

TS2 TYPE 1 “PLUG-N-GO”
MODULAR CABINET ASSEMBLY

This specification is fully met by the following Econolite models:

TS2 Type 1 “PLUG-N-GO” Modular Cabinet Assembly

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1. Introduction

This specification sets forth the minimum requirements for a TS2 Type 1 traffic control modular cabinet assembly. The cabinet assembly shall meet, as a minimum, all applicable sections of the NEMA Standard Publication No. TS2-2003. Where differences occur, this specification shall govern.

2. Cabinet Design and Construction

- 2.1. The cabinet shall be constructed from type 5052-H32 aluminum with a minimum thickness of 0.125 inches.
- 2.2. The cabinet shall be designed and manufactured with materials that will allow rigid mounting, whether intended for pole, base or pedestal mounting. The cabinet must not flex on its mount.
 - 2.2.1. A rain channel shall be incorporated into the design of the main door opening to prevent liquids from entering the enclosure. The cabinet door opening must be a minimum of 80 percent of the front surface of the cabinet. A stiffener plate shall be welded across the inside of the main door to prevent flexing.
 - 2.2.2. The top of the cabinet shall incorporate a 1-inch slope toward the rear to prevent rain accumulation.
- 2.3. Unless otherwise specified, the cabinet shall be supplied with a natural aluminum finish. Sufficient care shall be taken in handling to ensure that scratches are minimized. All surfaces shall be free from weld flash. Welds shall be smooth, neatly formed, free from cracks, blowholes and other irregularities. All sharp edges shall be ground smooth.
- 2.4. Where painted cabinets are specified, the exterior shall be degreased and primed with a spray applied iron phosphate coat- equivalent to a four-stage iron phosphate coat prior to painting. The final coat shall consist of a powder coat paint (TGIC or equivalent) applied with a minimum thickness of 2 mils.
- 2.5. All seams shall be sealed with RTV sealant or equivalent material on the interior of the cabinet.
- 2.6. All cabinets shall be supplied with a minimum of one removable shelf manufactured from 5052-H32 aluminum. Shelf shall be a minimum of 10 inches deep.
- 2.7. The shelf shall have horizontal slots at the rear and vertical slots at the front of the turned down side flange. The shelf shall be installed by first inserting the rear edge of the shelf on the cabinet rear sidewall mounting studs, then lowering the shelf on the front sidewall mounting studs. The shelf shall be held in place by a nylon tie-wrap inserted through holes on the front edge of the shelf and around the front sidewall mounting studs.
- 2.8. The front edge of the shelf shall have holes punched every 6 inches to accommodate tie-wrapping of cables/harnesses.
- 2.9. A minimum of one set of vertical "C" channels shall be mounted on each interior wall of the cabinet for the purpose of mounting the cabinet components. The channels shall accommodate spring mounted nuts or studs. All mounting rails shall extend to within 7 inches of the top and bottom of the cabinet. Sidewall rail spacing shall be 7.88 inches center-to-center. Rear wall rail spacing shall be 18.50 inches center-to-center.
- 2.10. The main door and police door-in-door shall close against a weatherproof and dust-proof, closed-cell neoprene gasket seal. The gasket material for the main door shall be a minimum of 0.250 inches thick by 1.00 inch wide. The gasket material for the police door shall be a minimum of 0.250 inches thick by 0.500 inches wide. The gaskets shall be permanently bonded to the cabinet.
- 2.11. The lower section of the cabinet shall be equipped with a louvered air entrance. The air inlet shall be large enough to allow sufficient air flow per the rated fan capacity. Louvers must satisfy the NEMA rod

