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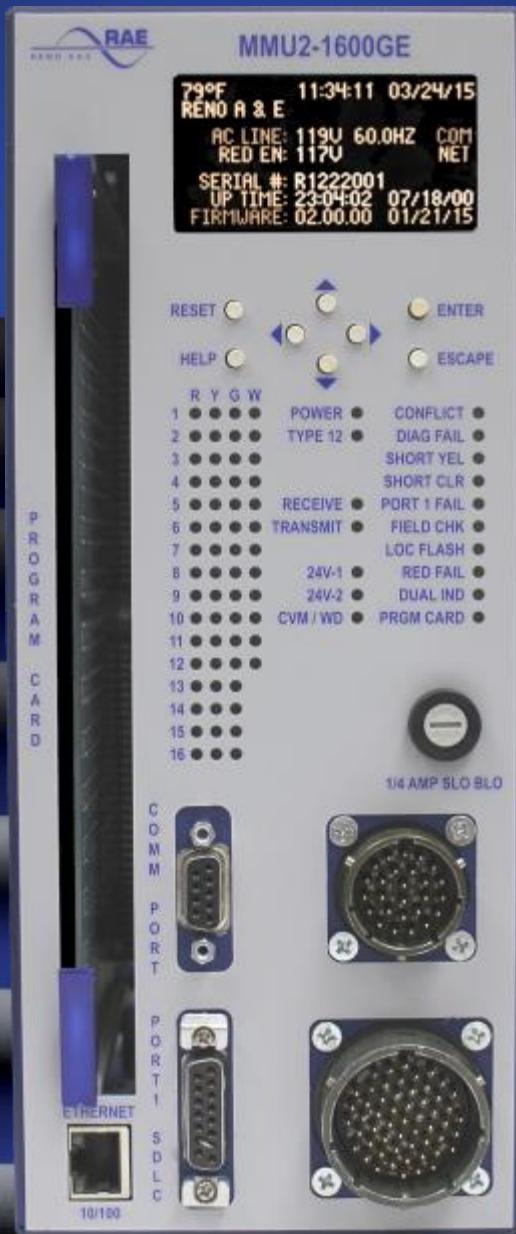
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MMU2-1600GE SERIES OPERATION MANUAL

Firmware Version 02.00.05

16 Configuration Types of Flashing Yellow Arrows



NEMA TS 2 Amendment 4-2012 Malfunction Management Unit

IMPORTANT NOTE

This Reno A&E Malfunction Management Unit was designed, built, inspected, and tested to ensure its proper operation. It is Reno A&E's recommendation that each Malfunction Management Unit be tested at least annually to ensure compliance with factory and NEMA specifications and proper operation and that the results of this testing be documented.

MMU2-1600G SERIES OPERATION MANUAL

TABLE OF CONTENTS

| | | |
|--------|----------------------------------------------------------|----|
| 1.0 | GENERAL DESCRIPTION | 6 |
| 2.0 | GENERAL CHARACTERISTICS | 7 |
| 2.1 | Inputs | 7 |
| 2.1.1 | AC Line | 7 |
| 2.1.2 | AC Neutral | 7 |
| 2.1.3 | Earth Ground | 7 |
| 2.1.4 | Field Terminals (Reds, Yellows, Greens, and Walks) | 7 |
| 2.1.5 | Red Enable | 8 |
| 2.1.6 | Logic Ground | 8 |
| 2.1.7 | +24V Monitor I | 8 |
| 2.1.8 | +24V Monitor II | 8 |
| 2.1.9 | 24V Monitor Inhibit | 8 |
| 2.1.10 | Controller Voltage Monitor (CVM) | 8 |
| 2.1.11 | Type Select | 8 |
| 2.1.12 | Local Flash Status | 9 |
| 2.1.13 | Port 1 Disable | 9 |
| 2.1.14 | Reset | 9 |
| 2.1.15 | Cabinet Interlock | 9 |
| 2.2 | Outputs | 9 |
| 2.2.1 | Output Relay | 9 |
| 2.2.2 | Start Delay Relay | 9 |
| 2.3 | Programming Card | 10 |
| 2.3.1 | Channel Compatibility | 10 |
| 2.3.2 | Minimum Flash | 10 |
| 2.3.3 | Minimum Yellow Change Channel Disable | 10 |
| 2.3.4 | Voltage Monitor Latch | 10 |
| 2.3.5 | Serial EEPROM | 10 |
| 2.4 | Features | 10 |
| 2.4.1 | Monitor Power Failure | 10 |
| 2.4.2 | Minimum Flashing Indication | 11 |
| 2.4.3 | Reset | 11 |
| 2.4.4 | Type 16 Only Mode | 11 |
| 2.4.5 | COM Port | 11 |
| 2.4.6 | Ethernet Port | 11 |
| 2.4.7 | Temperature Sensor | 12 |
| 2.4.8 | Real Time Clock | 12 |
| 2.4.9 | Up Time Accumulator | 12 |
| 2.4.10 | Configuration Monitoring (Beeping Monitor) | 12 |
| 2.4.11 | Factory Settings | 13 |
| 2.4.12 | User Unit Information | 13 |
| 2.5 | Fault Monitoring | 13 |
| 2.5.1 | Conflict Monitoring | 13 |
| 2.5.2 | Red Fail Monitoring | 14 |
| 2.5.3 | Dual Indication Monitoring | 14 |
| 2.5.4 | GY-Dual Indication Monitoring | 15 |
| 2.5.5 | Short Yellow Monitoring | 16 |
| 2.5.6 | Short Clearance Monitoring | 16 |
| 2.5.7 | Field Check Monitoring | 17 |
| 2.5.8 | Port 1 Fail Monitoring | 17 |
| 2.5.9 | +24 Volt Monitor I | 18 |
| 2.5.10 | +24 Volt Monitor II | 18 |
| 2.5.11 | Controller Voltage Monitor | 19 |
| 2.5.12 | Local Flash | 19 |
| 2.5.13 | External Watchdog Monitoring | 20 |
| 2.5.14 | Programming Card Absent Monitoring | 20 |
| 2.6 | Testing Modifiers | 20 |
| 2.6.1 | Flashing Don't Walk Monitoring | 20 |
| 2.6.2 | PPLT5 Monitoring | 20 |
| 2.6.3 | Flashing Yellow Arrow Monitoring (FYA) | 21 |
| 2.6.4 | LED Thresholds | 22 |
| 2.6.5 | Per Channel Red Enable | 22 |
| 2.6.6 | Modified CVM Latch | 23 |
| 2.6.7 | 12 Volt DC Monitoring | 23 |

| | | |
|---------------|---------------------------------------------------------------|----|
| 2.6.8 | Disable Local Flash | 23 |
| 2.6.9 | Flashing Green (Canadian Fast Flash)..... | 23 |
| 2.6.10 | Channels with Pedestrian Displays..... | 23 |
| 2.7 | Event Logging | 24 |
| 2.7.1 | Time Change Log | 24 |
| 2.7.2 | Monitor Reset Log | 24 |
| 2.7.3 | Configuration Event Log | 24 |
| 2.7.4 | Prior Faults Log | 24 |
| 2.7.5 | AC Line Log..... | 24 |
| 2.7.6 | Signal Sequence Log | 24 |
| 2.7.7 | Logging Options..... | 25 |
| 2.7.7.1 | Log Field Changes | 25 |
| 2.7.7.2 | Log Local Flash Events | 25 |
| 2.7.7.3 | Log CVM Events | 25 |
| 2.8 | Diagnostics | 25 |
| 2.8.1 | Memory | 25 |
| 2.8.2 | Microprocessor Monitor | 25 |
| 2.8.3 | Internal Voltage Monitors..... | 25 |
| 2.8.4 | Diagnostic Codes..... | 26 |
| 3.0 | SPECIFICATIONS | 27 |
| 3.1 | Physical | 27 |
| 3.2 | Electrical | 27 |
| 3.3 | Timing Functions | 28 |
| 3.4 | Connector Pin Assignments | 29 |
| 3.5 | Programming Card Pin Assignments | 31 |
| 3.6 | Programming Card Minimum Flash Programming | 31 |
| 4.0 | USER INTERFACE | 32 |
| 4.1 | Graphic Display Menu Structure | 33 |
| 4.2 | Front Panel Display and Pushbuttons..... | 34 |
| 4.3 | Help System | 34 |
| 4.4 | Run Time Display | 35 |
| 4.4.1 | Normal | 35 |
| 4.4.2 | Fault | 35 |
| 4.4.3 | Changes Pending | 35 |
| 4.4.4 | Upgrade Pending | 35 |
| 4.5 | Voltage Displays | 35 |
| 4.6 | Main Menu | 35 |
| 4.6.1 | Identification Menu | 36 |
| 4.6.1.1 | User Unit Information | 36 |
| 4.6.1.2 | Factory Unit Information | 36 |
| 4.6.1.3 | Ethernet Settings | 36 |
| 4.6.2 | Configuration Menu | 37 |
| 4.6.2.1 | Fault Monitoring Menu | 37 |
| 4.6.2.1.1 | Start Configuration | 37 |
| 4.6.2.1.2 | Cancel Configuration | 37 |
| 4.6.2.1.3 | Save Configuration | 37 |
| 4.6.2.1.4 | Rollback Changes | 37 |
| 4.6.2.1.5 | Testing Defaults | 38 |
| 4.6.2.1.6 | Configuration CRC | 38 |
| 4.6.2.1.7 | Config Settings Menu | 38 |
| 4.6.2.1.7.1 | Programming Card Menu | 38 |
| 4.6.2.1.7.1.1 | Per Channel Permissives | 38 |
| 4.6.2.1.7.1.2 | Minimum Yellow Change Disable / Latches / Minimum Flash | 38 |
| 4.6.2.1.7.2 | Dual Indication / Field Check | 39 |
| 4.6.2.1.7.3 | Per Channel Red Enables | 39 |
| 4.6.2.1.7.4 | Flashing Don't Walk Monitoring | 39 |
| 4.6.2.1.7.5 | Permissive Left Turn Settings | 39 |
| 4.6.2.1.7.6 | FYA Options | 41 |
| 4.6.2.1.7.7 | Threshold Settings | 41 |
| 4.6.2.1.7.8 | Logging Options | 41 |
| 4.6.2.1.7.9 | Others / Miscellaneous Location Settings | 41 |
| 4.6.2.1.8 | Factory Settings | 42 |
| 4.6.2.1.9 | Clear All Settings | 42 |
| 4.6.2.1.10 | Wizard | 42 |
| 4.6.2.1.10.1 | General Questions | 42 |
| 4.6.2.1.10.2 | Warning Screens | 47 |
| 4.6.2.1.10.3 | Almost Done | 47 |
| 4.6.2.2 | General Settings | 47 |
| 4.6.2.2.1 | AC Logging Events | 47 |

| | | |
|-------------|---------------------------------------------|----|
| 4.6.2.2.2 | User Unit Information | 47 |
| 4.6.2.2.3 | Factory Unit Information | 47 |
| 4.6.2.2.4 | Comm Port Settings | 48 |
| 4.6.2.2.5 | Ethernet Settings | 48 |
| 4.6.3 | Logging System | 48 |
| 4.6.3.1 | View Logs | 48 |
| 4.6.3.1.1 | View Date & Time Log | 48 |
| 4.6.3.1.2 | View AC Line Log | 48 |
| 4.6.3.1.3 | View Resets Log | 48 |
| 4.6.3.1.4 | View Configurations Log Menu | 49 |
| 4.6.3.1.4.1 | View Configurations Settings | 49 |
| 4.6.3.1.4.2 | Compare Current To Pending | 49 |
| 4.6.3.1.4.3 | Compare Configuration To Current | 49 |
| 4.6.3.1.4.4 | Compare Configuration To Prior | 49 |
| 4.6.3.1.4.5 | View Prior Faults Log | 49 |
| 4.6.3.1.5 | View Signal Sequence Log | 50 |
| 4.6.3.2 | Clear Logs | 50 |
| 4.6.3.3 | Clear All Logs | 50 |
| 4.6.3.4 | AC Logging Events Thresholds | 50 |
| 4.6.4 | Date & Time Menu | 50 |
| 4.6.4.1 | View / Set Date and Time | 50 |
| 4.6.4.2 | View / Set Daylight Saving Time Ahead | 51 |
| 4.6.4.3 | View / Set Daylight Saving Time Back | 51 |
| 4.6.4.4 | View Up Time | 51 |
| 4.6.5 | Real Time Monitor Status Menu | 51 |
| 4.6.5.1 | Channels 1 - 6 | 51 |
| 4.6.5.2 | Channels 7 - 12 | 51 |
| 4.6.5.3 | Channels 13 - 16 | 51 |
| 4.6.5.4 | Other AC and Miscellaneous Inputs | 51 |
| 4.6.5.5 | DC Inputs | 51 |
| 4.6.6 | Diagnostic Info | 52 |
| 4.6.6.1 | LED Test Settings | 52 |
| 4.6.6.2 | Screen Test | 52 |
| 4.6.6.3 | Fault Codes | 52 |
| 4.6.6.4 | Diagnostic SDLC Frames Menu | 52 |
| 4.6.6.5 | Firmware Versions | 52 |
| 4.6.6.6 | Diagnostic Statistics Menu | 53 |
| 4.6.6.6.1 | SDLC Statistics | 53 |
| 4.6.6.6.2 | Comm Port Statistics | 53 |
| 4.6.6.6.3 | Ethernet Port Statistics | 53 |
| 4.6.6.6.4 | DC Processor Communication Statistics | 53 |
| 4.6.6.6.5 | Speed Statistics | 53 |
| 4.6.6.7 | Factory Diagnostics | 53 |
| 4.7 | Front Panel LED Indicators | 54 |
| 4.7.1 | Field Status Indicators | 54 |
| 4.7.2 | Power / Type Indicators | 54 |
| 4.7.3 | Transmit / Receive Indicators | 54 |
| 4.7.4 | Fault Indicators | 54 |
| 4.7.5 | Function Disabled Indication | 55 |
| 4.8 | Audible Buzzer | 55 |
| 4.8.1 | Critical Failure | 55 |
| 4.8.2 | Configuration Change | 55 |
| 4.9 | FIRMWARE UPGRADE | 56 |

1.0 GENERAL DESCRIPTION

This product manual was written for people installing, operating, and maintaining the Reno A&E Model MMU2-1600GE Malfunction Management Unit (monitor).

The Reno A&E MMU2-1600G was designed to meet or exceed the standards defined in Section 4 of the NEMA Standards Publication TS 2-2003 and Amendment 4-2012. Section 4 responds to the need for a monitor to accomplish the detection of, and response to, improper and conflicting signals and improper operating voltages in a Controller Assembly (CA). This standard provides interchangeability between units of different manufacturers and downward compatibility to NEMA Standards Publication TS 1-1989. Amendment 4-2012 defines eight types of Flashing Yellow Arrow (FYA) operation. The MMU2-1600G supports the eight FYA types defined in Amendment 4 and eight additional types of FYA operation.

The MMU2-1600G detects the presence of voltage on conflicting field connection terminals, the absence of proper voltages on all of the signal field connection terminals of a channel, and monitors for the presence of satisfactory operating voltages within the Controller Unit (CU) and the monitor itself. If any of these conditions exist or are out of tolerance for the minimum time defined in Section 4 of the NEMA Standards Publication TS 2-2003, the Output relay's normally open contacts will transfer from the no fault state (relay energized) to the fault state (relay de-energized). The closure of the Output relay contacts will cause the transfer of the traffic signals to Flashing Operation. The fault is recorded by the MMU-1600G and displayed on the appropriate LED indicators.

The MMU2-1600G will operate in one of two modes depending on the signal level on the Type Select input. If the Type Select input is at Logic Ground potential, the monitor will operate as a Type 16 monitor with sixteen channels, otherwise it will operate as a Type 12 monitor with twelve channels.

Type 16 - Each of the sixteen channels monitors three 120 volt AC outputs; Green / Walk, Yellow, and Red / Don't Walk.

Type 12 - Each of the twelve channels monitors four 120 volt AC outputs; Green, Yellow, Walk, and Red.

For TS 2 type operation the MMU2-1600G is usually configured as a Type 16 monitor. The Type 16 monitor is intended for those applications in which there are three circuits per channel and the monitor channels have been wired in a one-to-one correspondence with the load switches, as defined in Section 5.5.3, Paragraph 9 of the NEMA Standards Publication TS 2-2003. The Type 12 monitor is intended to provide downward compatibility with a 12 channel conflict monitor unit (CMU) conforming to TS 1-1989.

The signal monitor portion of the monitor is capable of checking for the presence of voltage on conflicting field connection terminals in the Controller Assembly. For the purpose of conflict determination, a signal on any of the Green, Yellow, or Walk inputs associated with a channel shall be considered as that channel being active.

The signal monitor portion of the monitor is also capable of checking for the absence of any required signal voltage on each channel at the field connection terminals in the Controller Assembly. For this purpose a signal on the Green, Yellow, Walk, or Red/Don't Walk inputs associated with a channel shall be considered as that channel being active.

The voltage monitor portion of the monitor is capable of checking the Controller Unit Voltage Monitor output that indicates satisfactory operating voltage in the Controller Unit and the +24 volt direct current inputs.

The Model MMU2-1600G is fully programmable. The monitor has a unique graphics based Organic Light Emitting Diode (OLED) display. The OLED display allows access to all configuration settings, real-time monitor status with applicable AC and DC voltages, advanced diagnostic information, all logs including the most current signal sequence log, and context sensitive help screens.

An interchangeable programming card is provided to allow the assignment of permissive or compatible channels. Programming is accomplished through the use of soldered wire jumpers on the programming card. The programming card may be used in a monitor operating in either Type 16 or Type 12 mode. The programming card can be inserted into the monitor through a slot in the front panel. The programming card also contains a serial EEPROM. This device is used to store programming information not set by the wire jumpers. Features stored in the serial EEPROM include Flashing Don't Walk Monitoring, Co-Channel Childs, Per Channel Red Enable, Location, Unit ID, Agency ID, IP Address, and others.

When configured in the Type 16 mode and connected to a TS 2 Controller Unit, the monitor has the ability to exchange information in a standardized format with the Controller Unit in real time through the Port 1 interface. The monitor and the Controller Unit perform redundant checks on each other through messages defined in the TS 2 Standard. The Controller Unit can access monitor information including field signal input status, permissive programming, and fault status. This gives the Controller Unit the capability to function as a backup monitor and make enhanced event logging, remote intersection monitoring, and remote diagnostics possible. Likewise, the monitor receives information from the Controller Unit corresponding to Controller Unit output commands to the various load switches. Access to this information allows the monitor to more accurately respond to and diagnose fault situations.

Requirements outlined in the TS 2 Standard provide for messages to be generated by the Controller Unit and the monitor, which effectively extend the communications capabilities of a standard assembly. The monitor utilizes these message facilities to provide the highest level of enhanced application specific diagnostic reporting and monitoring.

The Model MMU2-1600G Series is comprised of the following monitors:

| | |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Model MMU2-1600G (Reno USA) | For applications calling for a NEMA TS 2-2003 compliant Malfunction Management Unit with integral graphics display. |
| Model MMU2-1600G (Reno Canada) | For applications calling for a NEMA TS 2-2003 compliant Malfunction Management Unit with integral graphics display and Canadian Fast Flash monitoring. |
| Model MMU2-1600GE (Reno USA) | For applications calling for a NEMA TS 2-2003 compliant Malfunction Management Unit with integral graphics display and optional Ethernet network connector. |
| Model MMU2-1600GE (Reno Canada) | For applications calling for a NEMA TS 2-2003 compliant Malfunction Management Unit with integral graphics display and Canadian Fast Flash monitoring and optional Ethernet network connector. |

2.0 GENERAL CHARACTERISTICS

2.1 INPUTS

2.1.1 AC Line

The over-current protected side of 120 volt AC 60 hertz source. This input (Connector A - Pin A) is used to generate the voltages required to operate the monitoring logic. The monitor has a front panel mounted over-current protection device in the 120 volt AC input to the unit. This fuse is a 1/4 AMP SLO-BLOW and should only be replaced with a fuse of the same type and value.

Typical Connection: Cabinet AC Line power source.

2.1.2 AC Neutral

The unfused and unswitched return side of the 120 volt AC 60 hertz power source. This input (Connector A - Pin V) is the referenced signal for all field terminal voltage sensing inputs. This input is not connected to Logic Ground or Earth Ground within the unit.

Typical Connection: Cabinet AC Neutral.

2.1.3 Earth Ground

The monitor has an input terminal (Connector A - Pin U) providing an independent connection to the chassis of the unit. This input is not connected to Logic Ground or AC Neutral within the unit.

Typical Connection: Cabinet Earth Ground.

2.1.4 Field Terminals (Reds, Yellows, Greens, and Walks)

The field terminal inputs are where the Red, Yellow, Green, and Walk indications are connected to the monitor. The inputs used and how they are used is determined by the state of the Type Select input (See Section [2.1.11](#)).

Type 16: Three inputs are provided for each channel to permit the monitoring of voltages at the Green, Yellow, and Red signal field terminals. If the channel is used to monitor pedestrian indication, they are connected Don't Walk to Red, Pedestrian Clearance to Yellow, and Walk to Green.

Type 12: Four inputs are provided for each channel to permit the monitoring of voltages at the Green, Yellow, Red, and Walk signal field terminals.

The thresholds used to determine the ON and OFF states of the field terminals can be modified from the standard (incandescent) thresholds to ones more appropriate for LED field displays. The LED thresholds are more restrictive than the standard thresholds. Therefore, you will not miss a fault using the LED thresholds that would have been detected using the standard thresholds.

In the Standard Mode (Incandescent Field Displays):

A Green, Yellow, or Walk signal input is sensed as ON when it exceeds 25V_{RMS} and a signal input is sensed as OFF when it is less than 15V_{RMS}. Signals between 15V_{RMS} and 25V_{RMS} may be in either state.

A Red signal input is sensed as ON when it exceeds 70V_{RMS} and a signal input is sensed as OFF when it is less than 50V_{RMS}. Signals between 50V_{RMS} and 70V_{RMS} may be in either state.

In the LED mode (LED Field Displays):

For the purpose of testing for Conflicts, Multiple Indications, and Flashing Don't Walk Monitoring, a Green, Yellow, Red, or Walk signal input is sensed as ON when it exceeds 25V_{RMS} and a signal input is sensed as OFF when it is less than 15V_{RMS}. Signals between 15V_{RMS} and 25V_{RMS} may be in either state.

For the purpose of testing for Red Fails, Co-Channel Childs, Short Yellows, and Short Clearance, a Green, Yellow, Red, or Walk signal input is sensed as ON when it exceeds 70V_{RMS} and a signal input is sensed as OFF when it is less than 50V_{RMS}. Signals between 50V_{RMS} and 70V_{RMS} may be in either state.

When the load connected to the sensing input of the monitor exhibits high impedance characteristics such as those caused by some LED signal displays or burned out lamps, it may be necessary to place a low impedance device (load resistor) external to the unit between the unit input and AC Neutral. See Section 6.2.4 of NEMA Standards Publication TS 2-2003.

Typical Connections: Field terminals for channel Reds, Yellows, Greens, and Walks as appropriate.

2.1.5 Red Enable

The presence of the proper voltage at this terminal (Connector B - Pin a) enables the monitor to detect the absence of voltage on all field signal inputs of a channel. The absence of the proper voltage inhibits the detection of the absence of voltage on all field signal inputs of a channel. This input is considered enabled when the input voltage exceeds 89V_{RMS} at the Red Enable input. This function is considered not enabled when the input voltage is less than 70V_{RMS} at the Red Enable input.

The presence of the proper voltage at this terminal also enables Minimum Yellow Change / Red Clearance Interval Monitoring and Field Check / Dual Indication Monitoring. The absence of the proper voltage at this terminal inhibits Minimum Yellow Change / Red Clearance Interval Monitoring.

The monitor will not recognize state changes of the Red Enable input while AC power is not valid. This ensures that short power interruptions do not cause unintended state changes of the Red Enable input.

Typical Connection: Control point that has 120VAC when the cabinet is in normal operation.

2.1.6 Logic Ground

A voltage reference point and current return for the Reset input, Controller Voltage Monitor input, +24V Monitor I input, +24V Monitor II input, Type Select input, +24V Monitor Inhibit input, Local Flash Status input, and Port 1 Disable input as well as the Port 1 SDLC communications signals. This termination (Connector A - Pin T) is not connected to either the AC Neutral or Earth Ground within the unit.

Typical Connection: Power Supply DC Common and/or Controller Logic Ground.

2.1.7 +24V Monitor I

+24V Monitor I (Connector A - Pin S) is monitored to assure a proper +24 volt DC level.

Typical Connection: Power Supply +24VDC or Controller +24VDC Output.

2.1.8 +24V Monitor II

+24V Monitor II (Connector B - Pin R) is monitored to assure a proper +24 volt DC level. This input can optionally be used to monitor a +12VDC supply (detector power) if the 24V-2 to 12VDC feature is enabled.

Typical Connection: Power Supply +24VDC, Controller +24VDC Output, or Power Supply +12VDC.

2.1.9 24V Monitor Inhibit

+24V Monitor Inhibit input (Connector A - Pin n) is a logic level input used to disable monitoring of the +24V Monitor I and +24V Monitor II inputs. Application of a True (Low) state to this input inhibits the operation of the +24 Volt Monitor and sets the +24 Volt Monitor Inhibit bit (bit 60) of the Type 129 Frame to 1.

Typical Connection: Unterminated or tied to +24VDC.

2.1.10 Controller Voltage Monitor (CVM)

The Controller Voltage Monitor input (Connector A - Pin V) is a logic level input. This input must stay in a low state (nominal 0 volts) for normal signal operation. When high or floating, the monitor will be in the fault condition. This input is sometimes used by controllers to perform time of day flash operations. In this case, the 24V Latch jumper on the program card cannot be installed for proper operation.

Typical Connection: Controller CVM Output

2.1.11 Type Select

The monitor operates as a Type 16 monitor with sixteen channels when the Type Select input (Connector A - Pin HH) is at logic True (Low) state; otherwise it operates as a Type 12 monitor with twelve channels.

