

# MMU-1600

## MALFUNCTION MANAGEMENT UNIT



*Engineering Excellence!*



**10.5" High x 4.5" Wide x 11.0" Deep**

- ✎ Operates in Type 16 or Type 12 mode.
- ✎ Meets and / or exceeds all NEMA TS 2 specifications. NEMA TS 1 compatible (Type 12 operation).
- ✎ Advanced diagnostic features isolate problems.
- ✎ Data logging capability allows viewing and recording of improper voltages.
- ✎ Event logging provides a detailed, time-stamped record of time change, MMU reset, MMU configuration changes, prior failures, AC line voltages, and signal sequence characteristics.
- ✎ 24 front panel mounted DIP switches allow for easy configuration of Field Check / Dual Enables and selection of options.
- ✎ 77 front panel mounted LEDs provide a clear, concise, real-time indication of the status of all channel inputs and fault conditions.
- ✎ Front panel mounted RS-232 Communications Port facilitates computer interface.
- ✎ Extended NEMA TS 2 features which enhance the safety and operation of the MMU-1600 include Advanced Hardware Architecture, Dual Indication Monitoring, GY-Dual Indication Monitoring, Field Check Monitoring, External Watchdog Monitoring, Program Card Absent Monitoring, Display LED Test, 12 Volt DC Monitoring, Modified CVM Latch, and Type 16 Only Mode.
- ✎ Canadian Fast Flash Monitoring version available.

### Overview:

The Model MMU-1600 Malfunction Management Unit is a fully featured unit that monitors up to 16 traffic signal channels for conflicting inputs, improper sequencing, incorrect timing, and invalid signal voltage levels. The MMU-1600 is fully compliant with NEMA Standard TS 2-1998. The MMU-1600 can operate in either Type 16 mode (sixteen channels) or Type 12 mode (twelve channels). When configured to operate in Type 12 mode, the unit is downward compatible with NEMA Standard TS 1-1989.

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## MMU-1600 SERIES ENHANCED FEATURES

The following is a list of features included in Reno A & E's Model MMU-1600 Malfunction Management Unit which enhance the safety and operation of the unit. These features extend the operational capabilities of the MMU-1600 beyond the requirements set forth in NEMA Standards Publication TS 2-1998.

**Hardware Features:** The MMU-1600 unit incorporates a 16-bit microprocessor as the main processing unit and 9 microcontrollers. All 9 microcontrollers are flash based and can be reprogrammed in circuit. The main processor uses two program memory chips. These chips can be PROM, EPROM, or Flash. These two chips are socketed to facilitate easy upgrades to the unit.

One of the nine microcontrollers is dedicated to monitoring internal voltages and diagnostic signals from the other microcontrollers and the main microprocessor. This microcontroller holds the rest of the system in the reset state until the AC Line voltage and all supply voltages have been verified as being within operational ranges.

The MMU is entirely connectorized internally with the exception of the two wires to the front panel fuse. This makes the MMU very easy to assemble and maintain. The possibility of wiring errors within the unit has been eliminated.

The MMU has an internal buzzer that indicates when the main processor is not running. This will only occur very briefly during power up, 1.5 seconds after loss of AC power, and during major diagnostic failures.

**Dual Indication Monitoring:** This monitoring feature functions in the manner that its name implies. It monitors for simultaneously active inputs of Green (Walk), Yellow, or Red (Don't Walk) on the same channel. A set of switches on the front panel labeled FIELD CHECK / DUAL ENABLES is provided to allow Dual Indication monitoring to be enabled on a per channel basis.

**Type 12** – When the MMU is operating in this mode: Dual Indication monitoring detects simultaneously active inputs of Green and Yellow, Green and Red, Yellow and Red, Walk and Yellow, or Walk and Red on the same channel. When any two inputs of a channel are sensed as active for more than 1000 milliseconds, the MMU transfers the Output relay contacts to the fault condition and illuminates the DUAL IND indicator.