- entry test for 3R ventilated enclosures. A non-corrosive, vermin- and insect-proof, removable air filter shall be secured to the air entrance. The filter shall fit snugly against the cabinet door wall.
- 2.12. The roof of the cabinet shall incorporate an exhaust plenum with a vent screen. Perforations in the vent screen shall not exceed 0.125 inches in diameter.
 - 2.13. The main door on a size 3 or larger cabinet shall be equipped with a three-point latching mechanism.
 - 2.14. The handle on the main door of a size 4 or larger cabinet shall utilize a shank of 5/8 inches minimum diameter. The handle on the main door of a size 3 cabinet shall utilize a shank of 7/16 inches minimum diameter. The handle shall include a hasp for the attachment of an optional padlock. The cabinet door handle shall rotate counter-clockwise to open. The handle shall not extend beyond the perimeter of the main door at any time. The lock assembly shall be positioned so that the handle shall not cause any interference with the key when opening the cabinet door.
 - 2.15. The main door hinge shall be a one-piece, continuous piano hinge with a stainless steel pin running the entire length of the door. The hinge shall be attached in such a manner that no rivets or bolts are exposed.
 - 2.16. The main door of a size 5 or larger cabinet shall include a mechanism capable of holding the door open at approximately 90, 145, and 165 degrees under windy conditions. Manual placement of the mechanism shall not be required by field personnel. The main door of a size 3, or 4 cabinet shall include a mechanism capable of holding the door open at approximately 90 and 165 degrees under windy conditions.
 - 2.17. The main door shall be equipped with a Corbin tumbler lock number 1548-1 or exact equivalent. Minimum of two keys shall be supplied.
 - 2.18. The police door-in-door shall be provided with a treasury type lock Corbin No. R357SGS or exact equivalent and has a minimum of one key.
 - 2.19. All base mounted cabinets require anchor bolts to properly secure the cabinet to its base. The cabinet flange for securing the anchor bolts shall not protrude outward from the bottom of the cabinet. When a size 3, 4, or 5 cabinet is base mounted, two anchor bolts shall be required for proper installation. Size 6 and 7 cabinets, four anchor bolts shall be required for proper installation.
 - 2.20. Each cabinet shall be of sufficient size to accommodate all equipment. At a minimum, the minimal cabinet sizes are as follows:
 - Size 3 cabinets - 40" H x 24" W x 15" D
 - Size 4 cabinets - 46" H x 24" W x 16" D
 - Size 5 cabinets - 48" H x 30" W x 16" D
 - Size 6 cabinets - 52" H x 44" W x 24" D
 - Size 7 cabinets - 72" H x 44" W x 24" D

3. Terminals and Facilities/Main Panel Design and Construction

- 3.1. The main panel shall be constructed from 5052-H32 brushed aluminum of 0.125 inches minimum thickness and installed so as to minimize flexing when plug-in components are installed.
- 3.2. All 8-, 12- and 16-position main panels are provided with a mounting mechanism which allows easy access to all wiring on the rear of the panel without the removal of any cabinet shelves. Lowering of the main panel can be accomplished without the use of hand tools. Complete removal can be accomplished by the use of simple hand tools.
- 3.3. The terminals and facilities shall be available as a minimum in the following configurations:
 - a. Configuration #1 - Four load switch sockets, two flash transfer relay sockets, one flasher socket, 1-BIU sockets(expandable to 2), one 8-channel detector rack with one BIU, and one Type-16 MMU.