Type 16: When configured for Type 16 operation, each channel has the capability of monitoring a Green (Walk), a Yellow, and a Red (Don't Walk) field signal output at the Terminals and Facilities field terminals. Type 16 operation is intended for those applications in which there are three circuits per channel and the monitor channels have been wired in a one-to-one correspondence with the load switches, as defined in Section 5.5.3, Paragraph 9 of the NEMA Traffic Controller Assemblies Standards Publication TS 2-2003.

Type 12: When configured for Type 12 operation, each channel has the capability of monitoring a Green, a Walk, a Yellow, and a Red field signal output at the Terminals and Facilities field terminals. Type 12 operation is intended for those applications in which downward compatibility with 12 channel Conflict Monitor Units (CMU) conforming to NEMA Traffic Control Systems Publication TS 1-1989 is required. All Port 1 communications errors are ignored when the monitor is configured to operate as a Type 12 monitor.

Typical Connection: Logic Ground for Type 16 operation. Unterminated or tied to +24VDC for Type 12 operation.

2.1.12 Local Flash Status

The Local Flash Status input (Connector B - Pin c) is a logic level input. When this input is in the low state (nominal 0 volts), the monitor will transfer the Output Relay contacts to the fault state and set the Local Flash Status bit (bit 79) in the Type 129 Frame to 1. At all other times, the Local Flash Status bit of the Type 129 Frame is set to 0.

Typical Connection: Police Panel flash switch and/or inside cabinet flash switch

2.1.13 Port 1 Disable

The Port 1 Disable input (Port 1 SDLC Connector - Pin 10) is a logic level input. When this signal is in the low state (nominal 0 volts), the monitor will ignore Port 1 SDLC communications errors. Port 1 SDLC communications errors are always ignored during type 12 operation.

Typical Connection: Unterminated when Port 1 SDLC communications will be used. Logic Ground when Port 1 SDLC communications are not used in Type 16 operation.

2.1.14 Reset

The Reset input (Connector A - Pin BB) is a logic level input. When this input transitions to the low state (nominal 0 volts), a fault reset is performed.

Typical Connection: Unterminated or tied to +24VDC. Should be used only for automated testing.

2.1.15 Cabinet Interlock

The monitor has two terminals internally connected to indicate the presence of the unit to external circuitry. These terminals are identified as Cabinet Interlock A (Connector A - Pin CC) and Cabinet Interlock B (Connector A - Pin DD).

Typical Connection: Interlock circuitry that will not allow the cabinet to operate normally with the monitor removed.

2.2 OUTPUTS

2.2.1 Output Relay

The Output relay of the monitor has two sets of isolated Form C contacts. These relay contacts are capable of switching all loads in the range from two milliamps at 18 volts DC to three amperes at 135V_{RMS} AC.

The Normally Open (N.O.) contacts of the Output relay are the contacts that are open when the unit is in the No Fault state and all voltages are sufficient for proper operation of the Controller Assembly. The relay coil is energized in the No Fault state.

Prior to the monitor transferring the Output relay contacts from the Fault state to the No Fault state, a Transition state with a duration of 500 milliseconds occurs. During the Transition state the Output relay contacts are the same as the Fault state and the monitor sets the Start-Up Flash Call bit (bit 80) of the Type 129 Frame to 1. At all other times the Start-Up Flash Call bit of the Type 129 Frame is set to 0.

Typical Connection: One set of contacts is used to control the flash transfer relays the other is usually used to apply stop timing to the controller.

2.2.2 Start Delay Relay

The Start-Delay relay has one set of Form C relay output contacts. These relay contacts are capable of switching all loads in the range from 2 milliamps at 18 volts DC to 3 amperes at 135V_{RMS} AC.

The monitor includes a means of detecting a loss of AC Line power. Upon restoration of AC Line following a monitor power loss, the Start-Delay relay maintains continuity between its Common and Normally Open contacts for a period of 2.0 ±0.5 seconds. Following this 2.0 second time period, the Start-Delay relay enables continuity to occur between its Common and Normally Closed contacts.

The operation of the Start-Delay relay normally results in the initiation of a start-up sequence within the Control Unit by interrupting the AC Line input to the Control Unit.

Typical Connection: The Common and Normally Closed contacts are used to route AC power to the controller.

2.3 PROGRAMMING CARD

This monitor uses a standardized programming card for channel compatibility (permissives), minimum flash time, per channel Minimum Yellow Change Disable, CVM latch, and 24 volt monitor latch. Programming of this card is accomplished through the use of soldered wire jumpers. The programming card plugs into the monitor through a slot in the front panel. The monitor is constructed with card guides to ease the insertion of the programming card. The programming card includes card ejectors to ease removal of the programming card. The edge of the programming card is flush with the surface of the front panel when it is properly seated in the programming card slot of the monitor. The **PRGM CARD** LED will illuminate if the programming card is not properly seated while power is applied.

Programming cards supplied by Reno A&E have an integral serial EEPROM which can store the other settings for the monitor which are not programmed using soldered jumpers.

See Section [3.5](#) for programming card connector pin assignments.

2.3.1 Channel Compatibility

The monitor requires programming action to provide compatibility between channels.

The programming card has 120 pairs of holes for channel compatibility programming jumpers. The 120 jumper hole pairs are logically labeled for easy identification of the jumper holes by channel pairs. A soldered wire jumper in a jumper hole pair defines a pair of channels as permissive or compatible.

2.3.2 Minimum Flash

The programming card has four pairs of holes for minimum flash programming jumpers. The four jumper hole pairs are logically labeled for easy identification of the jumper holes in binary weighted fashion. A soldered wire jumper in a jumper hole pair adds that designated input value to the binary weighted sum. Per the NEMA TS 2 standard, the actual value used is the binary weighted sum plus one.

2.3.3 Minimum Yellow Change Channel Disable

The programming card has sixteen pairs of holes for Minimum Yellow Change Disable programming jumpers. The sixteen jumper hole pairs are logically labeled for easy identification of the channel numbers. A soldered wire jumper in a jumper hole pair disables Minimum Yellow Clearance monitoring for that channel. Typically, all pedestrian channels should have these jumpers installed.

2.3.4 Voltage Monitor Latch

The programming card has two pairs of holes for latch programming jumpers. The two jumper hole pairs are logically labeled for easy identification of the +24 Volt Latch and CVM Latch. A soldered wire jumper in a jumper hole pair causes that fault condition to be latched.

2.3.5 Serial EEPROM

The programming card contains a serial EEPROM. This device is not called for in the NEMA TS-2 specification and is only compatible with other Reno A&E monitors. The programming card is interchangeable with other manufacturer's programming cards for the programming of the standard features. Reno A&E has provided the serial EEPROM as a way of copying the other programming settings from one monitor to another monitor. Using a non-Reno A&E programming card in this monitor will result in the monitor not being able to store the other programming settings for copying to other Reno A&E monitors. See Section [2.4.10](#) for additional information on how data stored in the serial EEPROM is used.

2.4 FEATURES

2.4.1 Monitor Power Failure

The monitor responds to a Power Failure by entering a non-latching flash state. The monitor responds to a Power Failure whether it is the result of the over-current protection device operation, failure of the monitor power supply, or absence of proper operating AC Line voltage as defined below.

The operating AC Line input is considered to be On if the voltage level is greater than 98V_{RMS} AC and it is considered to be Off if the voltage level is less than 89V_{RMS} AC. The hysteresis from the Off state to the On state or vice versa is at least 3V_{RMS} AC.

The monitor responds to Power Failure as follows:

- 1) If the AC Line input is Off for 450 milliseconds or less, the monitor continues to operate as though the AC Line had remained On. The Output relay contacts do not transfer to the fault condition during this interval. The Start-Delay relay maintains continuity between its Common and Normally Closed contacts.
- 2) If the AC Line input is Off for 500 milliseconds or more, the monitor transfers the Output relay contacts to the fault condition. The Start-Delay relay enables continuity between its Common and Normally Open contacts. The time interval from the start of the AC Line input being Off and the transfer of both relays to these states does not exceed 525 milliseconds. Both relays maintain these states for the duration of the Power Failure.

2.4.2 Minimum Flashing Indication

The monitor includes internal logic to enforce a user definable Minimum Flash time. Once the monitor has transferred the Output relay contacts to the fault condition, the state of the Output relay contacts is maintained for the Minimum Flash time before normal operation can resume.

All monitor initiated flash conditions will start the Minimum Flash timer. The monitor will not return to normal operation until this timer has expired unless it is terminated by use of the front panel reset pushbutton or reset input command which will cause an immediate transfer to the no fault state.

The duration of the Minimum Flash time is adjustable between the limits of 5 seconds and 15 seconds with an incremental adjustment of one second and is programmed using jumpers on the Program Card. The NEMA TS-2 specification requires that the monitor add one second to whatever value is programmed on the program card and that the value on the program card cannot be set to less than five seconds. This creates a useable range of 6 seconds to 16 seconds.

2.4.3 Reset

Activation of the front panel reset pushbutton or the reset input causes the Output relay contacts to transfer to the no fault condition. The monitor remains in the no fault condition only if there are no existing faults and all input voltages are at the proper operating levels. If the Minimum Flash timer is active, activation of the either reset will zero the timer and transfer to the no fault condition.

Each activation of the front panel reset pushbutton or the reset input causes a one-time reset input to the monitor. A continuously activated front panel reset or reset input will not prevent the monitor from checking any fault conditions and/or transferring the Output relay contacts to the fault condition. The front panel reset or reset input must be removed and reapplied to activate a new reset input to the monitor. Activation of either reset will cause all of the front panel LEDs to turn on for 300 milliseconds.

The only intended purpose of the reset input is to facilitate automated testing of the monitor.

2.4.4 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 monitor 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).

2.4.5 COM Port

The monitor has a front panel mounted DB-9, RS-232 communications port that can be used with Reno A&E's RaeComM software to view / modify configuration settings, view current status and voltages, view logs, and download firmware upgrades. The COM port supports the standard baud rates from 300 to 57600 with one or two stop bits and parity of odd, even, or none. The factory default is 57600, no parity, and one stop bit. The most current version of the RaeComM software can be found on the Reno A&E web site www.renoae.com under support / monitor support / software. Also see Application Note AN-002 for an introduction to the RaeComM software. This application note can be found on the web site under support / monitor support / application notes.

The monitor was designed to use a standard DB-9 extension cable (male to female, straight through) for connecting to a laptop or computer. This port does not support handshaking signals. Both the COM port and the optional Ethernet port can be used at the same time. See Section [3.4](#) for connector pin assignments.

2.4.6 Ethernet Port

The monitor has an optional high speed, 10BASE-T / 100BASE-TX Ethernet network jack that can be used for communications with Reno A&E's RaeComM software to view / modify configuration settings, view current status and voltages, view logs, and download firmware upgrades.

To use this port an IP Address and port number must be set in the monitor. Contact your network administrator for addresses valid for your network. The factory default is an IP Address of 192.168.1.150 (which is an unusable address) and port 10001 (this is the recommend value).

In order to prevent the accidental writing of information to an unintended monitor, the Ethernet port is read-only on power up. To make the Ethernet port read-write, press any pushbutton on the front of the monitor. This will unlock the monitor for a period of 15 minutes.

2.4.7 Temperature Sensor

The monitor is capable of monitoring the temperature inside of the cabinet. The temperature sensor is capable of monitoring temperatures in the range of -40° F to +214° F (-40° C to +101° C). The internal cabinet temperature is included in the data logged into the Prior Faults Log when a fault occurs. If the actual temperature inside the cabinet is below -40° F (-40° C) at the time the fault occurs, the temperature is logged as -40° F (-40° C). If the actual temperature inside the cabinet is above +214° F (+101° C) at the time the fault occurs, the temperature is logged as +214° F (+101° C).

2.4.8 Real Time Clock

The monitor has a Real Time Clock (RTC) that is used as a reference for all date and time stamped events that are logged by the monitor. The Real Time Clock is initialized to local Pacific Standard Time when the unit is undergoing final test. In addition, the Daylight Saving Time user option is set to Off.

The Real Time Clock is preprogrammed to recognize Leap Years and Daylight Saving Time events through the year 2099. Currently, per U.S. Federal standards, Daylight Saving Time is observed in the United States from 2:00 A.M. on the second Sunday in March until 2:00 A.M. on the first Sunday in November.

The update priority of any time setting that affects the Real Time Clock is as follows:

1. Controller Time - The Real Time Clock is programmed with the time setting received from the Controller. This information is received via the PORT 1 SDLC connector on the front of the monitor. If the Real Time Clock setting differs from the Controller Time setting by more than two (2) seconds, The Real Time Clock will be synchronized to the Controller clock. In the event that the Real Time Clock setting differs from the Controller Time setting by five (5) or more seconds, the Real Time Clock will be synchronized to the Controller clock and an entry will be made to the Time Change Log.
2. External Time Source (i.e. laptop computer) - The Real Time Clock setting can be modified through the use of the RaeComM software. Connection to the laptop computer is made via the COMM PORT serial connector or optional Ethernet connector on the front of the monitor. NOTE: Whenever the monitor is connected to an operational SDLC bus, any time setting entered via the serial port will be overwritten by the Controller Time setting.
3. Front Panel - The Real Time Clock setting can be modified through the front panel. NOTE: Whenever the monitor is connected to an operational SDLC bus, any time setting entered via the front panel will be overwritten by the Controller Time setting.

If it is necessary to change the Real Time Clock setting in a monitor that is being used in a NEMA TS 2 Cabinet Assembly, change the time setting on the cabinet controller. The time change will be broadcast to the monitor through the SDLC port.

2.4.9 Up Time Accumulator

The monitor has an Up Time Accumulator that keeps track of the total amount of time that the monitor has been powered up since it was manufactured. It is saved in the format of Years, Months, Days, Hours, Minutes, and Seconds. The MMU-1600G warranty coverage is valid for a total accumulated Monitor Up Time of two (2) years. Tracking and recording the total time that the unit was in service provides an accurate means of validating any potential warranty claims.

2.4.10 Configuration Monitoring (Beeping Monitor)

The monitor checks all configuration settings for changes once each second. If a change is found, an audible buzzer will start beeping to indicate that a configuration setting has changed except when the monitor is in one of the configuration screens. This is to keep the buzzer from being too annoying when you know you are making changes. However, if you leave the configuration menu the monitor will start beeping. If the change is undone, the beeping will stop. No fault monitoring configuration changes are implemented until the front panel reset pushbutton is pressed and held for five (5) seconds or the changes are saved using the Fault Configuration Menu. At that time five quick confirmation beeps will be heard, the new settings will be implemented, and a Configuration Change log entry made.

The following configuration settings are monitored: Programming Card jumpers, Type Select input, Factory Options, Dual Indication / Field Check, Per Channel Red Enables, Flashing Don't Walk Monitoring, Flashing Yellow Arrow Left Turns, Co-Channels, Thresholds, Logging Enables, Disable Local Flash, Modified CVM Latch, External Watchdog Enable, Type 16 Only, and Buzzer Disable.

On power up and any time the program card is changed the configuration stored on the program card is compared to the configuration stored in the monitor. If they do not match the user is prompted to choose which data set to use. If the program card is selected, the configuration settings on the card will be copied into the monitor. If the monitor is selected, the configuration settings on the program card are overwritten with the current monitor configuration. All user information

(Ethernet settings, Location, Location ID, and Agency ID) as well as fault monitoring settings are copied. See Section [4.10](#) for front panel display during selection of configuration source.

2.4.11 Factory Settings

The monitor is configured at the factory during final test. Data set at the factory includes: Model Number, Serial Number, Manufacture Date, Real Time Clock setting, Support for Flashing Greens, Enhanced Support of Econolite Controllers, Support for a Diagnostic LCD. The Up Time Accumulator is initialized to zero prior to final testing. Changes to Support for Flashing Greens, Enhanced Support of Econolite Controllers, and Support for a Diagnostic LCD are logged in the configuration log.

2.4.12 User Unit Information

The monitor has non-volatile memory that can be used to store the following user unit information: 40 character Location ID, 4 character Unit ID, and 5 character Agency ID. All of these IDs can consist of any alpha-numeric characters. Upper and lower case characters can be used but all lower case will be displayed as uppercase on the front panel graphic display.

2.5 FAULT MONITORING

2.5.1 Conflict Monitoring

Configuration: The jumpers installed on the Program Card determine permissive (non-conflicting) channels. A jumper in the row labeled “2” and the jumper hole pair labeled “6” would make Channels 2 and 6 permissive with each other. This is a two-way relationship. If channel 2 is programmed as permissive with channel 6 then channel 6 is automatically permissive with channel 2. The testing defaults for this feature are determined by the jumpers installed on the program card. Typically no jumpers are installed during automated testing.

Test Preformed: While a channel has a Green, Walk, or Yellow display active, the channel is tested to see if a non-permissive channel has a Green, Walk, or Yellow display active at the same time. If concurrently active conflicting displays are detected a conflict timer is started. If the conflict goes away the conflict timer is stopped (it is not cleared) and a non-conflict timer is started. If the conflict reappears the non-conflict timer is reset to zero and the conflict timer continues timing from its prior value. If the conflict timer reaches 300 milliseconds or more the monitor will latch a conflict fault. If the non-conflict timer reaches 666 milliseconds the conflict timer is reset to zero and the conflict is ignored. The normal voltage thresholds for this test are: Reds – ON when above 70V_{RMS} and OFF when below 50V_{RMS}, Greens / Yellows / Walks – ON when above 25V_{RMS} and OFF when below 15V_{RMS}.

Fault Action: The monitor transfers the Output relay contacts to the fault condition (continuity between the Normally Open and Common contacts), illuminates the **CONFLICT** indicator on the front panel, and sets the Conflict bit (bit 65) of the Type 129 Frame to 1. The Signal Sequence log and the Prior Faults log will record this fault.

Resetting the Fault: The monitor remains in this fault condition until the unit is reset by the activation of the front panel reset pushbutton or the activation of the reset input. Power loss or power interruption will not reset this fault. The Reset log will record the resetting of this fault.

Modifying Inputs: None

Feature Interactions:

Flashing Don't Walk Monitoring: When Flashing Don't Walk Monitoring is enabled and channels have programmed as active for this feature, a flashing red on a channel with this feature active will be included in the displays checked for conflicts. A conflict with a flashing red must exist for 1500 milliseconds to create a conflict fault.

Flashing Yellow Arrow Left Turns: A Flashing Yellow Arrow (FYA) signal requires a four section head. Each FYA signal requires two MMU channels. The channel with the protected left turn green arrow is the parent. The channel with the FYA indication is the child.

The protected green arrow of a FYA signal will conflict per the program card settings of the parent channel.

The FYA of a FYA signal will conflict per the program card settings of the child channel. If FYA Easy Programming is selected, the FYA channel will conflict per the program card settings of the opposing thru channel. If the FYA stops flashing, it will be monitored as a Solid Yellow Arrow.

The Yellow Arrow of an FYA signal is monitored per the program card settings of the parent channel. If ALLOW CONCURRENT YEL: is YES then the yellow following a FYA will not conflict with the opposing thru yellow. If IGNORE YEL TRAP: is YES, then the Yellow of the FYA channel can be on with the opposing thru green indication following a flashing yellow arrow.

If GREEN SOLO is selected and IGNORE UNUSED CHAN is YES, the Yellow signal of the FYA parent channel is ignored for conflicts.

If FYA SOLO is selected, the channel must have both RED ENABLE and FIELD CHECK/DUAL INDICATION OFF, no MYCD jumper, and is not selected as a pedestrian channel then the unused indication (Green or Yellow) of the FYA channel is ignored for conflicts.

LED Thresholds: When LED Thresholds is enabled the monitor senses Greens, Yellows, Reds, and Walks as ON when their voltage is above 25V_{RMS} and OFF when below 15V_{RMS} for the conflict test.

2.5.2 Red Fail Monitoring

Configuration: All channels will be monitored for the red fail fault unless the Per Channel Red Enables feature is enabled. When Per Channel Red Enables are enabled only channels that have been programmed as active for this feature will be included in the displays checked for red fail. The testing defaults for this feature are Per Channel Red Enables is disabled and all channels enabled for red fail testing.

Test Preformed: When a channel has no displays active (Red, Yellow, Green, or Walk) a red fail timer is started. If a display turns on for the channel the red fail timer is stopped (it is not cleared) and a non-red fail timer is started. If the no active display condition returns the non-red fail timer is reset to zero and the red fail timer continues timing from its prior value. If the red fail timer reaches 800 milliseconds or more the monitor will latch a red fail fault. If the non-red fail timer reaches 300 milliseconds the red fail timer is reset to zero and the red fail is ignored. The normal voltage thresholds for this test are: Reds – ON when above 70V_{RMS} and OFF when below 50V_{RMS}, Greens / Yellows / Walks – ON when above 25V_{RMS} and OFF when below 15V_{RMS}.

Fault Action: The monitor transfers the Output relay contacts to the fault condition (continuity between the Normally Open and Common contacts), illuminates the **RED FAIL** indicator on the front panel, and sets the Red Failure bit (bit 66) of the Type 129 Frame to 1. The Signal Sequence log and the Prior Faults log will record this fault.

Resetting the Fault: The monitor remains in this fault condition until the unit is reset by the activation of the front panel reset pushbutton or the activation of the reset input. Power loss or power interruption will not reset this fault. The Reset log will record the resetting of this fault.

Modifying Inputs:

Red Enable: All red fail testing will be disabled when this input is below 70V_{RMS}.

Load Switch Flash bit (bit 112) of the Type 0 Frame: All red fail testing will be disabled when this bit is set to one.

Feature Interactions:

Per Channel Red Enables: When Co-Channel / Per Channel Red Enables are enabled only channels that have been programmed as active for this feature will be included in the displays checked for red fail.

LED Thresholds: When LED Thresholds is enabled the Greens, Yellows, Reds, and Walks are sensed as ON when their voltage is above 25V_{RMS} and OFF when below 15V_{RMS} for the red fail test.

Flashing Greens (also known as Canadian Fast Flash): When Flashing Greens are enabled the timer thresholds are changed from 800 milliseconds to 1500 milliseconds for fault detection and from 300 milliseconds to 200 milliseconds for the reset of the fault timer.

PPLT5: The Green of the child channel will be included in the red fail test for that channel. If Co-Channel Includes Yellow is also enabled then the Green and Yellow of the child channel will be included in the red fail test for the channel with the Green ball (Parent).

Flashing Yellow Arrow Left Turns: A FYA signal is a logical combination of 4 indications. If any of the indications is off for 800ms then a red fail is indicated.

If FYA GREEN SOLO is selected and IGNORE UNUSED CHAN is YES the unused Red and Yellow signals of the FYA parent channel are ignored for red fail.

If FYA SOLO is selected, the channel must have both RED ENABLE and FIELD CHECK/DUAL INDICATION OFF, no MYCD jumper, and is not selected as a pedestrian channel then the unused indication (Green or Yellow) of the FYA channel is ignored for red failure.

2.5.3 Dual Indication Monitoring

Configuration: All channels with a setting of “Y” for Dual Indication / Field Check will be monitored for the dual indication fault. The testing defaults for this feature are all channels enabled for dual indication testing.

Test Preformed: When operating in the Type 12 mode the following dual indications are checked for: Yellow + Red, Green + Red, Green + Yellow, and Walk + Yellow. When operating in the Type 16 mode the following dual indications are checked for: Yellow + Red, Green + Red, and Green + Yellow. When a channel has multiple displays active a dual indication timer is started. If one of the indications turns off the dual indication timer is stopped (it is not cleared) and a single indication timer is started. If both of the indications turn off the dual indication timer is stopped (it is not cleared) and a no indication timer is started. If the dual indication condition returns the single indication and no indication timers are stopped (not cleared) and the dual indication timer continues timing from its prior value. If the dual indication timer reaches

600 milliseconds or more the monitor will latch a dual indication fault. If the single indication timer reaches 1000 milliseconds the dual indication timer, the single indication timer, and the no indication timer are reset to zero and the dual indication is ignored. If the no indication timer reaches 300 milliseconds the dual indication timer, the single indication timer, and the no indication timer are reset to zero and the dual indication is ignored. The normal voltage thresholds for this test are: Reds – ON when above 70V_{RMS} and OFF when below 50V_{RMS}, Greens / Yellows / Walks – ON when above 25V_{RMS} and OFF when below 15V_{RMS}.

Fault Action: The monitor transfers the Output relay contacts to the fault condition (continuity between the Normally Open and Common contacts), illuminates the **DUAL IND** indicator on the front panel, and sets the Spare Bit #2 bit (bit 68) of the Type 129 Frame to 1. The Signal Sequence log and the Prior Faults log will record this fault.

Resetting the Fault: The monitor remains in this fault condition until the unit is reset by the activation of the front panel reset pushbutton or the activation of the reset input. Power loss or power interruption will not reset this fault. The Reset log will record the resetting of this fault.

Modifying Inputs:

Red Enable: All dual indication testing will be disabled when this input is below 70V_{RMS}.

Load Switch Flash bit (bit 112) of the Type 0 Frame: All dual indication testing will be disabled when this bit is set to one.

Feature Interactions:

Field Check: Enabling dual indication monitoring will also enable field check monitoring.

Minimum Yellow Change Disable Jumpers: When Minimum Yellow Change Disable is jumpered for a channel the Red + Yellow fault timing threshold for the single indication timer is changed from 1000 milliseconds to 400 milliseconds.

Flashing Greens (also known as Canadian Fast Flash): When Flashing Greens are enabled the no indication timer thresholds for the Green + Red and Green + Yellow fault conditions are changed from 300 milliseconds to 100 milliseconds.

Flashing Yellow Arrow Left Turns: The Dual indication setting for a FYA channel is associated to the channel that has the green indication (Parent channel). The MMU will interpret the 4 indications for FYA. It will perform the additional tests of Red + FYA, Yellow + FYA, and Green + FYA.

If GREEN SOLO is selected and IGNORE UNUSED CHAN is YES, the unused Red and Yellow signals of the FYA parent channel is ignored for Dual Indication.

