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MMU-16E TS2 Malfunction Management Unit

Description

The MMU-16E is a Malfunction Management Unit (MMU) which meets or exceeds all specifications of Section 4 of the NEMA TS2-2003 Standard. It operates in either a TS2 Type-1 or Type-2 cabinet. Both cabinets require that an MMU be interfaced to the controller via the TS2 standardized high-speed SDLC serial bus. The MMU-16E can also operate as a Type-16 or a Type-12 MMU. Type-16 mode provides 16 channels (typically 8 vehicle, 4 ped, 4 overlap), where each channel consists of three 120 VAC inputs (green/Walk, yellow, red/Don't Walk). Type-12 mode provides 12 channels (typically 8 vehicle, 4 overlap), where each channel consists of four 120 VAC inputs (green, yellow, red, Walk). Type-12 mode provides downward compatibility with a Conflict Monitor Unit (CMU) conforming to TS1. The MMU-16E can serve as an MMU in a TS2 cabinet by any manufacturer or as a spare for a CMU in any 12-channel TS1 cabinet.

Enhanced Safety

The TS2 Standard helps ensure safer traffic control operation than the older TS1 and 170/179 standards. This is due, in part, to the fact that the TS2-specified MMU provides broader fault coverage than do older CMUs. In addition to monitoring load switch outputs, the MMU-16E is in continual communication with the TS2 controller via the SDLC bus, with a data exchange every 100 ms. Both the MMU-16E and controller have access to the same diagnostic information and can put the intersection into flash, thus providing redundancy of the MMU function, should the cabinet relay system fail to operate. This communication also provides the basis for the MMU-16E Field Check function.

The MMU-16E provides a full intersection display on the front panel making most improper field signal conditions immediately recognizable. Detailed MMU-16E diagnostics can also be displayed on the screen of the controller or via the EIA-232 port to aid in troubleshooting. Conditions leading to flash beyond those specified by TS1 include the following:

- Incompatibility between the controller and MMU at the program level. The MMU cannot be more permissive than the controller.
- Minimum Yellow Clearance monitor detects a missing or Short Yellow Interval for a vehicle channel.
- Minimum Yellow + Red Clearance monitor detects a missing or short interval between the end of an active green/Walk and the beginning of the next active green for a pedestrian channel or overlap without a true yellow output.
- AC power below 95 Vrms. The MMU-16E recognizes this brownout level as potentially unsafe, even though all TS2 cabinet components are specified to operate down to 89 Vrms.
- Any malfunction of the microprocessor, RAM, or PROM in the MMU or failure of the SDLC bus or controller.
- Front panel Option Switches allow the MMU-16E to be easily configured to all cabinet setup conditions.
- Field Check function provides the technician with a direct indication of the faulty field signal outputs. It monitors for any difference between the actual load switch output and the programmed controller output. This is an extra safety feature and a powerful troubleshooting tool for the technician. Faulty signals are directly displayed.
- Dual Indications on the same channel for green and yellow, green and red, yellow and red, Walk and yellow, or Walk and red. Dual Indication monitoring is the only way to detect a no-load condition on the red output or a constantly active red signal. This fault may also result from an open-load condition on a field wire.
- Field signal Root Means Squared (RMS) voltages, monitor status, and event logs are available via the front panel EIA-232 communication port.

Features

- Meets NEMA TS2-2003 MMU Standard
- Compatible with any TS2 Type-1 or Type-2 cabinet
- Downward compatible with TS1 CMU
- Full intersection signal display
- Field Check diagnostic directly pinpoints faulty inputs
- Full event logging capabilities with Signal Sequence Log
- A key component for safer traffic control

- Recurrent Pulse monitoring responds to voltage fluctuations on load switch outputs, which result in flickering or unwanted dimming. Such conditions may reflect problems which can result in unsafe signal indications. Any indication of a problem that involves intermittent operation is extremely helpful to a technician trying to diagnose a cabinet malfunction.
- Event logging provides a detailed and accurate time-stamped record of previous faults, fault resets, AC line events, and configuration changes. A Signal Sequence Log displays all signal states for up to 30 seconds prior to the fault.
- Faults are internal to the MMU-16E, including power supply voltages. The MMU-16E performs self-diagnostics beyond those specified by TS2 at power-on, then on an ongoing basis. Diagnostics can also be operator initiated, in which case they will include all front panel display functions.