- b. Configuration #2 - Eight load switch sockets, four flash transfer relay sockets, one flasher socket, 1-BIU sockets(expandable to 2), one 8-channel detector rack with one BIU, and one Type-16 MMU
 - c. Configuration #3 - Twelve load switch sockets, six flash transfer relay sockets, one flasher socket, 2- BIU sockets, one 16-channel detector rack with one BIU, and one Type-16 MMU
 - d. Configuration #4 - Sixteen load switch sockets, six flash transfer relay sockets, one flasher socket, 2- BIU sockets, one 16-channel detector rack with one BIU, and one Type-16 MMU.
- 3.4. All load switch and flash transfer relay socket reference designators shall be silk-screen labeled on the front and rear of the main panel to match drawing designations. Socket pins shall be marked for reference on the rear of the panel.
 - 3.5. A maximum of eight load switch sockets may be positioned horizontally or stacked in two rows on the main panel. Main panels requiring more than eight load switch sockets shall be mounted in two horizontal rows.
 - 3.6. All load switches shall be supported by a bracket, extending at least half the length of the load switch.
 - 3.7. The 4- and 8- load switch position main panels shall have all field wires contained within one or two row(s) of horizontally mounted terminal blocks.
 - 3.8. The 12- and 16-load switch position main panels shall have all field wires contained on two rows of horizontally mounted terminal blocks. The upper row shall be wired for the pedestrian and overlap field terminations. The lower row shall be reserved for phase one through phase eight vehicle field terminations.
 - 3.9. As an alternate a 16 position horizontal main panel and field terminal configuration may be used.
 - 3.10. All field output circuits shall be terminated on a non-fused barrier type terminal block with a minimum rating of 10 amps.
 - 3.11. All field input/output (I/O) terminals shall be identified by permanent alphanumeric labels. All labels shall use standard nomenclature per the NEMA TS2 specification.
 - 3.12. It shall be possible to flash either the yellow or red indication on any vehicle movement and to change from one color indication to the other by use of a screwdriver.
 - 3.13. Field terminal blocks shall be wired to use four positions per vehicle or overlap phase (green, yellow, and red, flash). It shall not be necessary to de-buss field terminal blocks for flash programming.
 - 3.14. The main panel shall contain at least one flasher socket (silk screen labeled) capable of operating a 15-amp, 2-pole, NEMA solid-state flasher. The flasher shall be supported by a bracket, extending at least half its length.
 - 3.15. One RC network shall be wired in parallel with each group of three flash-transfer relays and any other relay coils.
 - 3.16. All logic-level, NEMA-controller and Malfunction Management Unit input and output terminations on the main panel shall be permanently labeled. Cabinet prints shall identify the function of each terminal position.
 - 3.17. At a minimum, three 20-position terminal blocks shall be provided at the top of the main panel to provide access to the controller unit's programmable and non-programmable I/O. Terminal blocks for DC signal interfacing shall have a number 6-32 x 7/32 inch screw as minimum.
 - 3.18. All main panel wiring shall conform to the following wire size and color:
 - Green/Walk load switch output - brown wire - 14 gauge
 - Yellow load switch output - yellow wire - 14 gauge
 - Red/Don't Walk load switch - red wire output - 14 gauge
 - MMU (other than AC power) - violet wire - 22 gauge
 - Controller I/O - blue wire - 22 gauge
 - AC Line (power panel to - black wire main panel) - 8 / 10 gauge

- AC Line (main panel) - black wire - 10 gauge
 - AC Neutral (power panel to - white wire main panel) - 8 / 10 gauge
 - AC Neutral (main panel) - white wire - 10 gauge
 - Earth ground (power panel) - green wire - 8 gauge
 - Logic ground - gray wire - 22 gauge
 - Flash programming - Orange wire
 - Flasher terminal - Black wire red or yellow field terminal - 14 gauge
- 3.19. All wiring, 14 AWG and smaller, shall conform to MIL-W-16878/1, type B/N, 600V, 19-strand tinned copper. The wire shall have a minimum of 0.010 inches thick PVC insulation with clear nylon jacket and rated to 105 degrees Celsius. All 12 AWG and larger wire shall have UL listed THHN/THWN 90 degrees Celsius, 600V, 0.020 inches thick PVC insulation and clear nylon jacketed.
- 3.20. Connecting cables shall be sleeved in a braided nylon mesh or poly-jacketed. The use of exposed tie-wraps or interwoven cables is unacceptable.
- 3.21. All Terminals and Facilities configurations shall be provided with BIU wiring assignments consistent with NEMA TS2-1998 specifications.
- 3.22. All Terminals and Facilities configurations shall be provided with sufficient RS-485 Port 1 communication cables to allow for the intended operation of that cabinet. Each communication cable connector shall be a 15-pin metal shell D subminiature type. The cable shall be a shielded cable suitable for RS-485 communications.
- 3.23. All main panels shall be pre-wired for a Type-16 Malfunction Management Unit.
- 3.24. All wiring shall be neat in appearance. All cabinet wiring shall be continuous from its point of origin to its termination point. Butt type connections/splices are not acceptable.
- 3.25. All connecting cables and wire runs shall be secured by mechanical clamps. Stick-on type clamps are not acceptable.
- 3.26. The grounding system in the cabinet shall be divided into three separate circuits (AC Neutral, Earth Ground, and Logic Ground). These ground circuits shall be connected together at a single point as outlined in the NEMA TS2 Standard.
- 3.27. The main panel shall incorporate a relay to remove +24 VDC from the common side of the load switches when the intersection is placed into mechanical flash. The relay shall have a momentary pushbutton to apply power to the load switch inputs for ease of troubleshooting. The relay shall have a momentary pushbutton to apply power to the load switch inputs for ease of troubleshooting.
- 3.28. All pedestrian push button inputs from the field to the controller shall be opto-isolated through the BIU and operate at 12 VAC.
- 3.29. All wire (size 16 AWG or smaller) at solder joints shall be hooked or looped around the eyelet or terminal block post prior to soldering to ensure circuit integrity. Lap joint soldering is not acceptable.