If FYA SOLO is selected, the channel must have both RED ENABLE and FIELD CHECK/DUAL INDICATION OFF, no MYCD jumper, and is not selected as a pedestrian channel then the unused indication (Green or Yellow) of the FYA channel is ignored for Dual Indication.

LED Thresholds: When LED Thresholds is enabled the monitor senses Greens, Yellows, Reds, and Walks as ON when their voltage is above 25V_{RMS} and OFF when below 15V_{RMS} for the dual indication test.

2.5.4 GY-Dual Indication Monitoring

Configuration: Green-Yellow Monitoring Enabled is used to enable monitoring for this fault. When enabled all channels will have a minimum of Green + Yellow dual indication monitoring. All channels with a setting of “Y” for Dual Indication / Field Check will be monitored for all dual indication fault combinations (See Section [2.5.3](#) for fault combinations). The testing default for this feature is disabled.

Test Preformed: When a channel has a Green and a Yellow display active a dual indication timer is started. If one of the indications turns off the dual indication timer is stopped (it is not cleared) and a single indication timer is started. If both of the indications turn off the dual indication timer is stopped (it is not cleared) and a no indication timer is started. If the dual indication condition returns the single indication and no indication timers are stopped (not cleared) and the dual indication timer continues timing from its prior value. If the dual indication timer reaches 600 milliseconds or more the monitor will latch a dual indication fault. If the single indication timer reaches 1000 milliseconds the dual indication timer, the single indication timer, and the no indication timer are reset to zero and the dual indication is ignored. If the no indication timer reaches 300 milliseconds the dual indication timer, the single indication timer, and the no indication timer are reset to zero and the dual indication is ignored. The normal voltage thresholds for this test are: Reds – ON when above 70V_{RMS} and OFF when below 50V_{RMS}, Greens / Yellows / Walks – ON when above 25V_{RMS} and OFF when below 15V_{RMS}.

Fault Action: The monitor transfers the Output relay contacts to the fault condition (continuity between the Normally Open and Common contacts), illuminates the **DUAL IND** indicator on the front panel, and sets the Spare Bit #2 bit (bit 68) of the Type 129 Frame to 1. The Signal Sequence log and the Prior Faults log will record this fault.

Resetting the Fault: The monitor remains in this fault condition until the unit is reset by the activation of the front panel reset pushbutton or the activation of the reset input. Power loss or power interruption will not reset this fault. The Reset log will record the resetting of this fault.

Modifying Inputs:

Red Enable: All Green + Yellow dual indication testing will be disabled when this input is below 70V_{RMS}.

Load Switch Flash bit (bit 112) of the Type 0 Frame: All Green + Yellow dual indication testing will be disabled when this bit is set to one.

Feature Interactions:

Flashing Greens (also known as Canadian Fast Flash): When Flashing Greens are enabled the no indication timer threshold for the Green +Yellow fault condition is changed from 300 milliseconds to 100 milliseconds.

LED Thresholds: When LED Thresholds is enabled the monitor senses Greens, Yellows, Reds, and Walks as ON when their voltage is above 25V_{RMS} and OFF when below 15V_{RMS} for the dual indication test.

2.5.5 Short Yellow Monitoring

Configuration: Minimum Yellow Change Disable (MYCD) jumpers on the program card disable short Yellow monitoring for a channel. Typically pedestrian only channels will have MYCD jumpers installed. The testing defaults for this feature are determined by the jumpers installed on the program card. Typically no jumpers are installed during automated testing.

Test Preformed: When a channel has a Green that turns off, a Yellow must follow it and it must stay on for at least 2.7 seconds. When each Green turns off a 2.7 second timer is started. A Yellow must start within 1 second of the Green turning off. If the Red turns on before the Yellow, a short Yellow fault will be generated to show that the Yellow was skipped. When a Yellow turns on for at least 100 milliseconds another 2.7 second timer is started and must reach zero before the yellow turns off or a short Yellow fault will be generated. The normal voltage thresholds for this test are: Reds – ON when above 70V_{RMS} and OFF when below 50V_{RMS}, Greens, Walks, and Yellows – ON when above 25V_{RMS} and OFF when below 15V_{RMS}.

Fault Action: The monitor transfers the Output relay contacts to the fault condition (continuity between the Normally Open and Common contacts), illuminates the **SHORT YEL** indicator on the front panel, and sets the Minimum Clearance Failure bit (bit 74) of the Type 129 Frame to 1. The Signal Sequence log and the Prior Faults log will record this fault.

Resetting the Fault: The monitor remains in this fault condition until the unit is reset by the activation of the front panel reset pushbutton or the activation of the reset input. Power loss or power interruption will not reset this fault. The Reset log will record the resetting of this fault.

Modifying Inputs:

Red Enable: All short Yellow testing will be disabled when this input is below 70V_{RMS}.

Load Switch Flash bit (bit 112) of the Type 0 Frame: All short Yellow testing will be disabled when this bit is set to one.

Feature Interactions:

LED Thresholds: When LED Thresholds is enabled the monitor senses Greens, Yellows, Reds, and Walks as ON when their voltage is above 25V_{RMS} and OFF when below 15V_{RMS} for the short Yellow test.

Flashing Yellow Arrow Left Turns: Following a Green or Flashing Yellow Arrow indication on a FYA channel the Yellow Arrow of the FYA channel will be checked for short yellow and skipped yellow.

If FYA GREEN SOLO is selected and IGNORE UNUSED CHAN is YES the Yellow signal of the FYA parent channel is ignored for Short Yellow.

If FYA SOLO is selected, the channel must have both RED ENABLE and FIELD CHECK/DUAL INDICATION OFF, no MYCD jumper, and is not selected as a pedestrian channel then the unused indication (Green or Yellow) of the FYA channel is ignored for Short Yellow.

2.5.6 Short Clearance Monitoring

Configuration: All channels will be monitored for a short clearance fault.

Test Preformed: When a channel has a Green or Walk that turns off, a conflict channel cannot display a Green, Walk, or Yellow for at least 2.7 seconds. When each Green or Walk turns off a 2.7 second timer is started. If a conflicting Green, Walk, or Yellow turns on for at least 100 milliseconds the 2.7 second timer must have reached zero or a fault will be generated. The normal voltage thresholds for this test are: Reds – ON when above 70V_{RMS} and OFF when below 50V_{RMS}, Greens, Walks, and Yellows – ON when above 25V_{RMS} and OFF when below 15V_{RMS}.

Fault Action: The monitor transfers the Output relay contacts to the fault condition (continuity between the Normally Open and Common contacts), illuminates the **SHORT CLR** indicator on the front panel, and sets the Minimum Clearance Failure bit (bit 74) and Spare Bit #5 (bit 71) of the Type 129 Frame to 1. The Signal Sequence log and the Prior Faults log will record this fault.

Resetting the Fault: The monitor remains in this fault condition until the unit is reset by the activation of the front panel reset pushbutton or the activation of the reset input. Power loss or power interruption will not reset this fault. The Reset log will record the resetting of this fault.

Modifying Inputs:

Red Enable: All short clearance testing will be disabled when this input is below 70V_{RMS}.

Load Switch Flash bit (bit 112) of the Type 0 Frame: All short clearance testing will be disabled when this bit is set to one.

Feature Interactions:

LED Thresholds: When LED Thresholds is enabled the monitor senses Greens, Yellows, Reds, and Walks as ON when their voltage is above 70V_{RMS} and OFF when below 50V_{RMS} for the short Yellow test.

Flashing Yellow Arrow Left Turns: Following a Green or Flashing Yellow Arrow indication on a FYA channel the Yellow Arrow of the FYA channel will be checked for short clearance monitoring.

If FYA GREEN SOLO is selected and IGNORE UNUSED CHAN is YES the Yellow signal of the FYA parent channel is ignored for Short Clearance.

If FYA SOLO is selected, the channel must have both RED ENABLE and FIELD CHECK/DUAL INDICATION OFF, no MYCD jumper, and is not selected as a pedestrian channel then the unused indication (Green or Yellow) of the FYA channel is ignored for Short Clearance.

2.5.7 Field Check Monitoring

Configuration: All channels with a setting of “Y” for Dual Indication / Field Check will be monitored for a field check fault. The testing defaults for this feature are all channels enabled for field check testing.

Test Preformed: This monitoring function combines information about active field inputs with information received through the Port 1 communications between the Controller Unit and the monitor in a TS 2 Cabinet Assembly. The monitor 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 monitor do not correspond with the information received from the Controller Unit in the Type 0 Frame for 10 consecutive 100 millisecond periods a fault will be generated. The normal voltage thresholds for this test are: Reds – ON when above 70V_{RMS} and OFF when below 50V_{RMS}, Greens, Walks, and Yellows – ON when above 25V_{RMS} and OFF when below 15V_{RMS}.

Fault Action: The monitor transfers the Output relay contacts to the fault condition (continuity between the Normally Open and Common contacts), illuminates the **FIELD CHK** indicator on the front panel, and sets the Spare Bit #1 bit (bit 67) of the Type 129 Frame to 1. The Signal Sequence log and the Prior Faults log will record this fault.

Resetting the Fault: The monitor remains in this fault condition until the unit is reset by the activation of the front panel reset pushbutton or the activation of the reset input. Power loss or power interruption will not reset this fault. The Reset log will record the resetting of this fault.

Modifying Inputs:

Red Enable: All field check testing will be disabled when this input is below 70V_{RMS}.

Port 1 Disable: All field check testing will be disabled when this input is below 8V_{DC}.

Feature Interactions:

Dual Indication: Enabling field check monitoring will also enable dual indication monitoring.

Per Channel Red Enables: When Co-Channel / Per Channel Red Enables are enabled, only channels that have been programmed with a Per Channel Red Enable setting of “Y” will be included in the channels checked for a field check fault.

Flashing Don’t Walk Monitoring: When channels are programmed as Channels with Pedestrian Displays, the yellow of the active channels will not be checked for a field check fault. This does not require that the Flashing Don’t Walk Monitoring Enable be set to ON.

2.5.8 Port 1 Fail Monitoring

Configuration: If operating in the Type 16 mode, Port 1 timeouts will always be checked for unless Port 1 Disable (SDLC Connector - Pin 10) is low. The testing default for this feature is determined by the Port 1 Disable pin.

Test Preformed: If the monitor has not received a Type 0 Frame from the Controller Unit through the Port 1 SDLC communications bus for 300 milliseconds (three consecutive frame periods) a Port 1 fault will be generated. A Port 1 Timeout failure during the programmed Minimum Flash time or during a monitor Power Failure shall not cause a fault.

Fault Action: The monitor transfers the Output relay contacts to the fault condition (continuity between the Normally Open and Common contacts), illuminates the **PORT 1 FAIL** indicator on the front panel, and sets the Port 1 Timeout bit (bit 75) of the Type 129 Frame to 1. The Signal Sequence log and the Prior Faults log will record this fault.

Resetting the Fault: When receipt of 10 consecutive valid Type 0 Frames occurs, the monitor will transfer the Output relay contacts to the No Fault state unless three Port 1 timeouts have occurred in a calendar day. The monitor will not exit this third timeout state without user interaction (activation of the front panel reset pushbutton or activation of the reset input) or AC power being removed and reapplied. A user interaction will reset Port 1 Timeout counts to zero. AC power interruptions will not reset this count. When the monitor's clock passes through midnight, the count will be reset to zero. The Reset log will record the resetting of this fault.

Modifying Inputs:

Port 1 Disable: Port 1 failures will be ignored when this input is below 8V_{DC}.

Type Select: Port 1 failures will be ignored when this input is in the Type 12 mode (Unterminated or above 16V_{DC}).

Feature Interactions: None

2.5.9 +24 Volt Monitor I

Configuration: The 24V Latch jumper on the Program Card determines whether this fault is a latched fault. The testing default for this feature is determined by the jumper installed on the program card. Typically no jumper is installed during automated testing.

Test Preformed: A voltage greater than +22V_{DC} applied to the +24 Volt Monitor I input is recognized as adequate for proper operation. A voltage of less than +18V_{DC} is recognized as inadequate for proper operation. When the +24 Volt Monitor I input is detected as inadequate for more than 175 milliseconds, the monitor generates a fault. A +24V Monitor I failure during the programmed Minimum Flash time or during a monitor Power Failure shall not cause a fault.

Fault Action: The monitor transfers the Output relay contacts to the fault condition (continuity between the Normally Open and Common contacts), illuminates the **24V-1** indicator on the front panel, and sets the +24 Volt Monitor I bit (bit 58) of the Type 129 Frame to 1. The Signal Sequence log and the Prior Faults log will record this fault.

Resetting the Fault: Restoration of proper voltage to the +24V Monitor I input will reset this fault. Once tripped to the fault state, the minimum flash time must time before normal operation can be restored. The Reset log will record the resetting of this fault.

If the 24V Latch jumper is installed on the Program Card, the monitor remains in this fault condition until the unit is reset by the activation of the front panel reset pushbutton or the activation of the reset input. Power loss or power interruption will not reset this fault.

Modifying Inputs:

+24V Monitor Inhibit: +24V Monitor I failures will be ignored when this input is below 8V_{DC}.

Feature Interactions: None

2.5.10 +24 Volt Monitor II

Configuration: The 24V Latch jumper on the Program Card determines whether this fault is a latched fault. The testing default for this feature is determined by the jumper installed on the program card. Typically no jumper is installed during automated testing.

Test Preformed: A voltage greater than +22V_{DC} applied to the +24 Volt Monitor II input is recognized as adequate for proper operation. A voltage of less than +18V_{DC} is recognized as inadequate for proper operation. When the +24 Volt Monitor II input is detected as inadequate for more than 175 milliseconds, the monitor generates a fault. A +24V Monitor II failure during the programmed Minimum Flash time or during a monitor Power Failure shall not cause a fault.

Fault Action: The monitor transfers the Output relay contacts to the fault condition (continuity between the Normally Open and Common contacts), illuminates the **24V-2** indicator on the front panel, and sets the +24 Volt Monitor II bit (bit 59) of the Type 129 Frame to 1. The Signal Sequence log and the Prior Faults log will record this fault.

Resetting the Fault: Restoration of proper voltage to the +24V Monitor II input will reset this fault. Once tripped to the fault state, the minimum flash time must time before normal operation can be restored. The Reset log will record the resetting of this fault.

If the 24V Latch jumper is installed on the Program Card, the monitor remains in this fault condition until the unit is reset by the activation of the front panel reset pushbutton or the activation of the reset input. Power loss or power interruption will not reset this fault.

Modifying Inputs:

+24V Monitor Inhibit: +24V Monitor II failures will be ignored when this input is below 8V_{DC}.

Feature Interactions:

24V-2 To 12VDC: When this feature is enabled the voltage thresholds used are changed from greater than +22V_{DC} being valid to greater than +11.5V_{DC} and a voltage of less than +18V_{DC} being invalid to less than +10.75V_{DC}.

2.5.11 Controller Voltage Monitor

Configuration: The CVM Latch jumper on the Program Card determines whether this fault is a latched fault. The testing default for this feature is determined by the jumper installed on the program card. Typically no jumper is installed during automated testing.

Test Preformed: A voltage of less than 8V_{DC} is recognized as proper operation. A voltage greater than 16V_{DC} is recognized as improper operation. When the CVM input is detected as improper for more than 175 milliseconds, the monitor generates a fault. A CVM failure during the programmed Minimum Flash time or during a monitor Power Failure shall not cause a fault.

Fault Action: The monitor transfers the Output relay contacts to the fault condition (continuity between the Normally Open and Common contacts), illuminates the **CVM / WD** indicator on the front panel, and sets the Controller Voltage Monitor bit (bit 57) of the Type 129 Frame to 1. The Signal Sequence log will record this fault. The Prior Faults log will record this fault if Log CVM Events is enabled.

Resetting the Fault: Restoration of proper voltage to the CVM input will reset this fault. Once tripped to the fault state, the minimum flash time must time before normal operation can be restored. The Reset log will record the resetting of this fault.

If the CVM Latch jumper is installed on the Program Card, the monitor remains in this fault condition until the unit is reset by the activation of the front panel reset pushbutton or the activation of the reset input. Power loss or power interruption will not reset this fault.

Modifying Inputs:

Feature Interactions:

Modified CVM Latch: When this feature is enabled and the CVM Latch jumper is installed the monitor will not latch a CVM fault until the CVM input has been valid (Low) for more than 175 milliseconds. 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.

Log CVM Events: When this feature is enabled the Prior Faults log will record this fault. Disabling this feature is useful when the intersection uses the CVM input to provide time of day flash. This will keep the Prior Faults log from filling up with normal flash operations.

2.5.12 Local Flash

Configuration:

Test Preformed: A voltage of less than 8V_{DC} (low) is recognized as a request for Local Flash. A voltage greater than 16V_{DC} (or floating) is recognized as normal operation. When the Local Flash input is detected as low for more than 175 milliseconds, the monitor generates a fault. A Local Flash request during the programmed Minimum Flash time shall not cause a fault.

Fault Action: The monitor transfers the Output relay contacts to the fault condition (continuity between the Normally Open and Common contacts), illuminates the **LOC FLASH** indicator on the front panel, and sets the Local Flash bit (bit 79) of the Type 129 Frame to 1. The Signal Sequence log will record this fault. The Prior Faults log will record this fault if Log Local Flash Events is enabled.

Resetting the Fault: Restoration of a voltage greater than 16V_{DC} (or floating) to the Local Flash input will reset this fault. Once tripped to the fault state, the minimum flash time must time before normal operation can be restored. The Reset log will record the resetting of this fault.

Modifying Inputs:

Feature Interactions:

Disable Local Flash: When this feature is enabled and the Local Flash input will be ignored.

Log Local Flash Events: When this feature is enabled the Prior Faults log will record this fault. Disabling this feature is useful when the intersection uses the Local Flash input to provide time of day flash. This will keep the Prior Faults log from filling up with normal flash operations.

2.5.13 External Watchdog Monitoring

Configuration: The setting of External Watchdog Enable determines if this feature is active. The testing default for this feature is disabled.

Test Preformed: The External Watchdog input is connected to Pin S on Connector B (Spare 2). A voltage of less than 8V_{DC} is recognized as a low and a voltage greater than 16V_{DC} is recognized as a high. The input must change states at least once every 1500 milliseconds or the monitor generates a fault. A External Watchdog fault during the programmed Minimum Flash time or during a monitor Power Failure shall not cause a fault.

Fault Action: The monitor transfers the Output relay contacts to the fault condition (continuity between the Normally Open and Common contacts), flashes the **CVM / WD** indicator on the front panel, and sets the Spare Bit #4 (bit 70) of the Type 129 Frame to 1. The Signal Sequence log will record this fault. The Prior Faults log will record this fault if Log Local Flash Events is enabled.

Resetting the Fault: The monitor remains in this fault condition until the unit is reset by the activation of the front panel reset pushbutton or the activation of the reset input. Power loss or power interruption will not reset this fault. The Reset log will record the resetting of this fault.

Modifying Inputs: None

Feature Interactions: None

2.5.14 Programming Card Absent Monitoring

Configuration: None

Test Preformed: If the programming card is not present or not seated properly in the connectors the monitor generates a fault.

Fault Action: The monitor transfers the Output relay contacts to the fault condition (continuity between the Normally Open and Common contacts), illuminates the **PRGM CARD** indicator on the front panel. The Signal Sequence log and the Prior Faults log will record this fault.

Resetting the Fault: Proper insertion of a Program Card is required before the fault can be reset. The monitor remains in this fault condition until the unit is reset by the activation of the front panel reset pushbutton, activation of the reset input, power loss, or power interruption. The Reset log will record the resetting of this fault.

Modifying Inputs: None

Feature Interactions: None

2.6 TESTING MODIFIERS

2.6.1 Flashing Don't Walk Monitoring

Configuration: The setting of Flashing Don't Walk Enabled determines if this feature is active. All channels with a setting of "Y" for Channels with Pedestrian Displays will include a flashing red on that channel in the displays checked for conflicts. The testing defaults for this feature are all channels disabled for Channels with Pedestrian Displays and Flashing Don't Walk Monitoring Enabled set to no.

Tests Modified:

Conflict: Normal conflict testing checks active Green, Walk, and Yellow displays for being permissive. With this feature active, any channel with a setting of "Y" will have a flashing Red included in the channels checked as permissive. A flashing input is defined as an input that stays ON for at least 200 milliseconds and no longer than 600 milliseconds and is OFF for at least 200 milliseconds and no longer than 600 milliseconds. A Flashing Don't Walk conflict must exist for 1500 milliseconds to be detected as a fault. This time allows the monitor sufficient time to detect transitions from the flashing state to the solid on state and not falsely trip.

Typical Use: This feature is used to provide additional fault checking for Flashing Don't Walk displays. Without this feature a flashing Red input is never checked for conflicts.

2.6.2 PPLT5 Monitoring

Configuration: The setting of Co-Channel / Per Channel Red Enables determines if this feature is active. All channels with a setting of "X" for a Co-Channel Child setting will include the Green (and Walk if in Type 12 mode) on the child channel with the displays of that channel when checking for red fail. If Co-Channel Childs Includes Yellow is enabled the Yellow of the child channel is included as well as the Green (and Walk if in Type 12 mode). Co-Channel monitoring is disabled when

the RED ENABLE input is not active. The testing defaults for this feature are all Co-Channel Childs disabled and Co-Channel / Per Channel Red Enables set to no.

When a channel is programmed as a child of another channel, it is a one way relationship. Therefore, if channel 9 is assigned as a child of channel 2 there is no implied reverse relationship of channel 2 being a child of channel 9. If this operation is desired, it must be explicitly programmed as such.

Tests Modified:

Red Fail: Normal red fail testing ensures that at least one display is active for a channel. With this feature active, any channel with a setting of "Y" for a child channel will have the Green (and Walk if in Type 12 mode) of the child channel included when checking for a red fail. If Co-Channel Childs Includes Yellow is enabled the Yellow of the child channel is included as well as the Green (and Walk if in Type 12 mode).

Typical Use: This feature is useful when the monitor has a channel that may have all outputs off while another channel's output is on for the movement of traffic. Overlaps and Protected / Permitted applications with four and five section signal heads are common examples. Under normal operation, the Red Enable input would have to be deactivated during the time that channel would have no output to keep a Red Fail fault from occurring. The Co-Channel monitoring feature allows the user to select other channels that will be tested along with the parent channel such that a Red Fail fault will only occur if the parent channel has no outputs on and the Green, Walk, and optionally the Yellow of the child channels have no output on.

2.6.3 Flashing Yellow Arrow Monitoring (FYA)

Configuration: The Wizard configures 16 types of FYA left turn configurations. To manually set up FYA in the CONFIG SETTINGS MENU select the PERM LEFT (FYA) and FYA OPTIONS.

PERM LEFT (FYA)

FYA Solo – The Solid Red, Yellow and Green Arrow indications come from the Parent channel. The FYA will come from a child channel.

FYA 1-4 Yellow - This affects parent channels 1-4. When ON the FYA is driven by a Yellow output of the child channel. When OFF the FYA is driven by a Green output of the child channel.

FYA 5-16 Yellow - This affects parent channels 5-16. When ON the FYA is driven by a Yellow output of the child channel. When OFF the FYA is driven by a Green output of the child channel.

Green Solo – The Solid Green indication comes from the parent channel. The FYA, Solid Yellow Arrow, and Solid Red Arrow come from the child channel.

Ignore Unused Chan - If yes is selected the Yellow and Red drivers of the "Parent Channel" are ignored for conflict, dual indication, short clearance, and short yellow monitoring. If No is selected the Yellow and Red signal indications are monitored for all faults.

FYA Parent – The parent channel is the channel that contains the Green Arrow Signal Indication

FYA Child – The child channel is the channel that contains the FYA Signal Indication

FYA Opposing Thru – The thru channel opposing the FYA Parent Channel

Allow Concurrent Yel - If this feature is ON the Yellow arrow terminating the FYA will not conflict with the Yellow ball for the opposing through movement.

Tests Modified:

Conflict: The protected green arrow of a FYA signal will conflict per the program card settings of the parent channel.

The FYA of a FYA signal will conflict per the program card settings of the child channel. If FYA Easy Programming is selected, the FYA channel will conflict per the program card settings of the opposing thru channel. If the FYA stops flashing, it will be monitored as a Solid Yellow Arrow.

The Yellow Arrow of an FYA signal is monitored per the program card settings of the parent channel. If ALLOW CONCURRENT YEL: is YES then the yellow following a FYA will not conflict with the opposing thru yellow. If IGNORE YEL TRAP: is YES, then the Yellow of the FYA channel can be on with the opposing thru green indication following a flashing yellow arrow.

If GREEN SOLO is selected and IGNORE UNUSED CHAN is YES, the Yellow signal of the FYA parent channel is ignored for conflicts.

If FYA SOLO is selected, the channel must have both RED ENABLE and FIELD CHECK/DUAL INDICATION OFF, no MYCD jumper, and is not selected as a pedestrian channel then the unused indication (Green or Yellow) of the FYA channel is ignored for conflicts.

Red Fail: A FYA signal is a logical combination of 4 indications. If any of the indications is off for 800ms then a red fail is indicated.

Dual Indication: The Dual indication setting for a FYA channel is associated to the channel that has the green indication (Parent channel). The MMU will interpret the 4 indications for FYA. It will perform the additional tests of Red + FYA, Yellow + FYA, and Green + FYA.

Short Yellow Monitoring: Following a Green or Flashing Yellow Arrow indication on a FYA channel the Yellow Arrow of the FYA channel will be checked for short yellow and skipped yellow.

Short Clearance Monitoring: Following a Green or Flashing Yellow Arrow indication on a FYA channel the Yellow Arrow of the FYA channel will be checked for short clearance monitoring.

Typical Use: The monitoring of FYA Signals for the detection of, and response to, improper and conflicting signals and improper operating voltages in a Controller Assembly (CA).

2.6.4 LED Thresholds

Configuration: The setting of LED Thresholds determines if this feature is active. The testing default for this feature is LED Thresholds to no.