**Type 16** – When the MMU is operating in this mode: Dual Indication monitoring detects simultaneously active inputs of Green and Yellow, Green and Red, or Yellow and Red on the same channel. When any two inputs of a channel are sensed as active for more than 1000 milliseconds, the MMU transfers the Output relay contacts to the fault condition, illuminates the DUAL IND indicator, and sets the Spare Bit #2 bit (bit 68) of the Type 129 Frame to 1.

Dual Indication monitoring is disabled when the Red Enable input is not active or if the Load Switch Flash bit (bit 112) of the Type 0 Frame is set to 1.

The MMU remains in this fault condition until the unit is reset by the activation of the front panel reset switch or the activation of the Reset input. An MMU Power Failure does not reset the MMU when it has been triggered by detection of Dual Indications on a channel prior to the MMU Power Failure.

**GY-Dual Indication Monitoring:** This monitoring function detects simultaneously active inputs of Green and Yellow field signal inputs on the same channel. When the Green and Yellow inputs of a channel are sensed as active for more than 1000 msec the MMU transfers the Output relay contacts to the fault condition, illuminates the DUAL IND indicator, and sets the Spare Bit #2 bit (bit 68) of the Type 129 Frame to 1.

The MMU remains in this fault condition until the unit is reset by the activation of the front panel reset switch or the activation of the Reset input. An MMU Power Failure does not reset the MMU when it has been triggered by detection of GY-Dual Indications on a channel prior to the MMU Power Failure. GY-Dual Indication Monitoring may be enabled concurrently with Dual Indication Monitoring.

GY-Dual Indication Monitoring is enabled by the use of the front panel option switch labeled GY ENABLE. When the GY-Dual Indication Monitoring option is enabled, all channels which have the front panel FIELD CHECK/DUAL ENABLE switches set to OFF will be individually monitored for simultaneously active Green and Yellow inputs. All channels that have the front panel FIELD CHECK/DUAL ENABLE switches set to ON will function as described above in Dual Indication Monitoring.

GY-Dual Indication monitoring is disabled when the Red Enable input is not active or if the Load Switch Flash bit (bit 112) of the Type 0 Frame is set to 1.

**Field Check Monitoring:** This monitoring function combines information about active field inputs with information received through the Port 1 communications between the Controller Unit and the MMU in a TS2 Cabinet Assembly. The MMU will receive a Type 0 Frame from the Controller Unit (Type 1 or Type 2 CU) that contains an image of the controller output commands to the load switches.

When the field signal input states detected as active or inactive by the MMU do not correspond with the information received from the Controller Unit in the Type 0 Frame for 10 consecutive 100 millisecond periods, the MMU will enter the fault mode, transfer the Output relay contacts to the Fault position, illuminate the FIELD CHK indicator, and set the Spare Bit #1 bit (bit 67) of the Type 129 Frame to 1. The MMU remains in this fault condition until the unit is reset by the activation of the front panel reset switch or the activation of the Reset input. An MMU Power Failure does not reset the MMU when it has been triggered by detection of Field Check fault prior to the MMU Power Failure. Field Check Monitoring is enabled concurrently with Dual Indication Monitoring.

Field Check Monitoring is enabled for each channel, individually, through the use of front panel switches labeled FIELD CHECK / DUAL ENABLES. Field Check Monitoring is disabled when the RED ENABLE input is not active.

**External Watchdog Monitoring:** This monitoring function detects an optional external watchdog output from a Controller Unit or other external cabinet device. The external source should toggle the EXTERNAL WATCHDOG input logic state at least once every 1000 msec. If the MMU does not receive a change in state on the EXTERNAL WATCHDOG input for 1500 msec, the MMU will transfer the Output relay contacts to the Fault position, flash the CVM/WD LED on the front panel, and latch the state of all inputs. When operating in the Type 16 mode, Bit 70 (Spare Bit #4) of Frame 129 shall be set to indicate an External Watchdog fault has been detected.