4. Power Panel Design and Construction

- 4.1. The power panel shall be integrated into the main panel and be located on the lower right portion. The power panel shall be wired to provide the necessary filtered power to the load switches, flasher(s), and power bus assembly. The power components shall be equipped with a removable plastic front cover for technician protection. The design will allow a technician to access the main and auxiliary breakers without removing the protective front cover.
- 4.2. The power panel portion of the main panel shall include the following components:

- a. A minimum of a 40-amp main breaker for 12- or 16- position cabinets or a minimum of a 30-amp breaker for 4- or 8-position cabinets. This breaker shall supply power to the controller, MMU, signals, cabinet power supply and auxiliary panels. Breakers shall be at minimum, a thermal magnetic type, U.L. listed for HACR service, with a minimum of 10,000 amp interrupting capacity.
- b. A minimum of a 15-amp auxiliary breaker. This breaker shall supply power to the fan, light and GFI utility outlet.
- c. An EDCO model SHP-300-10 or exact approved equivalent surge arrester.
- d. A 50 amp, 125 VAC radio interference line filter.
- e. A normally-open, 60-amp, mercury contactor Mercury Displacement Industries, Inc model 60NC-120A or exact equivalent. As an alternate, a Solid State Signal buss relay may be substituted for the mercury contactor. The SSR shall be a Crydom Model# HA4875H or approved equal. A minimum of an 8-position neutral bus bar is capable of connecting three #12 wires per position.
- g. A minimum of 6-position ground bus bar capable of connecting three #12 wires per position.
- h. A NEMA type 5-15R GFI utility outlet.

5. Power Bus Assembly

- 5.1. The power bus assembly shall be manufactured from 0.090", 5052-H32 aluminum. It shall provide filtered power for the controller, malfunction management unit, cabinet power supply, and all auxiliary equipment. It shall include the SDLC Bus connecting cables wired into a surface-mounted compression terminal block. As an alternate SDLC Bus connections may be made via an SDLC Hub Assembly, Model # 171-1153-501
- 5.2. The Power Bus Assembly shall house the following components:
 - a. A minimum of three and a maximum of six power connectors.
 - b. Two terminal strips to hardwire the power connections.
 - c. SDLC terminal block with pre-wired cables or SDLC Hub Assembly Model # 171-1153-501.
- 5.3. All cabinet equipment requiring filtered power to operate shall be connected to the power bus assembly by a 12-pin Molex Robotic Type connector Model# 54332-1270 or exact equivalent or hardwired directly to the supplied terminal blocks.

6. Auxiliary Cabinet Equipment

- 6.1. The cabinet shall be provided with a thermostatically controlled (adjustable between 55-160 degrees Fahrenheit) ventilation fan in the top of the cabinet plenum. The fan plate shall be removable with the use of simple hand tools for serviceability. A minimum of one exhaust fan shall be provided. The fan shall be a ball bearing type fan and shall be capable of drawing a minimum of 100 cubic feet of air per minute. The Fan/Thermostat assembly shall be connected to the Power panel by means of a 4 position plug-in cable.
- 6.2. At minimum, a 40-watt incandescent refrigerator lamp and socket mounted on an aluminum bracket shall be mounted in the cabinet to sufficiently illuminate the field terminals. The lamp shall be wired to either a 15-amp ON/OFF toggle switch mounted on the power panel or to a door activated switch mounted near the top of the door.
 - 6.2.1. Alternately, a 25-watt incandescent lamp mounted on a 14-inch flexible arm shall be included. The flexible arm shall be permanently mounted to the middle of the cabinet door. The lamp shall be wired to either a 15-amp ON/OFF toggle switch mounted on the power panel or to a door activated switch mounted near the top of the door.