Tests Modified:

Conflict: Normal conflict testing senses Greens, Yellows, and Walks as ON when their voltage is above 25V_{RMS} and OFF when below 15V_{RMS}. Reds are ON when their voltage is above 70V_{RMS} and OFF when below 50V_{RMS}. With LED thresholds, the monitor senses Greens, Yellows, Reds, and Walks as ON when their voltage is above 25V_{RMS} and OFF when below 15V_{RMS}.

Red Fail: Normal red fail testing senses Greens, Yellows, and Walks as ON when their voltage is above 25V_{RMS} and OFF when below 15V_{RMS}. Reds are ON when their voltage is above 70V_{RMS} and OFF when below 50V_{RMS}. With LED thresholds, the monitor senses Greens, Yellows, Reds, and Walks are sensed as ON when their voltage is above 70V_{RMS} and OFF when below 50V_{RMS}.

Dual Indication: Normal dual indication testing senses Greens, Yellows, and Walks as ON when their voltage is above 25V_{RMS} and OFF when below 15V_{RMS}. Reds are ON when their voltage is above 70V_{RMS} and OFF when below 50V_{RMS}. With LED thresholds, the monitor senses Greens, Yellows, Reds, and Walks as ON when their voltage is above 25V_{RMS} and OFF when below 15V_{RMS}.

Short Yellow: Normal short Yellow testing senses Greens, Yellows, and Walks as ON when their voltage is above 25V_{RMS} and OFF when below 15V_{RMS}. Reds are ON when their voltage is above 70V_{RMS} and OFF when below 50V_{RMS}. With LED thresholds, the monitor senses Greens, Yellows, Reds, and Walks are sensed as ON when their voltage is above 70V_{RMS} and OFF when below 50V_{RMS}.

Short Clearance: Normal short Yellow testing senses Greens, Yellows, and Walks as ON when their voltage is above 25V_{RMS} and OFF when below 15V_{RMS}. Reds are ON when their voltage is above 70V_{RMS} and OFF when below 50V_{RMS}. With LED thresholds, the monitor senses Greens, Yellows, Reds, and Walks are sensed as ON when their voltage is above 70V_{RMS} and OFF when below 50V_{RMS}.

Field Check: Normal field check testing senses Greens, Yellows, and Walks as ON when their voltage is above 25V_{RMS} and OFF when below 15V_{RMS}. Reds are ON when their voltage is above 70V_{RMS} and OFF when below 50V_{RMS}. With LED thresholds, the monitor senses Greens, Yellows, Reds, and Walks as ON when their voltage is above 25V_{RMS} and OFF when below 15V_{RMS}.

Typical Use: Once any LED field displays are installed, using LED Thresholds will provide better fault checking by using voltage thresholds that are specifically suited to each type of test being performed.

2.6.5 Per Channel Red Enable

Configuration: The setting of Co-Channel / Per Channel Red Enables determines if this feature is active. When active all channels with a setting of “Y” for a Per Channel Red Enable setting will perform normal red fail testing (See Section [2.5.2](#)). Per Channel Red Enable is disabled when the RED ENABLE input is not active. The testing defaults for this feature are all Per Channel Red Enables enabled and Co-Channel / Per Channel Red Enables set to no.

Tests Modified:

Red Fail: Normal red fail testing ensures that at least one display is active for a channel. With this feature active, any channel with a setting of “-” for a Per Channel Red Enable will not be tested for red fail faults.

Field Check: Normal field check testing ensures that the at least one display is active for a channel. With this feature active, any channel with a setting of “-” for a Per Channel Red Enable will not be tested for field check faults.

Typical Use: This feature is useful when the user wants to monitor a display that may not be directly controlled by the controller but still wants to have Dual Indication testing for the channel. A typical application is an advance warning sign. The user may want to ensure that both indications are not on at the same time and that neither is on during specific times.

The Per Channel Red Enable feature gives the user the ability to permanently disable the Red Enable function and Field Check for specific channels. The Dual Indication function will still operate according to setting of the Dual Indication / Field Check enables. For the purpose of the Conflict function and the Short Clearance functions, a dark channel is treated as if it were Red.

2.6.6 Modified CVM Latch

Configuration: The setting of Modified CVM Latch determines if this feature is active. This feature only has an effect if the CVM Latch jumper is installed on the programming card. The testing default for this feature is set to no.

Tests Modified:

CVM: Normal CVM testing checks for the CVM input being low. When this feature is enabled and the CVM Latch jumper is installed, the monitor will not latch a CVM fault until the CVM input has been valid (Low) for more than 175 milliseconds.

Typical Use: 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. This feature basically requires that CVM be valid before a CVM fault will be latched.

2.6.7 12 Volt DC Monitoring

Configuration: The setting of 24V-2 to 12VDC determines if this feature is active. A low on the +24V Monitor Inhibit input inhibits the operation of the +12 Volt Monitor. The testing default for this feature is set to no.

Tests Modified:

+24 Volt Monitor II: Normal +24 Volt Monitor II testing checks for the +24V Monitor II (Connector B - Pin R) input being greater than +22V_{DC}. When this feature is enabled, a voltage greater than +11.5V_{DC} applied to the +24 Volt Monitor II input is recognized as adequate for proper operation. A voltage of less than +10.75V_{DC} applied to the +24 Volt Monitor II input is recognized as inadequate for proper operation.

Typical Use: This feature can be very useful in TS 2 cabinets with 12 VDC supplies. The monitor can now monitor a +12 VDC supply as well as a +24 VDC supply. The operation of the input is the same as if it were the +24V Monitor II; except the voltage levels are changed.

2.6.8 Disable Local Flash

Configuration: The setting of Disable Local Flash determines if this feature is active. The testing default for this feature is set to no.

Tests Modified:

Local Flash: Normal intersection operation requires that the Local Flash input (Connector B - Pin c) be greater than +22V_{DC}. When this feature is enabled, the Local flash input is ignored and normal intersection operation is allowed.

Typical Use: This feature is useful when it is desirable to ignore a command to begin flash operation of the intersection. This may come from a Time Clock or an output of the Controller that is controlled by Time Of Day, Coordination, a System Master, or Police Panel.

2.6.9 Flashing Green (Canadian Fast Flash)

Configuration: This is a factory option and cannot be changed by the user. If this function is required but it is not active, contact Reno A&E Technical Support for assistance. This feature is set to OFF for units sold in the United States and set to ON for units shipped to Canada.

Tests Modified:

Please refer to Reno A&E Application Note AN-004 in the Support section of the Reno A&E web site (renoae.com) under Monitor Support / Application Notes for a detailed description of how these tests are modified.

Red Fail: Red Fail Fault time is changed from 800 milliseconds to 1.5 seconds. Red Fail Reset time is changed from 300 milliseconds to 200 milliseconds.

Dual Indication: Green-Yellow Dual Indication Reset time is changed from 300 milliseconds to 100 milliseconds. Green-Red Dual Indication Reset time is changed from 300 milliseconds to 100 milliseconds

Typical Use: This feature is intended to support the use of flashing Green indications as used in Canada.

2.6.10 Channels with Pedestrian Displays

Configuration: The setting of Channels with Pedestrian Displays determines if this feature is active on a per channel basis. The testing default for this feature is set to no channels active.

Tests Modified:

Red Fail: Affects Type 12 operation only. Normal red fail testing ensures that at least a red, yellow, green, or walk display is active for a channel. Any channel with a setting of “Y” for Channels with Pedestrian Displays will not include the walk display in the testing for red fail faults on that channel.

Dual Indication: Normal dual indication testing uses 600 milliseconds as the fault time for Yellow + Red dual indications. Any channel with a setting of “Y” for Channels with Pedestrian Displays will use 800 milliseconds as the fault time for Yellow + Red dual indications.

Typical Use: In Type 12 mode of operation, this feature allows vehicle displays to be checked for a dark head even though a walk for the channel may be active. In Type 16 mode of operation, this feature allows for a longer Yellow + Red dual indication fault time to deal with some controllers that have a slight overlap between the pedestrian clearance interval and the don’t walk interval of a pedestrian channel.

2.7 EVENT LOGGING

Six different Event Logs provide detailed, date and time stamped documentation of selected events recorded by the monitor. This data is useful in troubleshooting and provides an accurate historical record of cabinet operation. When the date and time are not available through Port 1, the monitor will use its internal Real Time Clock as a date / time stamp for events.

2.7.1 Time Change Log

The Time Change Log records the 50 most recent time changes. Data recorded: Original Date / Time Stamp, New Date / Time Stamp, and Up Time Accumulator.

2.7.2 Monitor Reset Log

The monitor Reset Log records the 20 most recent resets. Data recorded: Date / Time Stamp, Faults at Time of Reset, and Source of Reset (Front Panel, External, or Power Loss).

2.7.3 Configuration Event Log

The Configuration Event Log records the 10 most recent configuration changes. Data recorded: Date / Time Stamp, Programming Card Jumpers, Type Select, Factory Options set through RaeComM, and User Options set through RaeComM.

2.7.4 Prior Faults Log

The Prior Faults Log records the 20 most recent faults. Data recorded: Date / Time Stamp; Cabinet Temperature; Faults Reported; Status of all Greens, Yellows, Reds, and Walks; Status of all DC Inputs; Status of Red Enable; Entire Front Panel Fault Display; AC Line Voltage; and Red Enable Voltage.

2.7.5 AC Line Log

The AC Line Log records the 50 most recent changes in AC line status. Data recorded: Date / Time Stamp, Event Type (Power Up / Reset, Low Voltage, Low Voltage Recovery, Shutdown, Low Voltage Alarm, Low Voltage Alarm Recovery, High Voltage Alarm, and High Voltage Alarm Recovery), and AC Line Voltage.

Through RaeComM, the user can adjust the High Voltage Alarm point and the Low Voltage Alarm point. These alarm points have a fixed, three volt hysteresis. Therefore, setting the High Voltage Alarm point to 135 volts will cause the recovery point to be set to 132 volts. Likewise, setting the Low Voltage Alarm point to 105 volts will cause the recovery point to be 108 volts. The factory defaults for these alarm points are 105 volts for the low alarm point and 135 volts for the high alarm point.

NOTE: The log will only record when these points are crossed. The minimum and maximum voltages seen are not recorded.

2.7.6 Signal Sequence Log

The Signal Sequence Log records 13 most recent failures. The logs can be configured to record events occurring prior to a fault in one of two different modes.

Event Mode: The Signal Sequence Log records the 60 most recent events preceding the failure. An event is defined as an instance when any AC or DC signal changes state. The monitor checks all inputs for changes in state every 33 milliseconds for the purpose of accumulating data for this log. Data recorded: Time Prior to Fault; Status of all Greens, Yellows, Reds, and Walks; RMS Voltages of all Greens, Yellows, Reds, and Walks; Status of all DC inputs; Status of Red Enable; AC Line Voltage; Red Enable Voltage; and DC Input Voltages.

Time Mode: The Signal Sequence Log records the 2 seconds preceding the failure. The monitor records all inputs every 33 milliseconds for the purpose of accumulating data for this log. Data recorded: Time Prior to Fault; Status of all Greens, Yellows, Reds, and Walks; RMS Voltages of all Greens, Yellows, Reds, and Walks; Status of all DC inputs; Status of Red Enable; AC Line Voltage; Red Enable Voltage; and DC Input Voltages.

2.7.7 Logging Options

2.7.7.1 Log Field Changes

When this feature is enabled the monitor will make entries in the Signal Sequence log only when an input has changed state. All inputs (AC and DC) are checked every 33 milliseconds for a change in state. If any input changed state, a new entry is placed in the Signal Sequence log. If this feature is disabled the monitor will make a new entry in the Signal Sequence log every 33 milliseconds. The disabled mode is typically the most useful mode for this feature but the Signal Sequence log can only record two seconds prior to the fault in this mode. However, when troubleshooting Short Yellow or Short Clearance faults, it may be desirable to record a longer Signal Sequence log. With this feature enabled the Signal Sequence log will typically record 40 to 50 seconds prior to the fault. The factory default for this feature is disabled.

2.7.7.2 Log Local Flash Events

When this feature is enabled the monitor will record Local Flash events in the Prior Faults log. Disabling this feature is useful when an intersection is normally put into Local Flash (time of day, etc) and you do not want to fill up the Prior Faults log with non-fault events. The factory default for this feature is **YES**.

2.7.7.3 Log CVM Events

When this feature is enabled the monitor will record CVM events in the Prior Faults log. Disabling this feature is useful when an intersection is normally put into flash using CVM (time of day, etc) and you do not want to fill up the Prior Faults log with non-fault events. The factory default for this feature is **YES**.

2.8 DIAGNOSTICS

The monitor is provided with a series of resident self-check diagnostics capabilities. Diagnostic failures are latched in the fault condition until the unit is reset by the activation of the front panel reset pushbutton or activation of the reset input. A diagnostic failure is not reset by a monitor Power Failure.

Failure of any of these diagnostics will result in the monitor Diagnostic Failure bit (bit 73) of the Type 129 Frame being set to 1. NOTE: Port 1 communications may not be possible during certain diagnostic failures.

2.8.1 Memory

The monitor verifies all memory elements on power up or upon reset of a Diagnostics failure. A failure of any of the memory tests will generate a diagnostics failure.

RAM Diagnostics: Test patterns are written to every byte of RAM in the monitor. After each write a read is performed to verify that the pattern is correct.

Flash ROM Diagnostics: A checksum is calculated for all of the ROM in the monitor. The calculated value is compared to a preprogrammed value stored in the ROM.

EEPROM Diagnostics: A checksum is calculated for all of the internal EEPROM in the monitor. The calculated value is compared to a preprogrammed value stored in the internal EEPROM.

Programming Card EEPROM Diagnostics: A checksum is calculated for all of the EEPROM on the programming card. The calculated value is compared to a preprogrammed value stored in the programming card EEPROM.

The monitor continues to verify the RAM, Program Flash, Storage Flash, and Programming Card EEPROM during normal operation. Checksums are calculated for the Program Flash and Storage Flash at a rate of at least 1024 bytes per second. Checksums are calculated for the entire Programming Card EEPROM once per second.

2.8.2 Microprocessor Monitor

The monitor continuously checks the operation of its microprocessor. The monitoring circuit receives a signal or logic state transition at least once every 33 milliseconds from the microprocessor. When the signal or logic state transition is not received for more than 50 milliseconds a diagnostics fault is generated.

2.8.3 Internal Voltage Monitors

The monitor checks the voltage levels of the internal DC power supplies. The +12 volt, +5 volt, digital +3.3 volt, analog +3.3 volt, and analog -3.3 volt power supplies are all monitored for proper voltage levels. When any of these voltage levels is invalid for more than 125 milliseconds a diagnostics fault is generated. These faults will not be logged by the monitor, as any one of these voltages being invalid will immediately place the monitor in a diagnostic failure mode with the microprocessor held in reset. This prevents any false faults or missed faults due to an internal power supply malfunction.

2.8.4 Diagnostic Codes

When a fault is detected, the monitor transfers the Output relay contacts to the fault condition and illuminates the front panel DIAG FAIL LED. The channel LEDs will also begin to flash a binary representation of the diagnostic code. The diagnostic code may be viewed on the Fault Codes screen or with RaeComM on the Real Time Status display.

| FAULT | CHANNEL | CODE | DESCRIPTION OF FAULT |
|-------------------------|---------|-------|-----------------------------------------------------------------------------------------------------------------------|
| Code Checksum | 1 | 0001h | The checksum calculated for the main code no longer matches the stored value. |
| Configuration Checksum | 2 | 0002h | The checksum calculated for the configuration and logging data does not match the stored value. |
| Flash Write Error | 3 | 0004h | A write to Flash memory did not complete normally. |
| RAM Error | 4 | 0008h | A RAM location failed to read back the test pattern written to it. |
| Boot Loader Checksum | 5 | 0010h | The checksum calculated for one or both of the boot loaders does not match the stored value. |
| DSP Timeout | 6 | 0020h | The DSP did not respond to a request for data in the required amount of time. |
| Ethernet Port Error | 7 | 0040h | The interface hardware for the Ethernet port is not functioning properly. |
| DC Processor Timeout | 8 | 0080h | The DC processor did not respond to a request for data in the required amount of time. |
| Shift Chain Error | 9 | 0100h | One of the shift chains could not shift a bit through the entire chain. |
| Task Watchdog Timeout | 10 | 0200h | One or more of the tasks did not complete in its allotted time. |
| Program Card Read | 11 | 0400h | The program card could not be read reliably. Bad solder joints on the program card jumpers commonly cause this error. |
| PC Memory Checksum | 12 | 0800h | The checksum calculated for the program card memory does not match the stored value. |
| PC Memory Timeout | 13 | 1000h | The program card memory did not respond to a request for data in the required amount of time. |
| Temperature Timeout | 14 | 2000h | The temperature sensor did not respond to a request for data in the required amount of time. |
| DSP Diagnostic Error | 15 | 4000h | The DSP is indicating that it has a diagnostic error. |
| During the Boot Process | 16 | 8000h | The fault identified above was found during the boot process. |

3.0 SPECIFICATIONS

3.1 PHYSICAL

WEIGHT: 75.2 oz. (2132 gm).

SIZE: 10.50 inches (26.67 cm) high x 4.50 inches (12.60 cm) wide x 11.00 inches (27.94 cm) deep including connectors and card ejectors.

STORAGE TEMPERATURE: -50° F to +185° F (-45° C to +85° C).

OPERATING TEMPERATURE: -30° F to +165° F (-34° C to +74° C).

HUMIDITY RANGE: 0 to 95% (relative).

CIRCUIT BOARDS: Printed circuit boards are 0.062 inch thick NEMA FR-4 glass epoxy with 2 oz. copper on both sides and plated through holes. Circuit boards and components are conformal coated with polyurethane.

CONNECTORS: (See Section [3.4](#) for connector pin assignments.)

CONNECTOR A: Intermates with a MS 3116 22-55 SZ.

CONNECTOR B: Intermates with a MS 3112 16-26 S.

PORT 1 SDLC CONNECTOR: DB-15, 15 pin, metal shell, D subminiature receptacle with gold plated female contacts and latching blocks.

COMM PORT CONNECTOR: DB-9, 9 pin, metal shell, D subminiature receptacle with gold plated female contacts and nuts for retaining screws.

ETHERNET CONNECTOR: High speed, 10Base-T / 100Base-TX - RJ-45 network jack (optional).

3.2 ELECTRICAL

POWER: 80 to 135 VAC, 60 Hz ± 3 Hz, 6 watts (nominal).

AC VOLTAGE INPUTS (NORMAL THRESHOLDS):

| | | |
|-----------------------|---------------------------------|--------------------------------|
| Green Signal Inputs: | OFF < 15 V _{RMS} | ON > 25 V _{RMS} |
| Walk Signal Inputs: | OFF < 15 V _{RMS} | ON > 25 V _{RMS} |
| Yellow Signal Inputs: | OFF < 15 V _{RMS} | ON > 25 V _{RMS} |
| Red Signal Inputs: | OFF < 50 V _{RMS} | ON > 70 V _{RMS} |

AC VOLTAGE INPUTS (LED DISPLAY THRESHOLDS):

THRESHOLDS FOR CONFLICT AND MULTIPLE INDICATION TESTS:

| | | |
|-----------------------|---------------------------------|--------------------------------|
| Green Signal Inputs: | OFF < 15 V _{RMS} | ON > 25 V _{RMS} |
| Walk Signal Inputs: | OFF < 15 V _{RMS} | ON > 25 V _{RMS} |
| Yellow Signal Inputs: | OFF < 15 V _{RMS} | ON > 25 V _{RMS} |
| Red Signal Inputs: | OFF < 15 V _{RMS} | ON > 25 V _{RMS} |

THRESHOLDS FOR RED FAIL, SHORT YELLOW, AND SHORT CLEARANCE TESTS:

| | | |
|-----------------------|---------------------------------|--------------------------------|
| Green Signal Inputs: | OFF < 50 V _{RMS} | ON > 70 V _{RMS} |
| Walk Signal Inputs: | OFF < 50 V _{RMS} | ON > 70 V _{RMS} |
| Yellow Signal Inputs: | OFF < 50 V _{RMS} | ON > 70 V _{RMS} |
| Red Signal Inputs: | OFF < 50 V _{RMS} | ON > 70 V _{RMS} |

POWER FAIL:

| | | |
|----------------|-------------------------------------|-------------------------------------|
| AC Line Input: | Dropout < 89 V _{RMS} | Restore > 98 V _{RMS} |
|----------------|-------------------------------------|-------------------------------------|

DC VOLTAGE INPUTS:

| | | |
|-----------------|--------------------------|----------------------------|
| +24 VDC Inputs: | Fault < +18 VDC | No Fault > +22 VDC |
| +12 VDC Input: | Fault < +10.75 VDC | No Fault > +11.5 VDC |

LOGIC INPUTS:

| | | |
|-----------------------------|--------------------|----------------------|
| CVM: | True< +8 VDC | False> +16 VDC |
| External Reset Input: | True< +8 VDC | False> +16 VDC |
| +24V Monitor Inhibit Input: | True< +8 VDC | False> +16 VDC |
| Port 1 Disable Input: | True< +8 VDC | False> +16 VDC |
| Type Select Input: | True< +8 VDC | False> +16 VDC |
| Local Flash Input: | True< +8 VDC | False> +16 VDC |
| External Watchdog Input: | True< +8 VDC | False> +16 VDC |

RESET: Meets and/or exceeds NEMA TS 2-2003 specifications. The monitor can be manually reset by depressing the **RESET** pushbutton on the front panel.

3.3 TIMING FUNCTIONS

| | | |
|----------------------|--------------------------------------------------------------------------------------|---------------------------------------------------|
| START DELAY: | | 2.0 sec (± 0.5 sec) |
| MINIMUM FLASH: | | 6 to 16 sec (± 1 sec) |
| PORT 1 FAIL: | | Typical 300 msec |
| FIELD CHECK FAIL: | | Typical 1000 msec |
| CONFLICT: | No Fault< 200 msec | Typical 300 msec |
| RED FAIL: | No Fault< 700 msec | Typical 800 msec |
| CVM FAULT: | No Fault< 125 msec | Typical 150 msec |
| +24 VDC MONITOR: | No Fault< 125 msec | Typical 150 msec |
| CLEARANCE FAIL: | No Fault< 2.8 sec | Typical 2.7 sec |
| DUAL INDICATION: | No Fault< 300 msec | Typical 500 msec |
| MONITOR POWER FAIL: | Ignore< 450 msec | Typical 483 msec |
| FLASHING DON'T WALK: | Flashing if state changes are > 200 msec and < 600 msec No Fault< 1400 msec | Typical 500 msec Typical 1500 msec |
| | | |

3.4 CONNECTOR PIN ASSIGNMENTS

Connector A

| Pin | Function (Type 16) | I/O | Function (Type 12) | I/O |
|-----|------------------------------------------------|-----|------------------------------------------------|-----|
| A | AC Line | I | AC Line | I |
| B | Output Relay 1 N.O. (Closes When Fault Occurs) | O | Output Relay 1 N.O. (Closes When Fault Occurs) | O |
| C | Output Relay 2 N.C. (Opens When Fault Occurs) | O | Output Relay 2 N.C. (Opens When Fault Occurs) | O |
| D | Channel 12 Green | I | Channel 12 Green | I |
| E | Channel 11 Green | I | Channel 11 Green | I |
| F | Channel 10 Green | I | Channel 10 Green | I |
| G | Channel 9 Green | I | Channel 9 Green | I |
| H | Channel 8 Green | I | Channel 8 Green | I |
| J | Channel 7 Green | I | Channel 7 Green | I |
| K | Channel 6 Green | I | Channel 6 Green | I |
| L | Channel 5 Green | I | Channel 5 Green | I |
| M | Channel 4 Green | I | Channel 4 Green | I |
| N | Channel 3 Green | I | Channel 3 Green | I |
| P | Channel 2 Green | I | Channel 2 Green | I |
| R | Channel 1 Green | I | Channel 1 Green | I |
| S | +24V Monitor I | I | +24V Monitor I | I |
| T | Logic Ground | I | Logic Ground | I |
| U | Earth Ground | I | Earth Ground | I |
| V | AC Neutral | I | AC Neutral | I |
| W | Output Relay 1 Common | I | Output Relay 1 Common | I |
| X | Output Relay 2 Common | I | Output Relay 2 Common | I |
| Y | Channel 12 Yellow | I | Channel 12 Yellow | I |
| Z | Channel 11 Yellow | I | Channel 11 Yellow | I |
| a | Channel 10 Walk (Type 12 Only) | I | Channel 10 Walk | I |
| b | Channel 10 Yellow | I | Channel 10 Yellow | I |
| c | Channel 9 Yellow | I | Channel 9 Yellow | I |
| d | Channel 8 Yellow | I | Channel 8 Yellow | I |
| e | Channel 7 Yellow | I | Channel 7 Yellow | I |
| f | Channel 6 Yellow | I | Channel 6 Yellow | I |
| g | Channel 5 Yellow | I | Channel 5 Yellow | I |
| h | Channel 3 Yellow | I | Channel 3 Yellow | I |
| i | Channel 15 Green | I | Channel 3 Walk | I |
| j | Channel 2 Yellow | I | Channel 2 Yellow | I |
| k | Channel 1 Yellow | I | Channel 1 Yellow | I |
| m | Controller Voltage Monitor | I | Controller Voltage Monitor | I |
| n | +24V Monitor Inhibit | I | +24V Monitor Inhibit | I |
| p | Output Relay 1 N.C. (Opens When Fault Occurs) | O | Output Relay 1 N.C. (Opens When Fault Occurs) | O |
| q | Output Relay 2 N.O. (Closes When Fault Occurs) | O | Output Relay 2 N.O. (Closes When Fault Occurs) | O |
| r | Channel 12 Walk (Type 12 Only) | I | Channel 12 Walk | I |
| s | Channel 11 Walk (Type 12 Only) | I | Channel 11 Walk | I |
| t | Channel 9 Walk (Type 12 Only) | I | Channel 9 Walk | I |
| u | Channel 16 Yellow | I | Channel 8 Walk | I |
| v | Channel 15 Yellow | I | Channel 7 Walk | I |
| w | Channel 13 Yellow | I | Channel 5 Walk | I |
| x | Channel 4 Yellow | I | Channel 4 Yellow | I |
| y | Channel 14 Green | I | Channel 2 Walk | I |
| z | Channel 13 Green | I | Channel 1 Walk | I |
| AA | Spare 1 | - | Spare 1 | - |
| BB | Reset | I | Reset | I |
| CC | Cabinet Interlock A | I | Cabinet Interlock A | I |
| DD | Cabinet Interlock B | O | Cabinet Interlock B | O |
| EE | Channel 14 Yellow | I | Channel 6 Walk | I |
| FF | Channel 16 Green | I | Channel 4 Walk | I |
| GG | Spare 2 | - | Spare 2 | - |
| HH | Type Select | I | Type Select | I |