The MMU remains in this fault condition until the unit is reset by the activation of the front panel reset switch or the activation of the Reset input. An MMU Power Failure will not reset the MMU when it has been triggered by the detection of an External Watchdog fault prior to the MMU Power Failure.

This monitoring function is enabled by use of the front panel option switch labeled WD ENABLE. The EXTERNAL WATCHDOG input is connected to pin "S" on Connector B (Spare 2).

**Program Card Absent Monitoring:** If the Program Card is not present or not seated properly in the connectors, the MMU unit will enter the fault mode, transfer the Output relay contacts to the Fault position, and illuminate the PRGM CARD indicator on the front panel. The MMU remains in this fault condition until the program card is properly inserted and the unit is reset by the activation of the front panel reset switch or the activation of the Reset input. An MMU Power Failure will reset the MMU when it has been triggered by the detection of a Program Card fault prior to the MMU Power Failure.

**Display LED Test:** All of the LEDs on the front panel can be illuminated by pressing the front panel reset switch or activating the Reset input. When the reset switch is pressed or the Reset input activated, all of the LEDs will illuminate for 300 milliseconds. This allows the user to insure that all displays are functioning correctly.

**12 Volt DC Monitoring:** This feature converts the +24V Monitor II (Connector B - pin "R") to a +12V Monitor. This feature can be very useful in TS2 cabinets with 12 VDC supplies. The MMU can now monitor a +12VDC supply as well as a +24 VDC supply. The operation of the input is the same as if it were the +24V Monitor II; only the voltage levels are changed.

A voltage greater than +11.5 volts DC applied to the +24 Volt Monitor II input is recognized by the MMU as adequate for proper operation of the CA. A voltage of less than +10.75 volts DC applied to the +24 Volt Monitor II input is recognized by the MMU as inadequate for proper operation of the CA.

When the +24 Volt Monitor II input is detected as inadequate for more than 175 milliseconds, the MMU transfers the Output relay contacts to the fault condition and sets the +24 Volt Monitor II bit (bit 59) of the Type 129 Frame to 1. The time interval between the beginning of the inadequate voltage level and the transfer of the Output relay contacts to the fault condition does not exceed 450 milliseconds.

Restoration of proper voltage level resets the +24V Monitor II portion of the MMU. A failure during the programmed Minimum Flash time or during an MMU Power Failure does not cause a fault condition.

A method of programming is provided on the programming card to cause the +24 volt DC failures to latch in the fault condition until the unit is reset by the activation of the front panel reset switch or activation of the Reset input. This also applies when the +24V Monitor II input has been converted to a +12V Monitor. A latched +12 volt DC failure is not reset by an MMU Power Failure.

Application of a True (Low) state to the +24V Monitor Inhibit input inhibits the operation of the +12 Volt Monitor.

This monitoring function is enabled by a front panel option switch labeled CONVERT 24V-2 TO 12VDC.

**Modified CVM Latch:** This feature is useful in cabinets where the CVM input may not always be valid within the programmed Minimum Flash time and where latched CVM failures is desired. In the modified mode of operation, the MMU will not latch a CVM failure until the CVM input has been valid for more than 175 milliseconds.

This function is enabled by a front panel option switch labeled MODIFIED CVM LATCH. This feature only has an effect if the CVM Latch jumper is installed on the programming card.

**Type 16 Only Mode:** This feature is useful in cabinets where the user is retrofitting a TS 2 monitor into a TS 1 cabinet and wants to use the Type 16 mode, but the existing Connector A harness does not have a wire for pin "HH" (Type Select). Activating this feature forces the MMU to operate in the Type 16 mode regardless of the logic level on the Type Select input. While this feature is on, the TYPE 12 LED will show the Function Disabled indication (50 milliseconds on, once every two seconds).