- 6.2.2. Alternately, a fluorescent lighting fixture shall be mounted on the inside top of the cabinet near the front edge. The fixture shall be rated to accommodate at minimum a F15T8 lamp operated from a normal power factor UL or ETL listed ballast. The lamp shall be wired to either a 15-amp ON/OFF toggle switch mounted on the power panel or to a door activated switch mounted near the top of the door.
- 6.2.3. Alternately, an LED cabinet lighting system may be used to illuminate the internal structure of the cabinet assembly. The LED cabinet lighting shall be Bivar 12" LED strips Model# BIVDL-C1358 and Power Supply Model# BIVPS-1026 or approved equal.
- 6.3. A resealable print pouch shall be mounted to the door of the cabinet. The pouch shall be of sufficient size to accommodate one complete set of cabinet prints.
- 6.4. A minimum of two sets of complete and accurate cabinet drawings shall be supplied with each cabinet.
- 6.5. A minimum of one set of manuals for the controller, Malfunction Management Unit and vehicle detector amplifiers shall be supplied with each cabinet.

7. Vehicle Detection

- 7.1. A minimum of one vehicle detector amplifier rack shall be provided in each cabinet. Detector racks shall be available in two configurations. These configurations shall be integrated on top left side portion of the main panel.
 - a. Configuration #1 - Shall support up to eight channels of loop detection (either four 2 channel detectors or two 4 channel detectors), two 2-channel preemption devices, and one BIU. This configuration shall be included as a standard on the 8-position main panel assembly.
 - b. Configuration #2 - Shall support up to 16 channels of loop detection (either eight 2 channel detectors or four 4 channel detectors), two 2-channel preemption devices and one BIU. This configuration shall be included as a standard on the 12 or 16 position main panel assembly.
- 7.2. Detector rack BIU mounting shall be an integral part of the detector rack.
- 7.3. All BIU rack connectors shall have jumper address pins corresponding to the requirements of the TS2 specification. The jumpers may be moved to change the address of any individual rack. The address pins shall control the BIU mode of operation. BIUs shall be capable of being interchanged with no additional programming.
- 7.4. Each cabinet shall contain detector interface panels for the purpose of connecting field loops and vehicle detector amplifiers. The panels shall be manufactured from FR4 G10 fiberglass, 0.062 inches thick, with a minimum of 2 oz. of copper for all traces.
- 7.5. One 8-position interface panel shall be provided for an 8-channel rack cabinet and one 16-position interface panel shall be provided for a 16-channel rack cabinet. The interface panel shall be secured to a mounting plate and attached to the left sidewalk of the cabinet.
- 7.6. Each interface panel shall allow for the connection of eight or sixteen independent field loops. A ground bus terminal shall be provided between each loop pair terminal to provide a termination for the loop lead-in cable ground wire.
- 7.7. Each interface panel shall provide a 10-position terminal block to terminate the field wires for up to two 2-channel preemption devices.
- 7.8. Lightning protection device mounting holes shall be provided to accommodate an Edco SRA-16C, or Edco SRA-6, or Edco LCA-6, or a varistor lightning protection device. Lightning protection devices shall not be provided unless specifically called for in the special provisions of this specification.

- 7.9. A cable consisting of 20 AWG twisted pair wires shall be provided to enable connection to and from the panel to a detector rack. The twisted pair wires shall be color coded red and white wire.
- 7.10. All termination points shall be identified by a unique number and silk screened on the panel.
- 7.11. Each detector rack shall accommodate rack mountable preemption devices such as EMTRAC or Opticom.
- 7.12. Each detector rack shall be powered by the cabinet power supply and be connected to the power bus assembly by means of a 12-pin Molex Robotic type connector Model# 54332-1270 or exact equivalent.