Connector B

| Pin | Function (Type 16) | I/O | Function (Type 12) | I/O |
|-----|----------------------------------------------------|-----|----------------------------------------------------|-----|
| A | AC Line | I | AC Line | I |
| B | Start-Delay Relay Common | I | Start-Delay Relay Common | I |
| C | Start-Delay Relay N.O. (Closed During Start Delay) | O | Start-Delay Relay N.O. (Closed During Start Delay) | O |
| D | Channel 12 Red | I | Channel 12 Red | I |
| E | Channel 11 Red | I | Channel 11 Red | I |
| F | Channel 9 Red | I | Channel 9 Red | I |
| G | Channel 8 Red | I | Channel 8 Red | I |
| H | Channel 7 Red | I | Channel 7 Red | I |
| J | Channel 6 Red | I | Channel 6 Red | I |
| K | Channel 5 Red | I | Channel 5 Red | I |
| L | Channel 4 Red | I | Channel 4 Red | I |
| M | Channel 2 Red | I | Channel 2 Red | I |
| N | Channel 1 Red | I | Channel 1 Red | I |
| P | Spare 1 | - | Spare 1 | - |
| R | +24V Monitor II | I | +24V Monitor II | I |
| S | External Watchdog (Spare 2) | I | External Watchdog (Spare 2) | I |
| T | Channel 13 Red | I | Channel 13 Red (Type 16 Only) | I |
| U | Start-Delay Relay N.C. (Open During Start Delay) | O | Start-Delay Relay N.C. (Open During Start Delay) | O |
| V | Channel 10 Red | I | Channel 10 Red | I |
| W | Channel 14 Red | I | Channel 14 Red (Type 16 Only) | I |
| X | Channel 15 Red | I | Channel 15 Red (Type 16 Only) | I |
| Y | Channel 16 Red | I | Channel 16 Red (Type 16 Only) | I |
| Z | Channel 3 Red | I | Channel 3 Red | I |
| a | Red Enable | I | Red Enable | I |
| b | Spare 3 | - | Spare 3 | - |
| c | Local Flash Status | I | Local Flash Status | I |

POR T1 SDLC Connector

| Pin | Function |
|-----|----------------------------------|
| 1 | RX Data + |
| 2 | Logic Ground |
| 3 | RX Clock + |
| 4 | Logic Ground |
| 5 | TX Data + |
| 6 | Logic Ground |
| 7 | TX Clock + |
| 8 | Logic Ground |
| 9 | RX Data - |
| 10 | Port 1 Disable (0 VDC = Disable) |
| 11 | RX Clock - |
| 12 | Earth Ground |
| 13 | TX Data - |
| 14 | Reserved |
| 15 | TX Clock - |

COMM PORT Connector

| Pin | Function |
|-----|---------------|
| 1 | No Connection |
| 2 | TX Data |
| 3 | RX Data |
| 4 | No Connection |
| 5 | Ground |
| 6 | No Connection |
| 7 | No Connection |
| 8 | No Connection |
| 9 | No Connection |

ETHERNET Connector

| Pin | Function |
|-----|-----------------------|
| 1 | Transmit Data + |
| 2 | Transmit Data - |
| 3 | Receive Data + |
| 4 | Not Used (Terminated) |
| 5 | Not Used (Terminated) |
| 6 | Receive Data - |
| 7 | Not Used (Terminated) |
| 8 | Not Used (Terminated) |

3.5 PROGRAMMING CARD PIN ASSIGNMENTS

Connector P1

| Pin | Row A Channel Pair | Row B Channel Pair | Row C Channel Pair |
|-----|--------------------|--------------------|--------------------|
| 1 | 1-2 | 1-3 | 1-4 |
| 2 | 1-5 | 1-6 | 1-7 |
| 3 | 1-8 | 1-9 | 1-10 |
| 4 | 1-11 | 1-12 | 1-13 |
| 5 | 1-14 | 1-15 | 1-16 |
| 6 | 2-3 | 2-4 | 2-5 |
| 7 | 2-6 | 2-7 | 2-8 |
| 8 | 2-9 | 2-10 | 2-11 |
| 9 | 2-12 | 2-13 | 2-14 |
| 10 | 2-15 | 2-16 | 3-4 |
| 11 | 3-5 | 3-6 | 3-7 |
| 12 | 3-8 | 3-9 | 3-10 |
| 13 | 3-11 | 3-12 | 3-13 |
| 14 | 3-14 | 3-15 | 3-16 |
| 15 | 4-5 | 4-6 | 4-7 |
| 16 | 4-8 | 4-9 | 4-10 |
| 17 | 4-11 | 4-12 | 4-13 |
| 18 | 4-14 | 4-15 | 4-16 |
| 19 | 5-6 | 5-7 | 5-8 |
| 20 | 5-9 | 5-10 | 5-11 |
| 21 | 5-12 | 5-13 | 5-14 |
| 22 | 5-15 | 5-16 | 6-7 |
| 23 | 6-8 | 6-9 | 6-10 |
| 24 | 6-11 | 6-12 | 6-13 |
| 25 | 6-14 | 6-15 | 6-16 |
| 26 | 7-8 | 7-9 | 7-10 |
| 27 | 7-11 | 7-12 | 7-13 |
| 28 | 7-14 | 7-15 | 7-16 |
| 29 | 8-9 | 8-10 | 8-11 |
| 30 | 8-12 | 8-13 | 8-14 |
| 31 | 8-15 | 8-16 | 9-10 |
| 32 | Common | Common | Common |
| | | | |

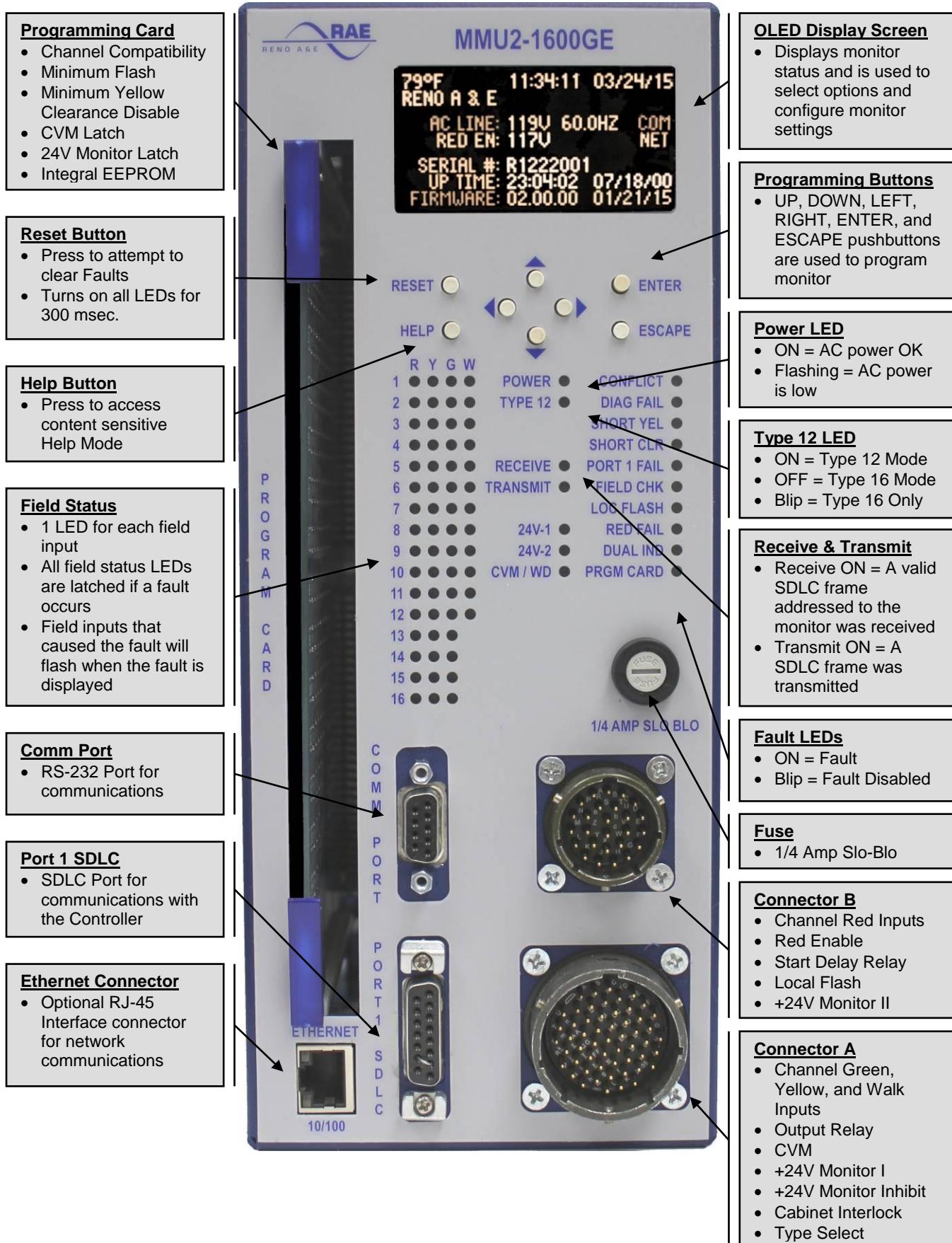
Connector P2

| Pin | Row A Channel Pair | Row B Channel Pair | Row C Channel Pair |
|-----|--------------------|--------------------|--------------------|
| 1 | 9-11 | 9-12 | 9-13 |
| 2 | 9-14 | 9-15 | 9-16 |
| 3 | 10-11 | 10-12 | 10-13 |
| 4 | 10-14 | 10-15 | 10-16 |
| 5 | 11-12 | 11-13 | 11-14 |
| 6 | 11-15 | 11-16 | 12-13 |
| 7 | 12-14 | 12-15 | 12-16 |
| 8 | 13-14 | 13-15 | 13-16 |
| 9 | 14-15 | 14-16 | 15-16 |
| 10 | MYCD-1 | MYCD-2 | MYCD-3 |
| 11 | MYCD-4 | MYCD-5 | MYCD-6 |
| 12 | MYCD-7 | MYCD-8 | MYCD-9 |
| 13 | MYCD-10 | MYCD-11 | MYCD-12 |
| 14 | MYCD-13 | MYCD-14 | MYCD-15 |
| 15 | MYCD-16 | Reserved | Reserved |
| 16 | Reserved | Reserved | Reserved |
| 17 | Reserved | Reserved | Reserved |
| 18 | Reserved | Reserved | Reserved |
| 19 | Reserved | Reserved | Reserved |
| 20 | Reserved | Reserved | Reserved |
| 21 | Minimum Flash | Minimum Flash | Minimum Flash |
| 22 | Minimum Flash | 24V Latch | CVM Latch |
| 23 | Reserved | Reserved | Reserved |
| 24 | Reserved | Reserved | Reserved |
| 25 | Reserved | Reserved | Reserved |
| 26 | Reserved | Reserved | Reserved |
| 27 | Reserved | Reserved | Reserved |
| 28 | Reserved | Reserved | Reserved |
| 29 | Reserved | Reserved | Reserved |
| 30 | +5 VDC | Reserved | EEPROM WP |
| 31 | EEPROM Data | Reserved | EEPROM Clock |
| 32 | Common | Common | Common |
| | | | |

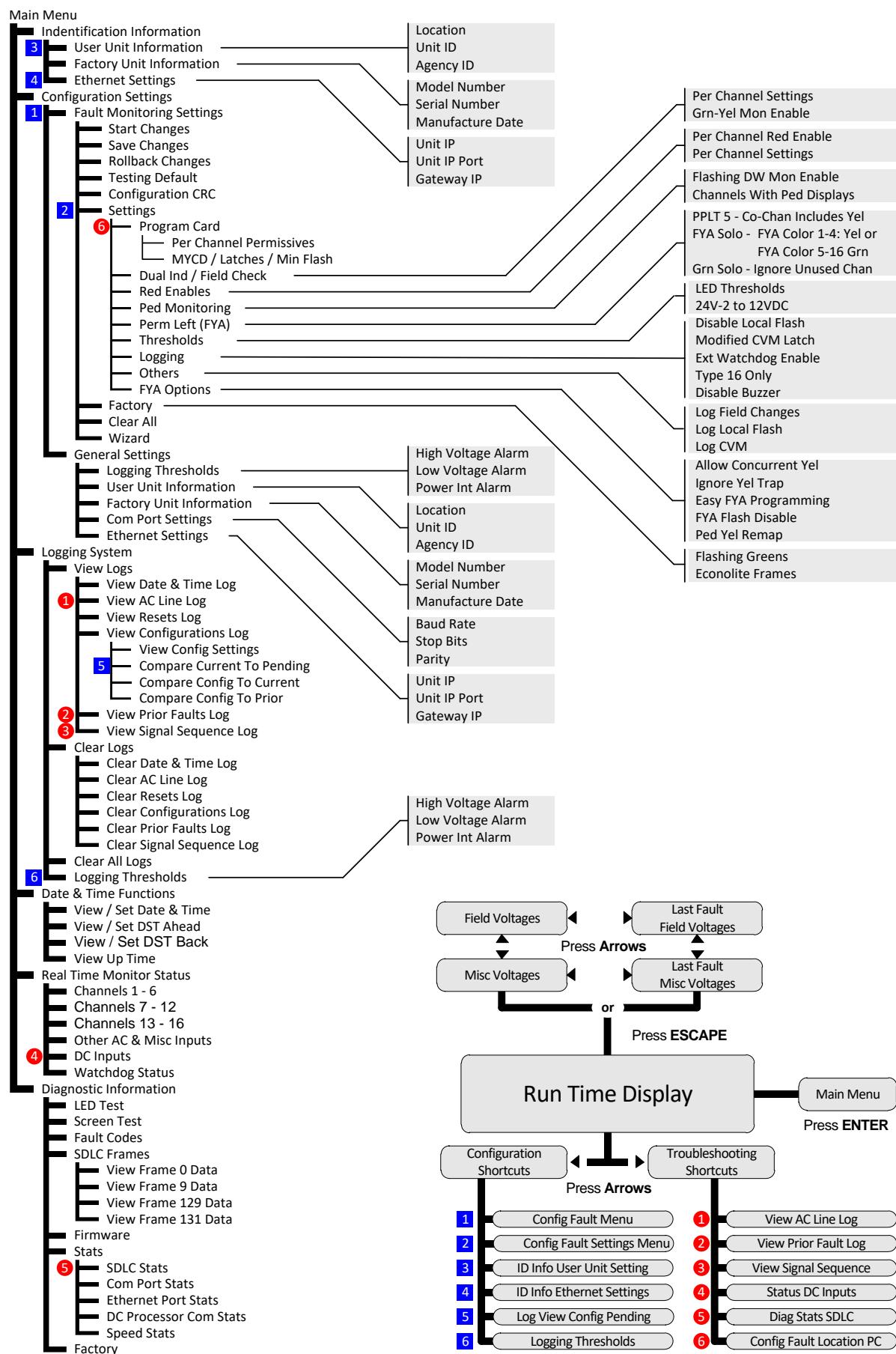
3.6 PROGRAMMING CARD MINIMUM FLASH PROGRAMMING

| Position 8 | Position 4 | Position 2 | Position 1 | Delay Time (Seconds) |
|------------|------------|------------|------------|----------------------|
| Open | Open | Open | Open | 6 |
| Open | Open | Open | Jumper | 6 |
| Open | Open | Jumper | Open | 6 |
| Open | Open | Jumper | Jumper | 6 |
| Open | Jumper | Open | Open | 6 |
| Open | Jumper | Open | Jumper | 6 |
| Open | Jumper | Jumper | Open | 7 |
| Open | Jumper | Jumper | Jumper | 8 |
| Jumper | Open | Open | Open | 9 |
| Jumper | Open | Open | Jumper | 10 |
| Jumper | Open | Jumper | Open | 11 |
| Jumper | Open | Jumper | Jumper | 12 |
| Jumper | Jumper | Open | Open | 13 |
| Jumper | Jumper | Open | Jumper | 14 |
| Jumper | Jumper | Jumper | Open | 15 |
| Jumper | Jumper | Jumper | Jumper | 16 |

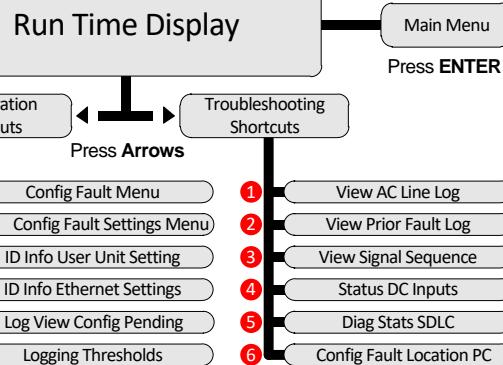
4.0 USER INTERFACE



4.1 GRAPHIC DISPLAY MENU STRUCTURE



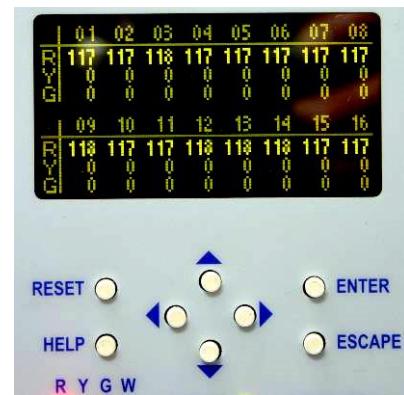
Run Time Display



4.2 FRONT PANEL DISPLAY AND PUSHBUTTONS

The MMU-1600G incorporates an Organic Light Emitting Diode (OLED) graphic display that provides an indication of monitor status and programming configuration and eight (8) momentary contact pushbutton switches that are used to select and program monitor options and settings. The monitor does have a screen saver mode for the display. Ten minutes after the last pushbutton press a screen saver will be displayed. The screen will gradually fade to black over a period of 60 minutes. Pressing any pushbutton will return the display to its display prior to the screen saver becoming active.

Up Pushbutton – The pushbutton labeled **▲** is used to navigate through menu selections or settings being viewed. Pressing this pushbutton while at the top of a menu will advance the cursor to the last menu item. If the setting being viewed can be changed, and the setting is displayed on a line consisting of more than one entry, pressing this pushbutton will increment the setting. When at the Run Time Display, this button will increase the front panel LED dimming level.



Down Pushbutton – The pushbutton labeled **▼** is used to navigate through menu selections or settings being viewed. Pressing this pushbutton while at the bottom of a menu will advance the cursor to the first menu item. If the setting being viewed can be changed, and the setting is displayed on a line consisting of more than one entry, pressing this pushbutton will decrement the setting. When at the Run Time Display, this button will decrease the front panel LED dimming level.

Left Pushbutton – The pushbutton labeled **◀** is used to navigate through menu selections or settings being viewed. If the setting being viewed can be changed, and the setting is displayed on a line consisting of more than one entry, pressing this pushbutton will advance the cursor to the setting to the left of the current entry. If the setting being viewed can be changed, and the setting is displayed on a line consisting of a single entry, pressing this pushbutton will decrement the setting. When at the Run Time Display, this button will display the Configuration Shortcuts menu.

Right Pushbutton – The pushbutton labeled **▶** is used to navigate through menu selections or settings being viewed. If the setting being viewed can be changed, and the setting is displayed on a line consisting of more than one entry, pressing this pushbutton will advance the cursor to the setting to the right of the current entry. If the setting being viewed can be changed, and the setting is displayed on a line consisting of a single entry, pressing this pushbutton will increment the setting. When at the Run Time Display, this button will display the Troubleshooting Shortcuts menu.

Reset Pushbutton – The pushbutton labeled **RESET** is used to reset the monitor. When the pushbutton is pressed, all front panel LEDs will be illuminated for 300 milliseconds to confirm the reset of the monitor. The **RESET** pushbutton is also used to access a diagnostic display mode that allows the user to view the current line voltage, active configurations settings, and past faults. See Section [4.9](#) for details.

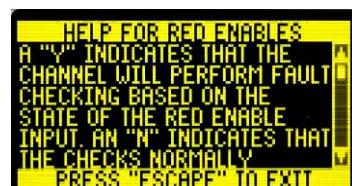
Help Pushbutton – The pushbutton labeled **HELP** is used to access a context sensitive help function. Pressing this pushbutton will bring up a display screen explaining the items displayed on the screen at the time the pushbutton was pressed.

Enter Pushbutton – The pushbutton labeled **ENTER** has several functions. From the Run Time display it is used to access the Main Menu. In a menu it is used to select a menu item. From a data screen it may be used to select characters to be modified, toggle settings, or accept changes to parameters that have been modified.

Escape Pushbutton – The pushbutton labeled **ESCAPE** is used to return to the prior screen displayed.

4.3 HELP SYSTEM

The monitor contains a very extensive, context sensitive help system that is activated by pressing the pushbutton labeled **HELP**. The help display includes a scroll bar on the right side where the position of the scroll button indicates your position in this help topic and the size of the button indicates the amount of the help text that is currently displayed. Use the up (**▲**) or down (**▼**) pushbuttons to scroll through the help topic and use the **HELP** or **ESCAPE** pushbuttons to exit the help system.



When a fault is displayed at the Run Time display, pressing the **HELP** pushbutton will display information about this type of fault and how to troubleshoot it.

4.4 RUN TIME DISPLAY

4.4.1 Normal

When first powered up and operating normally, the display will show the current temperature, time, and date; the user configurable monitor location and IP address; current AC line voltage and Red Enable voltage; current communication port and/or Ethernet port activity indicators; and monitor serial number, up time, and firmware version.

From this screen the user can press:

- ENTER** to access the Main Menu
- ESCAPE** to access the Real Time Field Voltage Display
- ▲ to increase the front panel LED dimming level
- ▼ to decrease the front panel LED dimming level
- ◀ to access the Configuration Shortcuts menu
- ▶ to access the Troubleshooting Shortcuts menu
- HELP** to access the context sensitive help system

74°F 10:39:12 04/09/08
S. VIRGINIA & LONGLEY
AC LINE: 121V 60.0HZ COM
RED EN: 121V NET
SERIAL #: 11223344
UP TIME: 12:03:18 00/02/00
FIRMWARE: 01.07.00 04/07/08

4.4.2 Fault

When a fault has been detected, the normal display will have the type of fault and date/time the fault occurred overlaid on the bottom portion of the screen and on an inverse background. Pressing **HELP** will display information relevant to the current fault. Pressing **ESCAPE** will display the field voltages latched at the time of the fault.

4.4.3 Changes Pending

When the monitor detects that a configuration change has occurred that should be logged, the monitor will begin to beep at a one hertz rate and the Run Time display will indicate that changes are pending. These changes will not be implemented until the changes are explicitly accepted. This can be done by pressing and holding the **RESET** pushbutton for five seconds until the monitor gives five quick confirmation beeps or navigate to the Fault Monitoring Menu and select Save Changes.

81°F 09:09:19 06/09/08
IP: 192.168.001.034:10001
AC LINE: 119V 60.0HZ COM
RED EN: 0V NET
CUM FAULT
OCCURRED: 06/09/08 08:32:59

82°F 09:15:49 06/09/08
RENO A&E ENGINEERING LAB
AC LINE: 118V 60.0HZ COM
RED EN: 0V NET
CHANGES PENDING
PRESS "HELP" FOR MORE INFO.

82°F 09:14:23 06/09/08
RENO A&E ENGINEERING LAB
AC LINE: 119V 60.0HZ COM
RED EN: 0V NET
UPGRADE PENDING
CYCLE POWER TO COMPLETE.

4.4.4 Upgrade Pending

When new firmware has been downloaded in to the monitor, the Run Time display will indicate that there is a pending upgrade and that you need to cycle power to complete the upgrade process.

4.5 VOLTAGE DISPLAYS

Pressing the **ESCAPE** pushbutton at the Run Time display accesses the Voltage Displays. There are four possible displays: Real Time Field Voltages, Real Time Misc. Voltages, Last Fault Field Voltages, and Last Fault Misc. Voltages. If a fault is currently displayed on the Run Time display the Last Fault Field Voltages will be the first screen displayed. These are the voltages on the inputs at the time of the fault. If there is no fault then the Real Time Field Voltages will be displayed first and are updated every 100 milliseconds. If the voltages for the last fault are being displayed, a text box with the text "LAST FAULT STATUS" will be displayed once every five seconds so that the user can easily distinguish real time voltages from latched fault voltages.

| | | | | | | | | |
|---|-----|-----|-----|-----|-----|-----|-----------|-----|
| | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 |
| R | 117 | 117 | 118 | 117 | 117 | 117 | 117 | 117 |
| Y | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| R | 118 | 117 | 117 | 118 | 118 | 118 | 117 | 117 |
| Y | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

REAL TIME STATUS
LINE: 117V RED EN: 117V
24U-1: 24.5V TYPE SEL: 00.00
24U-2: 24.5V LOC FLASH: 24.50
24 INH: 24.5V EXT RESET: 24.50
CUM: 00.00 EXT WD: 24.50
PORT1 DISABLE: YES
PRESS "ESCAPE" TO EXIT

From these screens the user can press:

- ENTER** to return to the Run Time display
- ESCAPE** to return to the Run Time display
- ▲ or ▼ toggle between field and misc. voltages
- ◀ or ▶ toggle between real time and last fault voltages
- HELP** to access the context sensitive help system

4.6 MAIN MENU

Pressing the **ENTER** pushbutton at the Run Time display accesses the Main Menu. The currently selected menu item will flash at a one hertz rate. To navigate to the selected menu item, press the **ENTER** pushbutton. A grayed out menu item is not accessible. The item will be skipped when navigating within the menu screen.