1. Specifications

1.1 TS2/TS1 Compatibility

The MMU meets all applicable Malfunction Management Unit sections of the NEMA TS2-2003 Standard. An independent testing laboratory verified that the MMU performs all functions under environmental conditions set forth by TS2. The MMU is able to operate as a Type-16 with sixteen channels (8 vehicle, 4 ped, 4 overlap) or as a Type-12 (8 vehicle, 4 overlap) with twelve channels. It is able to operate in any manufacturer's cabinet that meets TS2 or TS1 specifications. Operation is with no loss of TS2 or TS1 functionality.

2. Hardware

2.1 Enclosure

The MMU is compact to fit on limited shelf space. Overall dimensions, including mating connectors and harness, do not exceed 10.5 in. H x 4.5 in. W x 11 in. D. Model, serial number, and program information is permanently displayed on the top surface.

2.2 Electronics

- A microprocessor is used for all timing and control functions. Only the PROM for the microprocessor is socket-mounted. Socket contacts are gold plated and provide a gas-tight seal.
- User-programmed configuration settings are stored in EEPROM or via front panel DIP switches. Designs using a battery to maintain configuration data are not acceptable.
- Both sides of the printed circuit board assemblies are coated with a clear moisture-proof and fungus-proof sealant. Electrical mating surfaces are gold plated.
- All electrical components are rated by their manufacturer for the full NEMA operating temperature from -29.2°F to +165.2°F(-34° to +74°C).
- All 120 VAC field terminal inputs provide an internal impedance of at least 150K Ω at 0.5 W. All internal power supply voltages are monitored by the MMU.
- All AC voltages are measured using a True RMS voltage process.

2.3 Front Panel & Connectors

- All displays, configuration switches, and electrical connections are on the front panel of the MMU. Indicator lights are Super Bright LEDs in a water-clear T1 package. Individual red, yellow, and green indicators are provided for each channel.
- Connectors meet MIL-C-26482 and have a metallic shell, which is attached to the chassis. Electrical connections to the circuit board are via AWG #22 19-strand harness wire. For reliability and repairability, printed circuit board mounted connectors are not acceptable.
- An EIA-232 communications port is provided to communicate with the MMU. Status and historical event information is provided using a manufacturer-supplied software package.

3. Enhanced Functions

3.1 Dual Indication Monitor

Switches are provided on the front panel to enable Dual Indication monitoring on a per-channel basis. When voltages on two inputs of the same enabled channel are sensed as active for more than 400 ms, the MMU sets the output relay to the fault state, turns on a Dual Indication indicator light, and transmits the information via a SDLC response frame. In Type-12 operation, the MMU detects all simultaneous combinations of green and yellow, green and red, yellow and red, Walk and yellow, or Walk and red. In Type-16 operation, the MMU detects all simultaneous combinations of green/Walk and yellow, green/Walk and red/Don't Walk, and yellow and red/Don't Walk. A limited green/yellow Dual Indication monitoring mode is also selected to only detect simultaneous combinations of green and yellow for PP-Turn signals.

3.2 Field Check Fault Monitor

Switches are provided on the front panel to enable Field Check monitoring on a per-channel basis. When the input state sensed by the MMU for an enabled channel does not correspond with the data provided by the controller via the SDLC bus for more than 1000 ms, the MMU sets the output relay to the fault state, turns on an indicator light, and transmits the information via a SDLC response frame.

3.3 Field Check Status Monitor

A mode is provided for Field Check fault monitoring and display diagnostics during conditions of Conflict, Red Fail, Clearance Fail, or Dual Indication. A special fault indicator and the channel status display indicator(s) associated with any failed channel(s) will double-pulse every six seconds.

3.4 Recurrent Pulse Error Monitor

A Recurrent Pulse error detection function is provided to detect wave-forms on the load switch outputs leading to flickering or unwanted dimming. When a Conflict, Dual Indication, or Red Fail fault is detected with Recurrent Pulse status, the MMU sets the output relay to the fault state, turns on an indicator light, and transmits the information via a SDLC response frame. A special fault indicator and the channel status display indicator(s) associated with any failed channel(s) will double-pulse every six seconds.

3.5 External Watchdog Monitor

The MMU is able to monitor an external logic level output from the controller or other device in the cabinet. If the MMU does not sense a change in state for 1500 ms, the MMU sets the output relay to the fault state and turns on an indicator light.

3.6 Type Fault Monitor

At each power-up, the MMU verifies that the Type-12 or Type-16 operating mode set by hardware is consistent with the mode set by the last external reset.

3.7 Display Functions

The MMU keeps an event log of at least 100 events. The events consist of previous faults, MMU reset (exit from flash), AC Line events, and MMU configuration changes. A log displaying the signal states for 30 seconds prior to the last fault event is also provided.

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