8. Cabinet Test Switches and Police Panel

- 8.1. A test switch panel shall be mounted on the inside of the main door. The test switch panel shall provide as a minimum the following:
 - a. SIGNALS ON/OFF SWITCH - In the OFF position, power shall be removed from signal heads in the intersection. The controller shall continue to operate. When in the OFF position, the MMU shall not conflict or require reset.
 - b. AUTO/FLASH SWITCH - When in the flash position, power shall be maintained to the controller and the intersection shall be placed in flash. The controller shall not be stop timed when in flash. Wired according to NEMA-TS2-2003 the MMU forces the controller to initiate the start-up sequence when existing flash.
 - c. STOP TIME SWITCH - When applied, the controller shall be stop timed in the current interval.
 - e. CONTROL EQUIPMENT POWER ON/OFF - This switch shall control the controller, MMU, and cabinet power supply AC power.
Momentary test push buttons for all vehicle and pedestrian inputs to the controller are not required. The TS2 controller to be provided with the cabinet assembly shall provide vehicular and pedestrian call inputs from its keyboard while in the standard status display.
- 8.2. The police door switch panel shall contain the following:
 - a. SIGNALS ON/OFF SWITCH - In the OFF position, power shall be removed from signal heads in the intersection. The controller shall continue to operate. When in the OFF position, the MMU shall not conflict or require reset.
 - b. AUTO/FLASH SWITCH – When in the flash position, power shall be maintained to the controller and the intersection shall be placed in flash. The controller shall be stop timed when in flash. Wired according to NEMA-TS2-1998 the MMU forces the controller to initiate the start-up sequence when exiting flash.
 - c. AUTO/MANUAL SWITCH - Cabinet wiring shall include provisions for an AUTO/MANUAL switch and a momentary push button or hand cord. The AUTO/MANUAL switch and push button or hand cord shall not be provided unless it is called for in the CUSTOMER SPECIFICATION.
 - d. COORD/FREE SWITCH - Cabinet wiring shall include provisions for COORD/FREE switch. The COORD/FREE switch shall not be provided unless it is called for in the CUSTOMER SPECIFICATON.
- 8.3. All toggle type switches shall be heavy duty and rated 15 amps minimum. Single- or double-pole switches may be provided, as required.
- 8.4. Any exposed terminals or switch solder points shall be covered with a non-flexible shield to prevent accidental contact.
- 8.5. All switch functions must be permanently and clearly labeled.

- 8.6. All wire routed to the police door-in-door and test switch push button panel shall be adequately protected against damage from repetitive opening and closing of the main door.
- 8.7. All test switch panel wiring shall be connected to the main panel via a 50-pin Molex Robotic type connector Model# 54332-5001, or exact equivalent.
- 8.8. Wiring from the main panel to the test switch panel shall be connected to the switch panel via a 30-pin Molex Robotic type connector Model# 54332-3070 or exact equivalent.

9. Controller Telemetry Interface Panel

- 9.1. A telemetry interface harness and interface panel shall be supplied with each cabinet assembly when specified in the special provisions.
- 9.2. The harness shall be a minimum of 6 feet long and shall consist of two twisted shielded pairs, 22 AWG wire with drain wire in an overall jacket, terminated to a 9-pin "D" type connector at one end. The pin out of the 9-pin connector shall be in exact accordance with the NEMA TS2 Standard. The opposite end of the harness shall be terminated on a 10-position EDCO PCB-1B or exact equal lightning protection socket base.
- 9.3. All terminal block designations and peripheral board-mounted components shall be labeled as to their number and function and shall correspond to the cabinet wiring diagrams.
- 9.4. The following signals shall be accessible from the telemetry interface panel:
 - Local controller command lines 1 & 2
 - Local controller read back lines 1 & 2
 - Master controller command lines 1 & 2
 - Master controller read back lines 1 & 2
 - Earth grounds
- 9.5. A socket mounted communication line transient protection device shall be supplied with the telemetry interface panel. The device shall be an EDCO model PC642C-008D or exact approved equivalent. The transient protection device shall be wired in series with the telemetry communication circuit.
- 9.6. Communication line impedance shall be matched to the transmitter output impedance to minimize noise on the communication lines. The panel shall allow connection of a 620 ohm resistor across the command and read back lines, where necessary.