Press the **ESCAPE** pushbutton to move backward through the menu selections. The monitor will automatically select the item on the menu that was just exited as a reminder of where you have been.

| MENU TEXT | MENU FUNCTION |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IDENTIFICATION INFORMATION | View and/or edit the identifying information of user unit information, factory unit information, and Ethernet settings. |
| CONFIGURATION SETTINGS | View and/or edit the configuration settings of the monitor. |
| LOGGING SYSTEM | View and/or clear monitor logs. |
| DATE & TIME SETTINGS | View and/or edit the monitor date and time, daylight saving settings, and monitor uptime. |
| REAL TIME MONITOR STATUS | View all inputs to the monitor. These include field voltages, AC line voltage, Red Enable Voltage, temperature, Port 1 errors, all DC input voltages, and watchdog timings. |
| DIAGNOSTIC INFO | Initiate certain diagnostic procedures or to view diagnostic information. |

4.6.1 Identification Menu

| MENU TEXT | MENU FUNCTION |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| USER UNIT INFORMATION | View and/or edit the Location text, Unit ID text, and Agency ID text. |
| FACTORY UNIT INFORMATION | View the Model Number, Serial Number, and Manufacture Date of the monitor. |
| ETHERNET SETTINGS | View and/or edit the Unit IP address, Unit IP Port, and Gateway IP address for this monitor. These settings can still be set even if the unit does not support Ethernet. |

4.6.1.1 User Unit Information

Use the up (▲) or down (▼) pushbuttons to navigate between the fields on the display. A flashing character will indicate the currently selected character position. Use the left (◀) or right (▶) pushbutton to select the desired character position. Press the **ENTER** pushbutton to enter the data entry mode. Use the left (◀) or right (▶) pushbutton to select the desired text character and press the **ENTER** pushbutton to accept and store the character selected. Press the **ESCAPE** pushbutton to save the data on this display and exit to the previous display.

LOCATION – This text field is 40 characters long. The user can edit this field. This field is typically used to store the intersection that the monitor is installed at (example: VIRGINIA AVE. & LONGLEY AVE.)

UNIT ID – This text field is four (4) characters long. The user can edit this field. This field is typically used to store a unique intersection ID assigned by the agency maintaining the intersection.

AGENCY ID – This text field is five (5) characters long. The user can edit this field. This field is typically used to store an agency ID. This can be very useful when an agency or contractor provides maintenance services for more than one agency.

4.6.1.2 Factory Unit Information

This screen is read only and therefore there will be no cursor displayed on this screen. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

MODEL NUMBER – This text field is 20 characters long. The user cannot edit this field.

SERIAL NUMBER – This text field is 8 characters long. The user cannot edit this field.

MANUFACTURE DATE – This is a date field. The user cannot edit this field. This is the date that the monitor passed final quality testing.

4.6.1.3 Ethernet Settings

Use the left (◀) or right (▶) pushbutton to select the field to change. Use the up (▲) or down (▼) pushbutton to change the highlighted value. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to save the data on this display and exit to the previous display. These values can be edited even if the Ethernet option is not installed on the unit.

UNIT IP – The Unit IP address can be user configured from 0.0.0.0 to 255.255.255.255. The factory default setting is 0.0.0.0. Consult your Network Administrator for appropriate values for your network.

UNIT IP PORT – The Unit IP Port can be user configured from 00000 to 65535. The factory default setting is 10001. The factory default should be used unless your Network Administrator deems that a different port is desired for routing purposes.

GATEWAY IP – The Gateway IP address can be user configured from 0.0.0.0 to 255.255.255.255. The factory default setting is 0.0.0.0. This field is to support future features and currently is not used.

4.6.2 Configuration Menu

| MENU TEXT | MENU FUNCTION |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FAULT MONITORING SETTINGS | Access the Fault Monitoring Menu. This menu contains all of the displays for viewing and/or editing configuration settings that affect the fault monitoring abilities of the monitor. The monitor will log any change to any of these settings. |
| GENERAL SETTINGS | View and/or edit the configuration settings that do not affect the fault monitoring capabilities of the monitor. |

4.6.2.1 Fault Monitoring Menu

The right side of the menu divider bar (the dashes on the second line of the display) is used to provide an indication of the current status of the editing session. When an editing session has not been started the monitor will show a status of locked that will be indicated by **LCK**. When an editing session has been started but no changes have actually been made the monitor will show a status of unlocked that will be indicated by a flashing **UNL**. Once a modification has been made to any parameter, the flashing message will change from **UNL** to **MOD**. When the change has been canceled or saved (see below), the message will cease flashing and the display will return to **LCK**.

| MENU TEXT | MENU FUNCTION |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| START CHANGES or CANCEL CHANGES | Start an editing session or Cancel an editing session once one has been started. |
| SAVE CHANGES | Save any changes made during an editing session. |
| ROLLBACK CHANGES | Reactivate a prior set of configuration settings. |
| TESTING DEFAULTS | Set all configuration settings in the monitor to a known state that is usually the correct one for automated testing. |
| CONFIGURATION CRC | Display the CRC value for the last ten configurations. |
| SETTINGS | Access the menu for view and/or editing all of the individual configuration settings. |
| FACTORY | View the factory configuration settings. |
| CLEAR ALL | Set the configuration options for this monitor to the factory defaults. |
| WIZARD | Access the configuration wizard that can be used to automatically configure most settings in the monitor. |

4.6.2.1.1 Start Configuration

Before a change can be made to any Fault Monitoring setting, an editing session must be started. To initiate changes to the Fault Monitoring settings, use the arrow pushbuttons to select **YES** and press the **ENTER** pushbutton to unlock the monitor and confirm the start of an editing session of the Fault Monitoring configuration.

4.6.2.1.2 Cancel Configuration

To cancel any changes made to any Fault Monitoring setting, use the arrow pushbuttons to select **YES** and press the **ENTER** pushbutton to confirm the cancellation of the editing session and lock the monitor.

4.6.2.1.3 Save Configuration

To save changes to the Fault Monitoring settings use the arrow pushbuttons to select **YES** and press the **ENTER** pushbutton to confirm using the new Fault Monitoring settings and lock the monitor.

NOTE: When a new Fault Monitoring configuration has been saved, the monitor will provide an audible confirmation of the new configuration by sounding the buzzer (five chirps).

4.6.2.1.4 Rollback Changes

The monitor records the ten (10) most recent Fault Monitoring configurations in the Configurations Log. The Rollback Changes feature allows the user to select and restore any one of the ten previously used configurations.

Use the up (**▲**) or down (**▼**) pushbutton to select the desired previous configuration to restore and press the **ENTER** pushbutton to confirm the rollback and lock the monitor, or press the **ESCAPE** pushbutton to exit the Rollback Changes function.

NOTE: The program card settings of the previously stored configuration must match the settings on the programming card installed in the monitor or the configuration will be grayed out and inaccessible. If you want to use a grayed out configuration, insert the correct program card for that configuration and it will become selectable.

NOTE: The monitor will provide an audible confirmation of restoration of a previous configuration by sounding the buzzer (five chirps).

4.6.2.1.5 Testing Defaults

The Testing Defaults function can be used to quickly configure the monitor with the factory recommended settings for the purpose of automated testing. The testing defaults are all Dual Enables turned on, all other features turned off, the currently installed program card is used, and Daylight Saving and Buzzer Disable are not changed from their current settings.

Use the arrow pushbuttons to select **YES** and press the **ENTER** pushbutton to configure the monitor with the factory recommended settings for testing and lock the monitor.

NOTE: The monitor will provide an audible confirmation of implementation of the factory recommended configuration by sounding the buzzer (five chirps).

4.6.2.1.6 Configuration CRC

The monitor is capable of calculating a CRC (Cyclic Redundancy Check) value for every recorded configuration. This screen displays the last ten configurations and the CRC value for each configuration. This screen is view only.

4.6.2.1.7 Config Settings Menu

If the monitor has an editing session open, the menu items will be inverted if any setting accessed through that menu item has been changed. If the monitor has an editing session open, the display screens accessed through this menu will have a flashing cursor for any display that contains editable settings. If the monitor is locked (no editing session open), all of the display screens will be read-only and will not have a cursor displayed. The monitor will always indicate any pending setting changes by displaying the pending settings in inverse. This pending status is updated in real-time so that if changes were made to a monitor through the COM port or the Ethernet port while someone was viewing the display for that setting, the pending change would be immediately visible.

| MENU TEXT | MENU FUNCTION |
|----------------|------------------------------------------------------------------|
| PROGRAM CARD | Access the menu for viewing the program card settings. |
| DUAL IND / FC | View and/or modify the Dual Indication / Field Check settings. |
| RED ENABLES | View and/or modify the Per Channel Red Enables settings. |
| PED MONITORING | View and/or modify the pedestrian monitoring settings. |
| FYA LEFT TURNS | View and/or modify the Flashing Yellow Arrow Left Turn settings. |
| CO-CHANNELS | View and/or modify the Co-Channel settings. |
| THRESHOLDS | View and/or modify threshold settings. |
| LOGGING | View and/or modify the logging settings. |
| OTHERS | View and/or modify other miscellaneous settings. |

4.6.2.1.7.1 Programming Card Menu

| MENU TEXT | MENU FUNCTION |
|----------------------------|----------------------------------------------------------------------------------------------------------|
| PER CHANNEL PERMISSIVES | View the permissive jumpers on the program card. |
| MYCD / LATCHES / MIN FLASH | View Minimum Yellow Change Disable, CVM Latch, 24V Latch, and Minimum Flash jumpers on the program card. |

4.6.2.1.7.1.1 Per Channel Permissives

Programming card permissive settings are displayed on a per channel basis. A jumper symbol (‡) indicates that a channel (the row) is jumpered as permissive with another channel (the column). A dash (–) indicates a non-permissive channel combination. This display is view only. Use the up (▲) or down (▼) pushbutton to scroll the viewing window to the other channels. This display is view only. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

4.6.2.1.7.1.2 Minimum Yellow Change Disable / Latches / Minimum Flash

This display is view only. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

MYCD – Programming card Minimum Yellow Change Disable settings are displayed on a per channel basis. A jumper symbol (‡) indicates that the Minimum Yellow Change is disabled for that channel. A dash (–) indicates the Minimum Yellow Change is not disabled. MYCD jumpers are usually not needed for monitors operating in the Type 12 mode. In Type 16 mode, MYCD jumpers are usually required for all pedestrian channels.

LATCHES – CVM Latch determines if the monitor latches a CVM fault and requires a front panel or external reset in order to return to normal signal operation. If set to NO, after a CVM fault has occurred, the monitor will return to normal signal operation once the CVM input returns to the valid (low) state and the Minimum Flash time has expired.

24V Latch determines if the monitor latches a +24V Monitor I or +24V Monitor II fault and requires a front panel or external reset in order to return to normal signal operation. If set to NO, after a +24V Monitor fault has occurred, the monitor will return to normal signal operation once both of the +24V Monitor inputs return to the valid (> +22VDC) state and the Minimum Flash time has expired.

MINIMUM FLASH – The Minimum Flash time displayed is the time setting that is jumpered on the program card. According to the NEMA specification, the monitor will add one second to the jumpered time to get the actual Minimum Flash time used and that the jumpered value cannot be less than five seconds. If the jumpered value is less than five seconds, it will be displayed as five seconds as this will be the value used.

4.6.2.1.7.2 Dual Indication / Field Check

Use the arrow pushbuttons to navigate between the settings. Use the **ENTER** pushbutton to toggle a setting. Press the **ESCAPE** pushbutton to exit.

CHANNEL 1-16 DUAL INDICATION / FIELD CHECK – When this feature is enabled for a channel, the channel will be checked for more than one field indication being sensed as ON and the monitor will check the field status of each indication against the controller commanded state for each indication. Dual Indication and Field Check testing for each channel are turned on or off together. Enabled is indicated by a **Y** and disabled is indicated by a dash (**-**). Typically all vehicle channels are enabled although special consideration should be given to channels that are part of a vehicle display with more than three sections. Pedestrian channels can be enabled, but care must be taken to insure that the monitoring of the yellow portion of the channel matches what the controller thinks it should be. If not considered, field check faults may occur. The factory default for the Dual Indication / Field Check settings are all channels enabled. See Section [2.5.3](#) for more detailed information on Dual Indication testing. See Section [2.5.7](#) for more detailed information on Field Check testing.

GRN-YEL MON ENABLED – When this feature is enabled the monitor will check for simultaneously active Green and Yellow field signal inputs on the same channel. This feature is active on all channels when selected and is not active if the Red Enable input is not active. The factory default for Green-Yellow Dual Indication monitoring is off. See Section [2.5.4](#) for more detailed information on Dual Indication testing.

The Green - Yellow Enable feature can be used in conjunction with the Field Check / Dual Enables feature. Channels which have their Field Check / Dual Enable settings enabled will perform full Dual Indication monitoring. Channels, which have their Field Check / Dual Enable settings disabled, will perform the Green-Yellow Dual Indication monitoring only.

4.6.2.1.7.3 Per Channel Red Enables

Use the arrow pushbuttons to navigate between the settings. Use the **ENTER** pushbutton to toggle the setting. Press the **ESCAPE** pushbutton to exit. See Section [2.6.5](#) for more detailed information on Per Channel Red Enables.

PER CHAN RED EN / CO-CHAN – When this feature is enabled the monitor will only perform Red Fail and Field Check monitoring for channels that have been enabled for this feature when the Red Enable input is active. Only the Red Fail and Field Check monitoring are affected by this feature. Other monitoring normally controlled by the Red Enable input (Short Yellow, Short Clearance, and Dual Indication) still operate as defined and are not affected in any way by the activation of this feature. The factory default for this feature is no.

Enabling this feature also enables the Co-Channel feature. The Co-Channel feature allows the user to modify the Red Fail test for each channel to include the Green, Yellow, and/or Walk displays from other channels.

CHANNEL 1-16 RED ENABLES – Enabled is indicated by a **Y** and disabled is indicated by a dash (**-**). The per channel settings will be active only if the Per Chan Red En / Co-Chan setting is set to **YES**. The factory default for the channel settings of this feature is all channels enabled.

4.6.2.1.7.4 Flashing Don't Walk Monitoring

Use the arrow pushbuttons to navigate between the settings. Use the **ENTER** pushbutton to toggle the setting. Press the **ESCAPE** pushbutton to exit. See Section [2.6.1](#) for more detailed information on Flashing Don't Walk Monitoring.

FLASH DW MON ENABLED – When this feature is enabled the monitor will check Flashing Don't Walk (channel Red) of the channels configured as Channels With Pedestrian Displays, to confirm that they do not conflict with other Greens, Yellows, or Walks at the intersection. When a fault is detected due to this feature, it is displayed as a Conflict and the channel with a flashing RED input that was involved in the detected fault will be flashing its RED LED.

CHANNEL 1-16 CHANNELS WITH PEDESTRIAN DISPLAYS SETTINGS – Enabled is indicated by a **Y** and disabled is indicated by a dash (**-**). In Type 12 mode of operation, any enabled channel will have its walk input removed from the red fail test. The factory default for the channel settings of this feature is all channels disabled.

4.6.2.1.7.5 Permissive Left Turn (FYA) Settings

The Permissive left turn (FYA) has 3 Selections.

PPLT5 – In this mode the Left turn indication consists of 5 Separate drivers. It modifies the Red Fail Test. The "Parent" Channel consists of the Green Ball, Yellow Ball and Red Ball signal indication. The "Child" Channel Consists of the Solid Green Left Turn Signal Indication, and the Solid Yellow Left Turn Signal Indication.

CO-CHAN INCLUDES YEL – When this feature is enabled the monitor will include the yellow of the child channels as well as the green (and the Walk if in Type 12 mode). The factory default for this feature is **NO**.

CHANNEL 1-16 FLASHING PPLT5 MAPPING

There should only be 1 mapping per channel. The channels that have the solid green ball indication need to be mapped to the channel with the solid left turn green arrow indication. Example 6→1. If the solid yellow arrow indication is not used then the CO-CHAN INCLUDES YEL feature should be set to no.

FYA SOLO – When in this mode wiring for the monitor is fairly straightforward. The Protected Green, Yellow and Red Signal indications are on a single channel. The Flashing Yellow Arrow (FYA) is located in a separate "Child" channel. The monitor will logically map all 4 signal heads to the "Parent" channel (The channel with the green signal indication).

FYA COLOR 1-4: When in FYA Solo mode the FYA can be mapped as a Green or Yellow Signal Indication in channels 1 to 4. This feature also allows you to have a split FYA mapping (ex FYA Mode M,N,O,P).

FYA COLOR 5-16: When in FYA Solo mode the FYA can be mapped as a Green or Yellow Signal Indication in channels 5 to 16. This feature also allows you to have a split FYA mapping (ex FYA Mode M,N,O,P).

NOTE: When in FYA Solo mode unused signal indications in a channel will not be monitored when Red Enable, and Dual Indication are turned **OFF**, no MYCD jumper installed and it is not a PED channel.

GREEN SOLO – In this mode the Green Signal indication is in the "Parent" Channel. The Flashing Yellow Arrow, Solid Yellow Arrow and Solid Red Arrow indication are in a separate "Child" channel. The monitor will logically map all 4 signal heads to the "Parent" channel (The channel with the green signal indication).

Ignore Unused Chan: If yes is selected the Yellow and Red drivers of the "Parent Channel" are ignored for conflict, dual indication, short clearance, and short yellow monitoring. If No is selected the Yellow and Red signal indications are monitored for all faults.

CHANNEL 1-16 FYA MATRIX – The 16 vertical numbers indicates the Parent channel (channels with the protected left turn green). The 16 horizontal numbers indicate the Child Channels, which defines the opposing thru and FYA channels).

The channels that have protected left turn green indication should have four mappings. If channel 1 is a protected left turn, A "X" is place in the 1-1 (see Diagram 1). Another "X" is place in the opposing thru channel (1-2). The third "X" is placed in the FYA channel (1-9). The fourth "X" associates the FYA channel with the protected channel (9-1).

Diagram1- Protected Left Turns 1,3,5,7, Opposing thru 2,4,6,8. FYAs 9,10,11,12.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|----|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|
| 1 | X | X | | | | | | | X | | | | | | | |
| 2 | | | | | | | | | | | | | | | | |
| 3 | | | X | X | | | | | | X | | | | | | |
| 4 | | | | | | | | | | | | | | | | |
| 5 | | | | X | X | | | | | | X | | | | | |
| 6 | | | | | | | | | | | | | | | | |
| 7 | | | | | X | X | | | | | | X | | | | |
| 8 | | | | | | | | | | | | | | | | |
| 9 | X | | | | | | | | | | | | | | | |
| 10 | | | X | | | | | | | | | | | | | |
| 11 | | | | X | | | | | | | | | | | | |
| 12 | | | | | X | | | | | | | | | | | |
| 13 | | | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | | | | | |
| 16 | | | | | | | | | | | | | | | | |

If Ped Remap Option is used then the Pedestrian Channel will be mapped to the channel where the green indication is displayed on the monitor. Example Mode F 13 → 9

4.6.2.1.7.6 FYA Options

ALLOW CONCURRENT YEL – If YES is selected the Yellow arrow terminating the Flushing Yellow arrow will not conflict with the Yellow ball for the opposing through movement. Most FYA implementations will need to use this feature. The factory default for this feature is **NO**.

IGNORE YEL TRAP - If **NO** is selected then the yellow following a FYA and the opposing thru green will conflict. If **YES** is selected then all yellow following a FYA and the opposing thru green will not conflict. A YES allows a faster preemption handling cycle if in FYA

EASY FYA PROGRAMMING — If **NO** is selected then permissive jumpers are required between the FYA channel and the associated protected channel. If **YES** is selected then the permissive jumpers are required between the FYA channel and the associated protected channel. The FYA channel follows the permissive of the associated opposing thru..

DISABLE FLASH RATE- If **NO** (default) is selected flash rate monitoring is active. If **YES** when the FYA is on for greater than 700 milliseconds, the MMU2 will fail with a Dual Indication failure. Bit 81 of the Type 129

PED YELLOW REMAP- This setting is not editable by the user. It is set using the MMU2 Wizard Configuration.

4.6.2.1.7.7 Threshold Settings

Use the up (▲) or down (▼) pushbutton to navigate between the settings. Use the **ENTER** pushbutton to toggle the setting. Press the **ESCAPE** pushbutton to exit.

LED THRESHOLDS – When this feature is enabled the monitor will use more restrictive AC voltage thresholds for determining the ON and OFF state of field indications. See Section [2.6.4](#) for more information. The factory default for this feature is **NO**.

24V-2 TO 12VDC – When this feature is enabled the +24V Monitor II input thresholds will be modified to monitor +12 VDC. The new voltage threshold will be 11.5 VDC and above, sensed as valid; 10.75 VDC and below, sensed as invalid. Voltages between these thresholds may be sensed as valid or invalid. See Section [2.6.7](#) for more information. The factory default for this feature is **NO**.

4.6.2.1.7.8 Logging Options

Use the up (▲) or down (▼) pushbutton to navigate between the settings. Use the **ENTER** pushbutton to toggle the setting. Press the **ESCAPE** pushbutton to exit.

LOG FIELD CHANGES – When this feature is enabled the monitor will make entries in the Signal Sequence log only when an input has changed state. Otherwise, the Signal Sequence log records an entry every 33 milliseconds. See Section [2.7.7.1](#) for more information. The factory default for this feature is **NO**.

LOG LOCAL FLASH EVENTS – When this feature is enabled the monitor will record Local Flash events in the Prior Faults log. See Section [2.7.7.2](#) for more information. The factory default for this feature is **YES**.

LOG CVM EVENTS – When this feature is enabled the monitor will record CVM events in the Prior Faults log. See Section [2.7.7.3](#) for more information. The factory default for this feature is **YES**.

4.6.2.1.7.9 Others / Miscellaneous Location Settings

Use the up (▲) or down (▼) pushbutton to navigate between the settings. Use the **ENTER** pushbutton to toggle the setting. Press the **ESCAPE** pushbutton to exit.

DISABLE LOCAL FLASH – When this feature is enabled the monitor will ignore the Local Flash input. The **LOC FLASH** indicator will show this function as disabled (50 milliseconds on, once every two seconds) when this feature is enabled. This feature can be useful in scenarios where you want to temporarily disable Local Flash. See Section [2.6.8](#) for more information. The factory default for this feature is **NO**.

MODIFIED CVM LATCH – When this feature is enabled and the CVM Latch Enable jumper is installed on the programming card, the CVM input will not latch a CVM failure until the CVM input has been valid for more than 175 milliseconds. See Section [2.6.6](#) for more information. The factory default for this feature is **NO**.

EXTERNAL WATCHDOG ENABLE – When this feature is enabled the monitor will verify the status of an optional external watchdog output from a Controller Unit or other external cabinet device. See Section [2.5.13](#) for more information. The factory default for this feature is **NO**.

TYPE 16 ONLY – When this feature is enabled the monitor will always operate in the Type 16 mode. See Section [2.4.4](#) for more information. The factory default for this feature is **NO**.

DISABLE BUZZER – When this feature is enabled the monitor will not use the buzzer to annunciate a pending configuration change. This feature can be useful in the lab environment where many changes are being made to the monitor

for testing purposes. It is not recommended that this feature be enabled for any monitor in the field. The factory default for this feature is **NO**.

4.6.2.1.8 Factory Settings

This display is view only. Press the **ESCAPE** pushbutton to exit.

FLASHING GREENS – When this feature is enabled the monitor will modify its Red Fail and Dual Indication timings to deal with the fast flashing Green indications used in Canada. Only monitors used in Canada should have this factory option enabled. See Section [2.6.9](#) for more information.

ECONOLITE FRAMES – When this feature is enabled the monitor will respond to special SDLC frames requested by Econolite controllers.

4.6.2.1.9 Clear All Settings

The Clear All Settings function can be used to quickly configure the monitor with all settings set to OFF.

Use the arrow pushbuttons to select **YES** and press the **ENTER** pushbutton to clear all settings in the monitor and lock the monitor.

NOTE: The monitor will provide an audible confirmation of implementation of the clear all settings function by sounding the buzzer (five chirps).

4.6.2.1.10 Wizard

IMPORTANT: It is the users responsibility to confirm that the settings generated by the wizard are appropriate for the actual intersection.

The wizard is used to quickly configure a monitor for intersections using standard dual ring phasing. The first screen is a reminder that the settings generated by the wizard are based on the information provided. Therefore, if you do not provide the correct information, the wizard will probably not generate the correct configuration.

4.6.2.1.10.1 General Questions

ANY LED SIGNAL HEADS – If any LED signals are used at the intersection select **YES**. If all indications are incandescent select **NO**.

PED CHANNELS – Selects the pedestrian channels. The choices are: **TS1** – The Walk indication is in the same channel as the vehicle throughs (Type 12 operation) and the Don't Walks are not monitored. **9-12** – The pedestrian indications are connected to channels 9 through 12. **13-16** – The pedestrian indications are connected to channels 13 through 16.

PED CH REDS TIED HIGH – If TS1 is selected for PED CHANNELS this item will show **N/A** and cannot be selected. Otherwise, select whether the pedestrian channel Red (Don't Walk) inputs are tied to AC+ in the cabinet or to the actual pedestrian channel Reds. The choices are: **YES** – The Red input is tied to AC+ and the Don't Walks are not monitored. **NO** – The Red (Don't Walk) inputs are connected to the Don't Walk indications.

USE EXTERNAL WATCHDOG – If the cabinet will use the external watchdog feature select **YES** otherwise select **NO**.

LEFT TURN CONFIGURATION – There are three selections **PROT, MMU2, CONF**.

PROT This left turn is a standard protected left turn movement. This is the default left turn type.

MMU2 Allows the selection of sixteen FYA configurations types (A thru P). This includes the eight Flashing Yellow Arrow (FYA) configuration types (A thru H) defined in NEMA TS 2-2003 (R2008) Amendment 4-2012. When a FYA configuration type is selected the following menu will display:

FYA CONFIGURATION – If **NO** is selected the Flashing Yellow Arrow permissives and the permissives for the yellow following the FYA are derived from the channel with the FYA driver. IF **YES** is selected the Flashing Yellow Arrow permissives and the permissives for the yellow following the FYA are derived from the opposing thru channel.

