK	1 – 8
15	CI – 17	SWPK	1 – 10
16	CI – 18	SWPK	2 – 6
17	CI – 19	SWPK	2 – 8
18	CI – 20	SWPK	2 – 10

PIN	SOURCE (SOCKET)	DEST. (PLUG)
19	CI – 21	NC
20	CI – 22	NC
21	CI – 23	NC
22	CI – 24	NC
23	CI – 25	NC
24	CI – 26	NC
25	CI – 27	NC
26	CI – 28	NC
27	CI – 29	NC
28	CI – 30	NC
29	CI – 31	NC
30	CI – 32	NC
31	CI – 33	NC
32	CI – 34	NC
33	CI – 35	NC
34	CI – 36	NC
35	CI – 37	NC
36	CI – 38	NC
37	T + B	NC



CONNECTORS C4

NOTE:

A THE C4 CONNECTOR IS ONLY APPLICABLE TO A 401R SERIES TRAFFIC CONTROL CABINET.

ONTARIO TRAFFIC SIGNAL CONTROL EQUIPMENT SPECIFICATIONS

401 SERIES–CONNECTOR C4 WIRING LIST

Date	Nov. 2002	Rev	1	OTSCES – 1670.03