10. Auxiliary Devices

10.1. Load Switches

- 10.1.1. Load switches shall be solid state and shall conform to the requirements of Section 6.2 of the NEMA TS2 Standard.
- 10.1.2. Signal load switches shall have a minimum rating of 10 amperes at 120 VAC for an incandescent lamp load.
- 10.1.3. The front of the load switch shall be provided with three indicators to show the input signal from the controller to the load switch.
- 10.1.4. Load switches shall be dedicated per phase. The use of load switches for other partial phases is not acceptable.
- 10.1.5. The full complement of load switches shall be supplied with each cabinet to allow for maximum phase utilization for which the cabinet is designed.

10.2. *Flashers*

- 10.2.1. The flasher shall be solid state and shall conform to the requirements of section 6.3 of the NEMA TS2 Standard.
- 10.2.2. Flashing of field circuits for the purpose of intersection flash shall be accomplished by a separate flasher.
- 10.2.3. The flasher shall be rated at 15 amperes, double pole with a nominal flash rate of 60 FPM.

10.3. *Flash Transfer Relays*

- 10.3.1. All flash transfer relays shall meet the requirements of Section 6.4 of the NEMA TS2 Standard.
- 10.3.2. The coil of the flash transfer relay must be de-energized for flash operation.
- 10.3.3. The full complement of relays shall be supplied with each cabinet to allow for maximum phase utilization for which the cabinet is designed.

10.4. *Malfunction Management Units (MMU)*

- 10.4.1. Each cabinet assembly shall be supplied with one MMU as defined by the requirements of Section 4 of the NEMA TS2 Standard.
- 10.4.2. Malfunction Management Units shall be a Type 16. The MMU shall be Econolite Control Products, Inc. Model MMU-16 (EDI Model MMU-16) or approved equal.

10.5. *Bus Interface Units (BIU)*

- 10.5.1. All BIUs shall meet the requirements of Section 8 of the NEMA TS2 Standard.
- 10.5.2. The full complement of Econolite Control Products, Inc. Model 32860G1 Bus Interface Units shall be supplied with each cabinet to allow for maximum phase and function utilization for which the cabinet is designed.
- 10.5.3. Each Bus Interface Unit shall include power on, transmit and valid data indicators. All indicators shall be LEDs.

10.6. *Cabinet Power Supply*

- 10.6.1. The cabinet power supply shall meet the requirements of Section 5.3.5 of the NEMA TS2 Standard.
- 10.6.2. The cabinet power supply shall provide LED indicators for the line frequency, 12 VDC, 12 VAC, and 24 VDC outputs.
- 10.6.3. The cabinet power supply shall provide (on the front panel) jack plugs for access to the +24 VDC for test purposes.
- 10.6.4. One Econolite Control Products, Inc. Model 1084-003 cabinet power supply shall be supplied with each cabinet assembly and shall be wired directly to the Power Bus Assembly via a 12-pin Molex Robotic type connector Model# 54332-1270 or exact equivalent.

11. Testing and Warranty

11.1. *Testing*

- 11.1.1. Each controller and cabinet assembly shall be tested as a complete entity under signal load for a minimum of 48 hours.
- 11.1.2. Each assembly shall be delivered with a signed document detailing the cabinet final tests performed.
- 11.1.3. The cabinet shall be assembled and tested by the controller manufacturer or authorized local distributor to ensure proper component integration and operation.

11.2. *Warranty*

- 11.2.1. The controller and Malfunction Management Unit shall be warranted by the manufacturer against mechanical and electrical defects for a period of two years from date of shipment. The manufacturer's warranty shall be supplied in writing with each cabinet and controller. Second party extended warranties are not acceptable.
- 11.2.2. The cabinet assembly and all other components shall be warranted for a period of one year from date of shipment.
- 11.2.3. Any defects shall be corrected by the manufacturer or supplier at no cost to the owner.