ALLOW CONCURRENT YEL – If the Yellow arrow for terminating the Flashing Yellow arrow is allowed to be on at the same time as the Yellow ball for the opposing through movement, select **YES**. If the Yellow arrow and the Yellow ball will never be on at the same time, select **NO**. This will be the same for all Flashing Yellow arrow left turns.

EASY FYA PROGRAMMING – If **NO** is selected then permissive jumpers are required between the FYA channel and the associated protected channel. If **YES** is selected then the permissive jumpers are required between the FYA channel and the associated protected channel. The FYA channel follows the permissive of the associated opposing thru.

IGNORE FYA UNUSED - If **NO** is selected the unused signal indications in a FYA application are monitored for all expected fault conditions. If **YES** is selected the unused signal indications are ignored, and will not cause a fault state.

IGNORE YEL TRAP - If **NO** is selected then the yellow following a FYA and the opposing thru green will conflict. If **YES** is selected then all yellow following a FYA and the opposing thru green will not conflict. A YES allows a faster preemption handling cycle if in FYA

DISABLE FLASH RATE - If **NO** (default) is selected flash rate monitoring is active. If the FYA is on for greater than 700 milliseconds, the MMU2 will fail with a Dual Indication failure. Bit 81 of the Type 129 Response Frame will be set to 1 to indicate a flash rate failure. If **YES** is selected and a FYA is on for more than 700 milliseconds the FYA will be treated as a solid yellow arrow indication.

Sixteen FYA Types

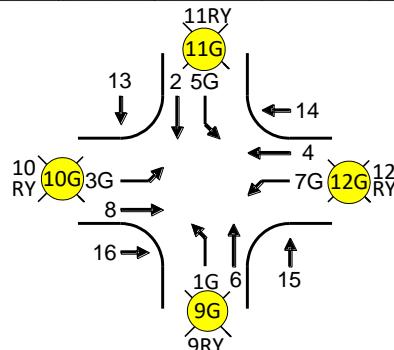
The FYA left turn requires a 4 section head. The 4 indications are a Red Arrow, Solid Yellow Arrow, Flashing Yellow Arrow (permissive) and a Green Arrow. This requires the MMU2 to use 2 channels to monitor A FYA left turn for the proper signals. Some of the MMU2 Configuration Types are more efficient in use of the MMU2 channels. This is important because the MMU2 has a limited number of channels.

Type A, B, C and D require 1 channel for each protected left turns (1, 3, 5, 7) and 4 channels for the 4 FYAs.

The MMU2 uses 16 channels to monitor the 8 phases and 4 Peds. This leaves 0 MMU2 channels available. The Red and Yellow or the Green of the Protected Left Turn has to be rewired.

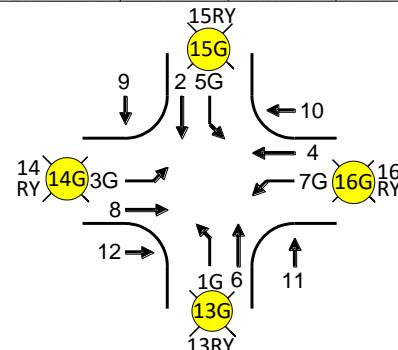
Type A

| Opposing Thru | Chan 2 | Chan 4 | Chan 6 | Chan 8 |
|---------------|----------|-----------|-----------|-----------|
| Left Turns | Chan 1 | Chan 3 | Chan 5 | Chan 7 |
| Red Arrow | 9 Red | 10 Red | 11 Red | 12 Red |
| Yellow Arrow | 9 Yellow | 10 Yellow | 11 Yellow | 12 Yellow |
| FYA Arrow | 9 Green | 10 Green | 11 Green | 12 Green |
| Green Arrow | 1 Green | 3 Green | 5 Green | 7 Green |



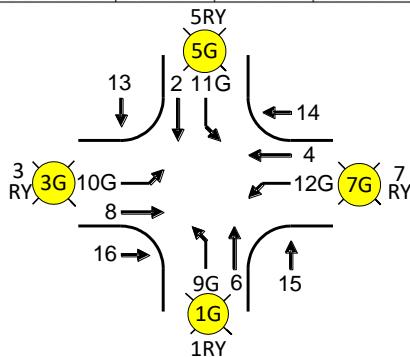
Type B

| Opposing Thru | Chan 2 | Chan 4 | Chan 6 | Chan 8 |
|---------------|-----------|-----------|-----------|-----------|
| Left Turns | Chan 1 | Chan 3 | Chan 5 | Chan 7 |
| Red Arrow | 13 Red | 14 Red | 15 Red | 16 Red |
| Yellow Arrow | 13 Yellow | 14 Yellow | 15 Yellow | 16 Yellow |
| FYA Arrow | 13 Green | 14 Green | 15 Green | 16 Green |
| Green Arrow | 1 Green | 3 Green | 5 Green | 7 Green |



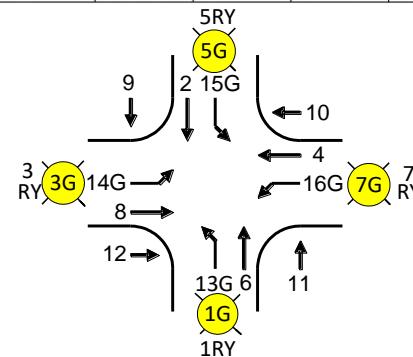
Type C

| Opposing Thru | Chan 2 | Chan 4 | Chan 6 | Chan 8 |
|---------------|----------|----------|----------|----------|
| Left Turns | Chan 1 | Chan 3 | Chan 5 | Chan 7 |
| Red Arrow | 1 Red | 3 Red | 5 Red | 7 Red |
| Yellow Arrow | 1 Yellow | 3 Yellow | 5 Yellow | 7 Yellow |
| FYA Arrow | 1 Green | 3 Green | 5 Green | 7 Green |
| Green Arrow | 9 Green | 10 Green | 11 Green | 12 Green |



Type D

| Opposing Thru | Chan 2 | Chan 4 | Chan 6 | Chan 8 |
|---------------|----------|----------|----------|----------|
| Left Turns | Chan 1 | Chan 3 | Chan 5 | Chan 7 |
| Red Arrow | 1 Red | 3 Red | 5 Red | 7 Red |
| Yellow Arrow | 1 Yellow | 3 Yellow | 5 Yellow | 7 Yellow |
| FYA Arrow | 1 Green | 3 Green | 5 Green | 7 Green |
| Green Arrow | 13 Green | 14 Green | 15 Green | 16 Green |



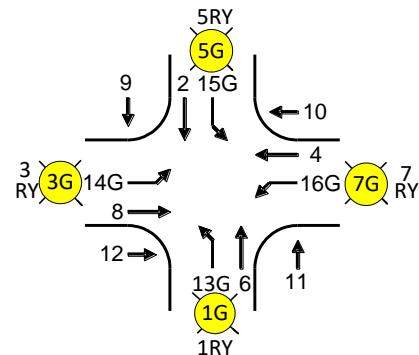
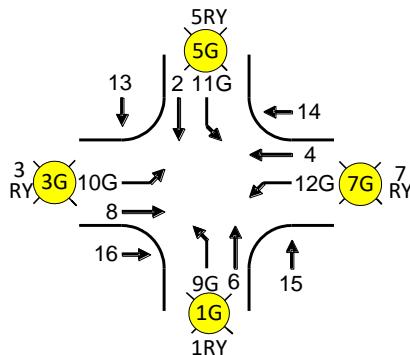
Type E and F require 1 channel for each protected left turns (1, 3, 5, 7) and 4 channels for the 4 FYAs. The MMU2 uses 16 channels to monitor the 8 phases and 4 Peds. This leaves 0 MMU2 channels available. Type E and F uses the opposing Ped Yellow for the Protected Left Turn Green. Type E the MMU2 monitors and displays the opposing Ped Yellows on channels 9G, 10G, 11G and 12G. Type F the MMU2 monitors and displays the opposing Ped Yellows on channels 13G, 14G, 15G and 16G.

Type E

| Opposing Thru | Chan 2 | Chan 4 | Chan 6 | Chan 8 |
|---------------|----------|----------|----------|----------|
| Left Turns | Chan 1 | Chan 3 | Chan 5 | Chan 7 |
| Red Arrow | 1 Red | 3 Red | 5 Red | 7 Red |
| Yellow Arrow | 1 Yellow | 3 Yellow | 5 Yellow | 7 Yellow |
| FYA Arrow | 1 Green | 3 Green | 5 Green | 7 Green |
| Green Arrow | 9 Green | 10 Green | 11 Green | 12 Green |

Type F

| Opposing Thru | Chan 2 | Chan 4 | Chan 6 | Chan 8 |
|---------------|----------|----------|----------|----------|
| Left Turns | Chan 1 | Chan 3 | Chan 5 | Chan 7 |
| Red Arrow | 1 Red | 3 Red | 5 Red | 7 Red |
| Yellow Arrow | 1 Yellow | 3 Yellow | 5 Yellow | 7 Yellow |
| FYA Arrow | 1 Green | 3 Green | 5 Green | 7 Green |
| Green Arrow | 13 Green | 14 Green | 15 Green | 16 Green |



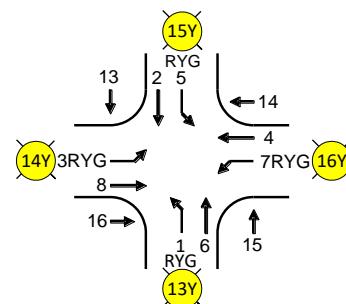
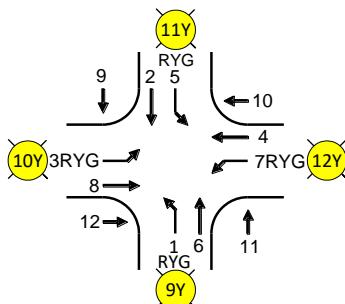
Type G and H require 1 channel for each protected left turn (1, 3, 5, 7) and the Ped Yellow for the FYA. The Controller Unit must be able to use the Ped Yellow as a FYA. FYA Type G has the Peds on channels 9,10,11,12. FYA Type H has the Peds on channels 13,14,15,16. The MMU2 uses 12 channels to monitor the 8 phases and 4 Peds in the FYA Configuration Type G and H. This leaves 4 MMU2 channels available. There is also less cabinet rewiring, because the protected phase remains in 1, 3, 5, 7.

Type G

| Opposing Thru | Chan 2 | Chan 4 | Chan 6 | Chan 8 |
|---------------|----------|-----------|-----------|-----------|
| Left Turns | Chan 1 | Chan 3 | Chan 5 | Chan 7 |
| Red Arrow | 1 Red | 3 Red | 5 Red | 7 Red |
| Yellow Arrow | 1 Yellow | 3 Yellow | 5 Yellow | 7 Yellow |
| FYA Arrow | 9 Yellow | 10 Yellow | 11 Yellow | 12 Yellow |
| Green Arrow | 1 Green | 3 Green | 5 Green | 7 Green |

Type H

| Opposing Thru | Chan 2 | Chan 4 | Chan 6 | Chan 8 |
|---------------|-----------|-----------|-----------|-----------|
| Left Turns | Chan 1 | Chan 3 | Chan 5 | Chan 7 |
| Red Arrow | 1 Red | 3 Red | 5 Red | 7 Red |
| Yellow Arrow | 1 Yellow | 3 Yellow | 5 Yellow | 7 Yellow |
| FYA Arrow | 13 Yellow | 14 Yellow | 15 Yellow | 16 Yellow |
| Green Arrow | 1 Green | 3 Green | 5 Green | 7 Green |



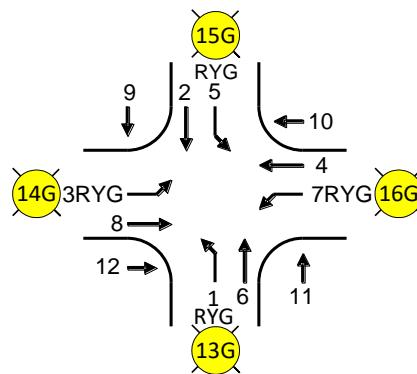
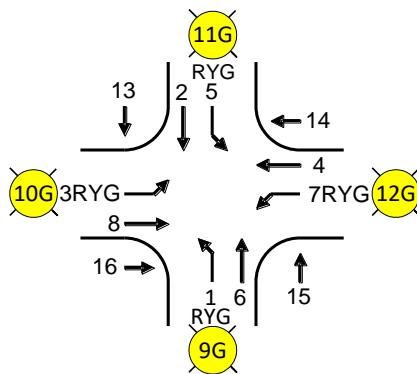
Type I and J require 1 channel for each protected left turns (1, 3, 5, 7) and 4 channels for the 4 FYAs. The MMU2 uses 16 channels to monitor the 8 phases and 4 Peds. This leaves 0 MMU2 channels available. Type I and J uses the opposing Ped Yellow for the FYA. Type I the MMU2 monitors and displays the opposing Ped Yellows on channels 9G, 10G, 11G and 12G. Type F the MMU2 monitors and displays the opposing Ped Yellows on channels 13G, 14G, 15G and 16G.

Type I

| Opposing Thru | Chan 2 | Chan 4 | Chan 6 | Chan 8 |
|------------------------------------------------------------------------------------------------|----------|----------|----------|----------|
| Left Turns | Chan 1 | Chan 3 | Chan 5 | Chan 7 |
|  Red Arrow | 1 Red | 3 Red | 5 Red | 7 Red |
|  Yellow Arrow | 1 Yellow | 3 Yellow | 5 Yellow | 7 Yellow |
|  FYA Arrow | 9 Green | 10 Green | 11 Green | 12 Green |
|  Green Arrow | 1 Green | 3 Green | 5 Green | 7 Green |

Type J

| Opposing Thru | Chan 2 | Chan 4 | Chan 6 | Chan 8 |
|------------------------------------------------------------------------------------------------|----------|----------|----------|----------|
| Left Turns | Chan 1 | Chan 3 | Chan 5 | Chan 7 |
|  Red Arrow | 1 Red | 3 Red | 5 Red | 7 Red |
|  Yellow Arrow | 1 Yellow | 3 Yellow | 5 Yellow | 7 Yellow |
|  FYA Arrow | 13 Green | 14 Green | 15 Green | 16 Green |
|  Green Arrow | 1 Green | 3 Green | 5 Green | 7 Green |



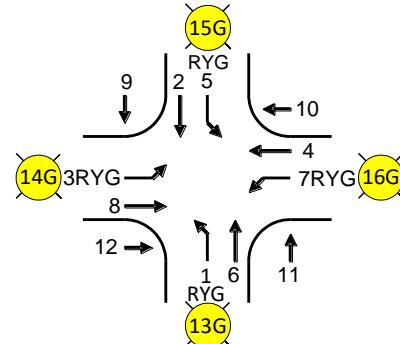
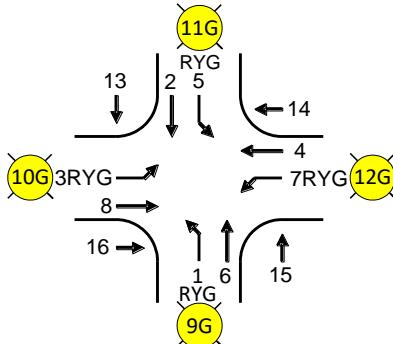
Type K and L require 1 channel for each protected left turns (1, 3, 5, 7) and 4 channels for the 4 FYAs. Type K assigns the Green of channels 9,10,11,12 as FYAs. Type L assigns the Green of channels 13,14,15,16 as FYAs. The MMU2 all 16 channels to monitor the 8 phases and 4 Peds. There is less cabinet rewiring, because the protected phase remains in 1, 3, 5, 7.

Type K

| Opposing Thru | Chan 2 | Chan 4 | Chan 6 | Chan 8 |
|--------------------------------------------------------------------------------------------------|----------|----------|----------|----------|
| Left Turns | Chan 1 | Chan 3 | Chan 5 | Chan 7 |
|  Red Arrow | 1 Red | 3 Red | 5 Red | 7 Red |
|  Yellow Arrow | 1 Yellow | 3 Yellow | 5 Yellow | 7 Yellow |
|  FYA Arrow | 9 Green | 10 Green | 11 Green | 12 Green |
|  Green Arrow | 1 Green | 3 Green | 5 Green | 7 Green |

Type L

| Opposing Thru | Chan 2 | Chan 4 | Chan 6 | Chan 8 |
|--------------------------------------------------------------------------------------------------|----------|----------|----------|----------|
| Left Turns | Chan 1 | Chan 3 | Chan 5 | Chan 7 |
|  Red Arrow | 1 Red | 3 Red | 5 Red | 7 Red |
|  Yellow Arrow | 1 Yellow | 3 Yellow | 5 Yellow | 7 Yellow |
|  FYA Arrow | 13 Green | 14 Green | 15 Green | 16 Green |
|  Green Arrow | 1 Green | 3 Green | 5 Green | 7 Green |



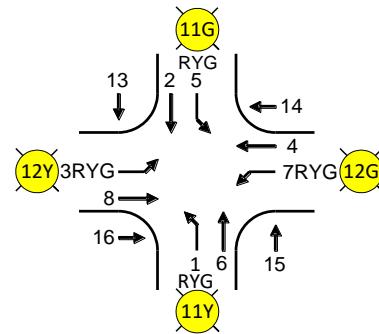
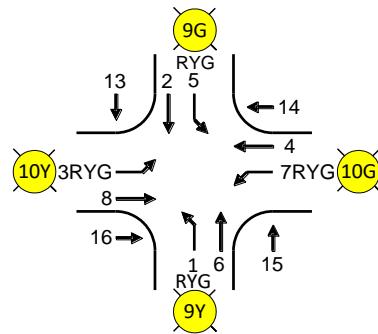
Type M, N, O, and P require 1 channel for each protected left turns (1, 3, 5, 7) and 2 channels for the 4 FYAs. The opposing left turn phases 1, 5 and 3, 7 use the Yellow and Green of the same channel for the FYAs. The MMU2 uses 14 channels to monitor the 8 phases and 4 Peds. This leaves 2 MMU2 channels available. There is also less cabinet rewiring, because the protected phase remains in 1, 3, 5, 7.

Type M

| Opposing Thru | Chan 2 | Chan 4 | Chan 6 | Chan 8 |
|---------------|----------|-----------|----------|----------|
| Left Turns | Chan 1 | Chan 3 | Chan 5 | Chan 7 |
| Red Arrow | 1 Red | 3 Red | 5 Red | 7 Red |
| Yellow Arrow | 1 Yellow | 3 Yellow | 5 Yellow | 7 Yellow |
| FYA Arrow | 9 Yellow | 10 Yellow | 9 Green | 10 Green |
| Green Arrow | 1 Green | 3 Green | 5 Green | 7 Green |

Type N

| Opposing Thru | Chan 2 | Chan 4 | Chan 6 | Chan 8 |
|---------------|-----------|-----------|----------|----------|
| Left Turns | Chan 1 | Chan 3 | Chan 5 | Chan 7 |
| Red Arrow | 1 Red | 3 Red | 5 Red | 7 Red |
| Yellow Arrow | 1 Yellow | 3 Yellow | 5 Yellow | 7 Yellow |
| FYA Arrow | 11 Yellow | 12 Yellow | 11 Green | 12 Green |
| Green Arrow | 1 Green | 3 Green | 5 Green | 7 Green |

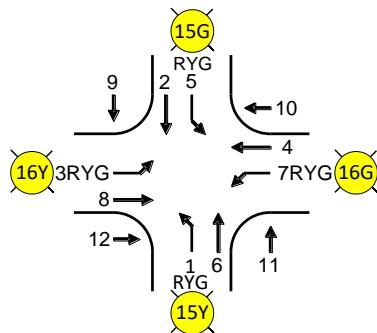
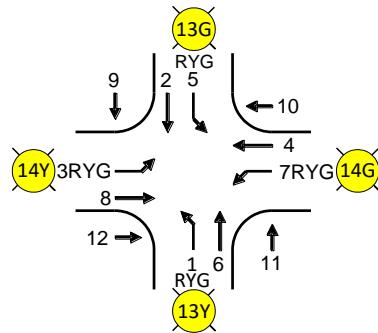


Type O

| Opposing Thru | Chan 2 | Chan 4 | Chan 6 | Chan 8 |
|---------------|-----------|-----------|----------|----------|
| Left Turns | Chan 1 | Chan 3 | Chan 5 | Chan 7 |
| Red Arrow | 1 Red | 3 Red | 5 Red | 7 Red |
| Yellow Arrow | 1 Yellow | 3 Yellow | 5 Yellow | 7 Yellow |
| FYA Arrow | 13 Yellow | 14 Yellow | 13 Green | 14 Green |
| Green Arrow | 1 Green | 3 Green | 5 Green | 7 Green |

Type P

| Opposing Thru | Chan 2 | Chan 4 | Chan 6 | Chan 8 |
|---------------|-----------|-----------|----------|----------|
| Left Turns | Chan 1 | Chan 3 | Chan 5 | Chan 7 |
| Red Arrow | 1 Red | 3 Red | 5 Red | 7 Red |
| Yellow Arrow | 1 Yellow | 3 Yellow | 5 Yellow | 7 Yellow |
| FYA Arrow | 15 Yellow | 16 Yellow | 15 Green | 16 Green |
| Green Arrow | 1 Green | 3 Green | 5 Green | 7 Green |



CONF Allows the MMU2 to be configured for PPLT with a 5 section head a PPLT with a 4 section head or FYA with a 4 section head not defined by the sixteen types A thru P. When in the **CONF** Menus the **▲** and **▼** buttons move through the selections. The **◀** and **▶** buttons changes the selection.

PPLT5 This left turn uses a five section head with a Green arrow, Yellow arrow, Green ball, Yellow ball, and a Red ball. If this type is selected, other setting will be displayed.

PPLT4 This left turn uses a five section head with a Green arrow, Green ball, Yellow ball, and a Red ball. If this type is selected, other setting will be displayed.

FYA allows the selection of the channels with the protected left turn, the channel with the FYA and driver color (yellow or green), and the opposing thru. When the selections are made and the **ENTER** button is pushed the **FYA CONFIGURATION** Screen will be displayed

4.6.2.1.10.2 Warning Screens

After pressing **ENTER** at the Left Turn Summary screen, the wizard will perform a series of configuration checks between the data entered and the jumpers currently installed on the program card. The wizard will assume standard phasing for a dual ring intersection while performing these checks. Press **HELP** at each warning to receive additional information on each warning. The wizard will not tell you which permissive jumpers to install or remove. It will only warn you that the current jumpers do not match the expected jumpers for a standard dual ring configuration with the channel assignments given to the wizard.

4.6.2.1.10.3 Almost Done

If there were no warning or you ignored all warnings, you will get the Almost Done screen. Pressing **ENTER** here will create a new configuration based on the information provided. This new configuration is not saved. It is the pending configuration. The user should confirm that the settings created by the wizard are appropriate for the actual intersection.

4.6.2.2 General Settings

| MENU TEXT | MENU FUNCTION |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------|
| LOGGING THRESHOLDS | View and/or edit the AC Logging Threshold settings of high voltage alarm, low voltage alarm, and power interrupt duration. |
| USER UNIT INFORMATION | View and/or edit the Location text, Unit ID, and Agency ID. |
| FACTORY UNIT INFORMATION | View the Model Number, Serial Number, and Manufacture Date. |
| COM PORT SETTINGS | View and/or edit the Com port baud rate, stop bits, and parity settings. |
| ETHERNET SETTINGS | View and/or edit the Unit IP address, Unit IP Port, and Gateway IP address. |

4.6.2.2.1 AC Logging Events

These settings affect the entries made to the AC Line log. Use the up (**▲**) or down (**▼**) pushbutton to navigate between the settings. Use the left (**◀**) or right (**▶**) to change the highlighted setting. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

HIGH VOLTAGE – The AC high voltage alarm threshold setting can be user configured from **98V** to **135V** in one volt increments. The recovery voltage is automatically set to three volts lower than the alarm voltage. The factory default for this setting is **130V**.

LOW VOLTAGE – The AC low voltage alarm threshold setting can be user configured from **98V** to **135V** in one volt increments. The recovery voltage is automatically set to three volts higher than the alarm voltage. The factory default for this setting is **105V**.

POWER INT – The Power Interrupt interval setting can be user configured from **17MS** to **500MS** in 16.66 millisecond increments (rounded up or down to the nearest whole number). The factory default for this setting is **100MS**.

4.6.2.2.2 User Unit Information

See Section [4.6.1.1](#)

4.6.2.2.3 Factory Unit Information

See Section [4.6.1.2](#)

4.6.2.2.4 Comm Port Settings

Use the left (◀) or right (▶) pushbutton to navigate to the desired setting to change. Use the up (▲) or down (▼) pushbutton to change the highlighted setting. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit to the previous display.

BAUD RATE – The Communications Port Baud Rate setting can be set to any of the following values: **300, 1200, 2400, 4800, 9600, 19200, 38400**, or **57600**. The factory default setting is **57600**.

STOP BITS – The Communications Port Stop Bits setting can be set to **1** or **2**. The factory default setting is **1**.

PARITY – The Communications Port Parity setting can be set to **NONE, ODD**, or **EVEN**. The factory default setting is **NONE**.

4.6.2.2.5 Ethernet Settings

See Section [4.6.1.3](#)

4.6.3 Logging System

| MENU TEXT | MENU FUNCTION |
|--------------------|----------------------------------------------------------------------------------------------------------------------------|
| VIEW LOGS | View monitor logs. |
| CLEAR LOGS | Clear individual logs. |
| CLEAR ALL LOGS | Clear all logs. |
| LOGGING THRESHOLDS | View and/or edit the AC Logging Threshold settings of high voltage alarm, low voltage alarm, and power interrupt duration. |

4.6.3.1 View Logs

| MENU TEXT | MENU FUNCTION |
|--------------------------|------------------------------------------|
| VIEW DATE & TIME LOG | View the Date & Time log. |
| VIEW AC LINE LOG | View the AC Line log. |
| VIEW RESETS LOG | View the Resets log. |
| VIEW CONFIGURATIONS LOG | Access the View Configurations Log menu. |
| VIEW PRIOR FAULTS LOG | View the Prior Faults log. |
| VIEW SIGNAL SEQUENCE LOG | View the Signal Sequence log. |

4.6.3.1.1 View Date & Time Log

The monitor records the thirty (30) most recent date and/or time changes in the Date & Time Log. Original Date and Time, New Date and Time, and Up Time are recorded. This display is view only.

Use the left (◀) or right (▶) pushbutton and the up (▲) or down (▼) pushbutton to scroll through the entries. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

4.6.3.1.2 View AC Line Log

The monitor records the fifty (50) most recent changes in AC line status in the AC Line Log. Date and Time, Event Type (Power Up, Power Down, Low Voltage, Low Voltage Recovery, Low Voltage Alarm, Low Voltage Alarm Recovery, High Voltage Alarm, High Voltage Alarm Recovery, and Power Interrupt), AC Line Voltage / Event Duration, and AC Line Frequency are recorded. This display is view only.

Use the left (◀) or right (▶) pushbutton and the up (▲) or down (▼) pushbutton to scroll through the entries. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

4.6.3.1.3 View Resets Log

The monitor records the twenty (20) most recent resets in the Resets Log. Date and Time, Fault Cleared and Reset Source are recorded. This display is view only.

Press the **ENTER** pushbutton to view the Resets Log. Use the left (◀) or right (▶) pushbutton and the up (▲) or down (▼) pushbutton to scroll through the entries. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

4.6.3.1.4 View Configurations Log Menu

| MENU TEXT | MENU FUNCTION |
|----------------------------|---------------------------------------------------------------------------------------------------------|
| VIEW CONFIG SETTINGS | View the currently active configuration settings. |
| COMPARE CURRENT TO PENDING | View the differences between the current configuration and any pending configuration changes. |
| COMPARE CONFIG TO CURRENT | View the differences between any previous configuration and the current configuration. |
| COMPARE CONFIG TO PRIOR | View the differences between any previous configuration and the configuration immediately preceding it. |

4.6.3.1.4.1 View Configurations Settings

The monitor records the ten (10) most recent Monitor Configurations in the Configurations Log. Date and Time, the total number of Active Features, and a list of the Active Features are recorded. This display is view only. The Rollback Changes feature (Section [4.6.2.1.4](#)) can be used to select and restore any one of the previously stored configurations.

Use the left (◀) or right (▶) pushbutton to select one of the ten (10) Configurations Settings to view. Use the up (▲) or down (▼) pushbutton to scroll through the list of Active Features. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

4.6.3.1.4.2 Compare Current To Pending

This feature allows the user to compare the pending configuration changes to the current monitor configuration. The total number of different settings, a list of the different settings, and the current state and the pending state for each feature are displayed. This display is view only. If the monitor is beeping due to a configuration change and you are not sure what changes are pending, this screen will quickly identify the pending changes.

Use the up (▲) or down (▼) pushbutton to scroll through the list of features that are different. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

4.6.3.1.4.3 Compare Configuration To Current

This feature allows the user to compare each of the previous nine (9) monitor configurations stored in the Configurations Log to the current monitor configuration. Date and Time, the total number of Different Features, a list of the Different Features, and the current state and the prior state for each feature are displayed. This display is view only.

Use the left (◀) or right (▶) pushbutton to select one of the nine (9) Configurations Settings to view/compare. Use the up (▲) or down (▼) pushbutton to scroll through the list of features that are different. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

4.6.3.1.4.4 Compare Configuration To Prior

This feature allows the user to compare the nine (9) most recent monitor configurations stored in the Configurations Log to its previous monitor configuration. Date and Time, the total number of different features, a list of the different features, and the new state and the prior state for each different feature are displayed. This display is view only. This screen allows you to easily see what has changed from configuration to configuration.

Use the left (◀) or right (▶) pushbutton to select one of the nine (9) Configurations Settings to view/compare. Use the up (▲) or down (▼) pushbutton to scroll through the list of features that are different. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

4.6.3.1.4.5 View Prior Faults Log

The monitor records the twenty (20) most recent faults in the Prior Faults Log. Date and Time, Temperature, AC Line Voltage, Fault Type, Diagnostic Fault Code (if applicable), Red Enable Voltage, AC Line Status, Red Enable Status, Port 1 Disable Status, monitor Type Setting, Type Select Status, Local Flash Status, CVM Status, External Reset Status, External Watchdog Status, 24V-1 Status, 24V-2 Status, and +24V Monitor Inhibit Status are displayed on the graphic screen while the front panel LEDs display the same information that was displayed at the time of the fault. This display is view only.

Use the up (▲) or down (▼) pushbutton to select the entry to view. Use the left (◀) or right (▶) pushbutton to scroll through the entry selected. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

4.6.3.1.5 View Signal Sequence Log

The monitor records the sixty (60) most recent events preceding a fault in the Signal Sequence Log. The Fault Type, Date and Time, Time Prior to Fault; Status of all Greens, Yellows, Reds, and Walks; RMS Voltages of all Greens, Yellows, Reds, and Walks; Status of all DC inputs; Status of Red Enable; AC Line Voltage; Red Enable Voltage; and DC Input Voltages are recorded. This display is view only.

| | | | |
|------------|----|------|--------|
| R | 0V | CH 1 | ▲ |
| R | 0V | CH 2 | ▼ |
| R | 0V | CH 3 | ▼ |
| R | 0V | CH 4 | ▲ |
| R | 0V | CH 5 | ▼ |
| R | 0V | CH 6 | ▼ |
| FAULT: CVM | | | 0.033S |

The display consists of a voltage section, two status sections, and a single line footer showing the Fault Type and the Time Prior to Fault. Use the **ENTER** pushbutton to toggle between the three display sections.

When the voltage section is highlighted, the up (▲) or down (▼) pushbutton will toggle the voltage display between Red, Yellow, Green, and Walk voltages. The left (◀) or right (▶) pushbutton will move the cursor bar to one of sixty (60) positions corresponding to the Time Prior to Fault.

When the either status section is highlighted, the up (▲) or down (▼) pushbutton will toggle the status display between Channels 1 through 16, AC Line, Red Enable, 24V-2, 24V-1, CVM, Type Select, 24V Inhibit, Local Flash, External Watchdog, External Reset, and Port 1 Disable (if applicable). The left (◀) or right (▶) pushbutton will move the cursor bar to one of sixty (60) positions corresponding to the Time Prior to Fault.

Press the **ESCAPE** pushbutton to exit.

4.6.3.2 Clear Logs

| MENU TEXT | MENU FUNCTION |
|---------------------------|--------------------------------|
| CLEAR DATE & TIME LOG | Clear the Date & Time log. |
| CLEAR AC LINE LOG | Clear the AC Line log. |
| CLEAR RESETS LOG | Clear the Resets log. |
| CLEAR CONFIGURATIONS LOG | Clear the Configurations log. |
| CLEAR PRIOR FAULTS LOG | Clear the Prior Faults log. |
| CLEAR SIGNAL SEQUENCE LOG | Clear the Signal Sequence log. |

For each of these screens, use the arrow pushbuttons to select **YES** and press the **ENTER** pushbutton to clear the selected log of the monitor. Use the arrow pushbuttons to select **NO** and press the **ENTER** pushbutton to exit or the just press the **ESCAPE** pushbutton to exit.

NOTE: When a log is cleared, the monitor will provide an audible confirmation by sounding the buzzer (five chirps).

4.6.3.3 Clear All Logs

Use the arrow pushbuttons to select **YES** and press the **ENTER** pushbutton to clear the all of the logs for the monitor. Use the arrow pushbuttons to select **NO** and press the **ENTER** pushbutton to exit or the just press the **ESCAPE** pushbutton to exit.

NOTE: When the Clear All Logs function is used, the monitor will provide an audible confirmation by sounding the buzzer (five chirps).

4.6.3.4 AC Logging Events Thresholds

See Section [4.6.2.2.1](#)

4.6.4 Date & Time Menu

| MENU TEXT | MENU FUNCTION |
|------------------------|-------------------------------------------------------|
| VIEW / SET DATE & TIME | View and/or set the Date & Time. |
| VIEW / SET DST AHEAD | View and/or set the Daylight Saving Ahead occurrence. |
| VIEW / SET DST BACK | View and/or set the Daylight Saving Back occurrence. |
| VIEW UP TIME | View the monitor up time accumulator. |

4.6.4.1 View / Set Date and Time

Current Date, Time, and Daylight Saving Time settings are shown as well as a fields that can be used to set New Date, Time, and Daylight Saving Time settings.

Use the left (◀) or right (▶) pushbutton to navigate between the New Date, Time, and Daylight Saving Time fields. Use the up (▲) or down (▼) pushbutton to change the highlighted setting. Press the **ENTER** pushbutton to accept and store the New Date, Time, and/or Daylight Saving Time settings. Press the **ESCAPE** pushbutton to exit.

4.6.4.2 View / Set Daylight Saving Time Ahead

Current Daylight Saving Time Ahead settings for Month, Week, Day of Week, Hour, Minute, and Second are shown. Currently, per U.S. Federal standards, Daylight Saving Time is observed in the United States from 2:00 A.M. on the second Sunday in March until 2:00 A.M. on the first Sunday in November.

Use the up (▲) or down (▼) pushbutton to navigate between the Daylight Saving Time Ahead fields. Use the left (◀) or right (▶) pushbutton to change the highlighted setting. Press the **ENTER** pushbutton to accept and store the modified Daylight Saving Time Ahead settings. Press the **ESCAPE** pushbutton to exit.

4.6.4.3 View / Set Daylight Saving Time Back

Current Daylight Saving Time Back settings for Month, Week, Day of Week, Hour, Minute, and Second are shown. Currently, per U.S. Federal standards, Daylight Saving Time is observed in the United States from 2:00 A.M. on the second Sunday in March until 2:00 A.M. on the first Sunday in November.

Use the up (▲) or down (▼) pushbutton to navigate between the Daylight Saving Time Back fields. Use the left (◀) or right (▶) pushbutton to change the highlighted setting. Press the **ENTER** pushbutton to accept and store the modified Daylight Saving Time Back settings. Press the **ESCAPE** pushbutton to exit.

4.6.4.4 View Up Time

The MMU-1600G warranty coverage is valid for a total accumulated Monitor Up Time of two (2) years. Monitor Up Time is displayed in Months, Days, Years, Hours, Minutes, Seconds format (MM/DD/YY / HR:MN:SC). This display is view only.

Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

4.6.5 Real Time Monitor Status Menu

| MENU TEXT | MENU FUNCTION |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CHANNELS 1 - 6 | View the real time voltages on the field inputs for channels 1 through 6. |
| CHANNELS 7 - 12 | View the real time voltages on the field inputs for channels 7 through 12. |
| CHANNELS 13 - 16 | View the real time voltages on the field inputs for channels 13 through 16. |
| OTHER AC & MISC INPUTS | View the real time voltages on the AC and Red Enable inputs as well as number of samples taken for every input every line cycle, temperature, and current number of Port 1 errors. |
| DC INPUTS | View the real time voltages on the DC inputs. |

4.6.5.1 Channels 1 - 6

This display shows the Red, Yellow, Green, and Walk (if appropriate) AC field voltages for channel 1 through channel 6. This display is view only. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

NOTE: A more condensed version of this information is available by pressing **ESCAPE** at the Run Time display.

4.6.5.2 Channels 7 - 12

This display shows the Red, Yellow, Green, and Walk (if appropriate) AC field voltages for channel 7 through channel 12. This display is view only. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

NOTE: A more condensed version of this information is available by pressing **ESCAPE** at the Run Time display.

4.6.5.3 Channels 13 - 16

This display shows the Red, Yellow, Green, and Walk (if appropriate) AC field voltages for channel 1 through channel 6. This display is view only. NOTE: If the monitor is configured to operate in Type 12 mode, a message reading **NOT AVAILABLE IN TYPE 12** will be displayed. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

NOTE: A more condensed version of this information is available by pressing **ESCAPE** at the Run Time display.

4.6.5.4 Other AC and Miscellaneous Inputs

This display shows the current AC line voltage and frequency, Red Enable voltage, samples taken of every AC input per line cycle, temperature, and Port 1 errors since midnight or the last reset (whichever came last). This display is view only. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

4.6.5.5 DC Inputs

This display shows the current status of the monitor DC Inputs. The voltage is shown for +24V Monitor I, +24V Monitor II, +24V Inhibit, CVM, Type Select, Local Flash, External Reset, and the External Watchdog inputs. Status of the Port 1 Disable is displayed. This display is view only. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

4.6.6 Diagnostic Info

| MENU TEXT | MENU FUNCTION |
|-------------|----------------------------------------------------------------|
| LED TEST | Run front panel LED diagnostic routine. |
| SCREEN TEST | Run display screen diagnostic routine. |
| FAULT CODES | View various monitor fault codes. |
| SDLC FRAMES | Access the menu for displaying various SDLC frame buffers. |
| FIRMWARE | View the firmware versions and dates. |
| STATS | Access the menu for displaying various operational statistics. |
| FACTORY | Access the menu for factory diagnostic information. |

4.6.6.1 LED Test Settings

Use the up (▲) or down (▼) pushbutton to navigate between fields. Use the left (◀) or right (▶) pushbutton to change the selected setting. Press the **ENTER** pushbutton or **ESCAPE** pushbutton to exit.

TEST SPEED – Values between **000** and **127** use the standard test pattern. Values between **128** and **253** use a simulated eight phase intersection with pedestrians pattern. **254** will turn all LEDs on and leave them on. **255** will turn all LEDs off and leave them off. A smaller number indicates a faster speed for the test pattern.

LED TEST – When set to **ON**, the appropriate test patterns will be displayed on the front panel LEDs overriding the normal display.

NOTE: In most instances, once the LED Test has been completed, the function should be turned OFF. If the LED Test has been left ON, repeat the procedure outlined above or press the **RESET** pushbutton to turn the function OFF.

4.6.6.2 Screen Test

Use the up (▲) or down (▼) pushbutton to navigate between fields. Use the left (◀) or right (▶) pushbutton to change the selected setting. Press the **ENTER** pushbutton or **ESCAPE** pushbutton to exit.

TEST SPEED – Values between **001** and **023** can be selected. A smaller number indicates a faster speed for the test pattern.

SCREEN TEST – When set to **ON**, the test patterns will be displayed until the **ENTER** or **ESCAPE** pushbutton is pressed to cancel the Screen Test.

4.6.6.3 Fault Codes

This display shows the values for Global Faults, Boot Diagnostic Faults, 186 Diagnostic Faults, DSP Diagnostic Faults, DSP Transfer Faults, and Shift Error Faults. If you experience a Diagnostic fault, record all of the values on this screen and contact Reno A&E Tech Support for guidance. This display is view only. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

4.6.6.4 Diagnostic SDLC Frames Menu

| MENU TEXT | MENU FUNCTION |
|---------------------|---------------------------|
| VIEW FRAME 0 DATA | View SDLC Frame 0 data. |
| VIEW FRAME 9 DATA | View SDLC Frame 9 data. |
| VIEW FRAME 129 DATA | View SDLC Frame 129 data. |
| VIEW FRAME 131 DATA | View SDLC Frame 131 data. |

These displays shows the data of the last valid SDLC frame received (frame 0 or 9) or the data that will be transmitted if an SDLC frame request (frame 129 or 131) is received by the monitor. This information is displayed in hex format. The **ENTER** pushbutton will toggle the display between the hex mode and an ASCII mode. This display is view only. Press the **ESCAPE** pushbutton to exit. Press the **HELP** pushbutton to view the data organization within each frame.

4.6.6.5 Firmware Versions

This display shows the currently installed firmware versions and release dates for the primary bootloader (BOOT1), secondary bootloader (BOOT2), main monitor code (MAIN), AC signal processor (DSP), and DC signal processor (DC). This display is view only. Press the **ESCAPE** pushbutton to exit.

4.6.6.6 Diagnostic Statistics Menu

| MENU TEXT | MENU FUNCTION |
|------------------------|---------------------------------------------|
| SDLC STATS | View SDLC statistics. |
| COM PORT STATS | View Com port statistics. |
| ETHERNET PORT STATS | View Ethernet port statistics. |
| DC PROCESSOR COM STATS | View DC Processor communication statistics. |
| SPEED STATS | View various performance statistics. |

4.6.6.6.1 SDLC Statistics

This display shows the number of frames transmitted (TX FRMS), number of frames received (RX FRMS), total number of frames received with errors (RX ERRS), number of frames received with buffer overrun errors (OVERRUN), number of frames received with buffer overflow errors (OVERFLW), number of frames with framing errors (FRAMING), number of very short frames received (V SHORT), number of short frames received (SHORT), number of long frames received (LONG), number of frames received with the incorrect control byte (CONTROL), number of frames received with a CRC error (CRC), and number of frames aborted (ABORT). This display is view only. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

4.6.6.6.2 Comm Port Statistics

This display shows the number of bytes transmitted (TX BYTES), number of bytes received (RX BYTES), number of buffer overrun errors (OVERRUN), number of framing errors (FRAMING), number of procedure faults (PROC FLT), number of breaks received (BREAKS), number of parity errors received (PARITY), number of frames received with a checksum error (CHKSUM), number of start of frame errors (SOF), and number of end of frame errors (EOF). This display is view only. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

4.6.6.6.3 Ethernet Port Statistics

This display shows the number of bytes transmitted (TX BYTES), number of bytes received (RX BYTES), number of buffer overrun errors (OVERRUN), number of framing errors (FRAMING), number of procedure faults (PROC FLT), number of breaks received (BREAKS), number of parity errors received (PARITY), number of frames received with a checksum error (CHKSUM), number of start of frame errors (SOF), and number of end of frame errors (EOF). This display is view only. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

4.6.6.6.4 DC Processor Communication Statistics

This display shows the number of bytes transmitted (TX BYTES), number of bytes received (RX BYTES), number of buffer overrun errors (OVERRUNS), number of framing errors (FRAMING), number of breaks received (BREAKS), and number of parity errors received (PARITY). This display is view only. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

4.6.6.6.5 Speed Statistics

This display shows the current number of samples taken for every AC inputs every line cycle, number of code bytes checksummed each second, and the number of RAM Bytes Tested per Second. This display is view only. Press the **ENTER** pushbutton or the **ESCAPE** pushbutton to exit.

4.6.6.7 Factory Diagnostics

The features and data accessible within the Factory Diagnostics menu and submenus are intended for use by qualified Test and Technical Support personnel only. Should the need arise, the user will be instructed on the correct use of these features and data.

4.7 FRONT PANEL LED INDICATORS

The monitor has 77 light emitting diodes (LEDs) that are used to convey information to the user. These LEDs are color coded to increase viewability and enhance the intuitiveness of the display. The LEDs are extremely bright to allow viewing of the front panel indicators in direct sunlight. The front panel display is updated every 16 milliseconds.

The front panel display is broken up into four logical groups: Field Status, Power / Type, Transmit / Receive, and Fault.

4.7.1 Field Status Indicators

There are 60 field status indicators, one for each field input defined by the TS 2 specification for Type 16 and Type 12. The display is logically organized into four columns and sixteen rows. The columns are labeled **R** for Red, **Y** for Yellow, **G** for Green, and **W** for Walk. The rows are numbered from **1** to **16**, corresponding to the channel numbers for Type 16 and Type 12.



The indicator for a field input will be on if the RMS voltage over the last 33 milliseconds (two cycles of AC power) is above the threshold for that type of input. (See Section [3.2](#) for the voltage levels for each type of input.)

When a fault is detected, the field status is latched and the field input involved in the detected fault will flash at a 5 Hz rate. The following table lists the information displayed on the Field Status indicators during the various fault conditions.

| FAULT CONDITION | FIELD STATUS INDICATION |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 24V-1 24V-2 CVM / WD PORT 1 FAIL | ON - Field inputs that were ON for at least 33 milliseconds at the time of the fault. |
| CONFLICT | ON - Field inputs that were ON for at least 33 milliseconds at the time of the fault. FLASHING - Field inputs that were ON and were the cause of the fault. |
| DIAG FAIL | ON - The binary coded value of the diagnostic error code with channel 1 being the least significant bit and channel 16 the most significant bit. NOTE: This may be incorrectly displayed depending on the type of diagnostic failure being experienced. |
| SHORT YEL | ON - Field inputs that were ON for at least 100 milliseconds at the time of the fault. FLASHING - The Yellow field inputs on which a Short Yellow was detected. |
| SHORT CLR | ON - Field inputs that were ON for at least 33 milliseconds at the time of the fault. FLASHING - The Green field inputs that were not OFF for at least 2.7 seconds before a conflicting channel was detected as active. |
| FIELD CHK | ON - Field inputs that were ON for at least 33 milliseconds at the time of the fault. FLASHING - The field inputs that did not agree with the load switch commands from the CU. |
| LOC FLASH PRGM CARD | Current field status. (NOT LATCHED) |
| RED FAIL | ON - Field inputs that were ON for at least 100 milliseconds at the time of the fault. FLASHING - All field inputs for the channel(s) that had no display. |
| DUAL IND | ON - Field inputs that were ON for at least 100 milliseconds at the time of the fault. FLASHING - Field inputs that were ON and were the cause of the fault. |

4.7.2 Power / Type Indicators

The **POWER** indicator is on continuously when the AC line voltage is above 98V_{RMS}. When the AC line voltage is below 89V_{RMS}, the indicator will flash at a 1 Hz rate to indicate low line voltage. While the AC line voltage is low, all field status indicators will be off. Any active fault indicators will stay on.

The **TYPE 12** indicator is on continuously when the monitor is operating in the Type 12 mode. This occurs when the Type Select input (Connector A - Pin HH) is not at a True (Low) logic level. This indicator will have a disabled indication if the monitor is configured to operate in Type 16 only mode.

4.7.3 Transmit / Receive Indicators

The **RECEIVE** indicator turns on for 50 milliseconds every time a valid SDLC frame addressed to the monitor is received.

The **TRANSMIT** indicator turns on for 50 milliseconds every time a SDLC frame is transmitted.

4.7.4 Fault Indicators

When the monitor Output relay contacts are transferred to the fault condition and the monitor is not timing Minimum Flash, a fault indicator will be illuminated to identify the source of the fault.

There are two fault indicators with dual function capability. One is the **CVM / WD** indicator. If the fault is a CVM fault, the **CVM / WD** indicator will be on solid. If the fault is a WD (External Watchdog) fault, the **CVM / WD** indicator will flash at a five Hz rate. The other fault indicator with dual function capability is the **PRGM CARD** indicator. The **PRGM CARD** indicator will be on solid if the programming card is not properly seated while power is applied. The **PRGM CARD** indicator will flash at a five Hz rate if a Reno A&E supplied programming card which has a defective serial EEPROM is inserted in the programming card slot and the device (the EEPROM) is activated. The **PRGM CARD** indicator will also flash at a five Hz rate if a non-Reno A&E programming card is inserted in the programming card slot and the *Programming Card Memory Usage* feature is activated.

Any monitoring function that is disabled for any reason will display a Function Disabled indication.

4.7.5 Function Disabled Indication

When a function has been disabled, the associated indicator will turn on for 50 milliseconds once every two seconds.

Functions may be disabled for one of several different reasons:

| INDICATOR | DISABLE CONDITION |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TYPE 12 | The monitor is configured to operate in Type 16 Only mode. |
| 24V-1 | The +24V Monitor Inhibit input (Connector A - Pin n) is at a logic TRUE (Low) state. |
| 24V-2 | The +24V Monitor Inhibit input (Connector A - Pin n) is at a logic TRUE (Low) state. |
| SHORT YEL | The Red Enable input (Connector B - Pin a) is below 70VAC. |
| SHORT CLR | The Red Enable input (Connector B - Pin a) is below 70VAC. |
| PORT 1 FAIL | The Port 1 Disable input (Port 1 Connector - Pin 10) is at 0 VDC. Port 1 communications are not active during Type 12 operation. |
| FIELD CHK | The Port 1 Disable input (Port 1 Connector - Pin 10) is at 0 VDC. The Red Enable input (Connector B - Pin a) is below 70VAC. The LOAD SWITCH Flash bit is set to 1 in the Type 0 frame from the Controller Unit. |
| LOC FLASH | The monitor is configured to operate with the Disable Local Flash feature enabled. |
| RED FAIL | The Red Enable input (Connector B - Pin a) is below 70VAC. The LOAD SWITCH Flash bit is set to 1 in the Type 0 frame from the Controller Unit. |
| DUAL IND | The Red Enable input (Connector B - Pin a) is below 70VAC. |

4.8 AUDIBLE BUZZER

The monitor is equipped with an audible buzzer. This buzzer is used to bring important events to the attention of the user. The buzzer can be disabled for pending configuration notifications only. This can be done through the RaeComM software or via the front panel (See Section [4.6.2.1.7.9](#)).

4.8.1 Critical Failure

When the monitor main microprocessor is held in the reset state due to a critical hardware failure, the buzzer will stay on constantly. There is no way to disable this indication, as it is an indication that the monitor is not operational.

4.8.2 Configuration Change

Configuration changes can originate from several sources. They are the front panel, the Com port, the Ethernet port, and the program card. The monitor checks for configuration changes once each second. If a configuration change is identified, the audible buzzer will start to beep at a one second rate. The one second beep is disabled when the user is currently in the fault monitoring configuration on the front panel. This beeping is an indication that a change to the current configuration has been identified and is pending. The monitor does not implement any configuration changes until the front panel **RESET** pushbutton is pressed and help for five seconds or Save Changes is confirmed in fault monitoring configuration on the front panel. At that time the monitor will give 5 confirmation chirps and the buzzer will stop beeping. If the configuration parameters that were changed are restored to their original states (undone), the buzzer will stop beeping.

NOTE: If power is removed from the monitor prior to the configuration changes being accepted by pressing the **RESET** pushbutton or Save Changes is confirmed in fault monitoring configuration on the front panel, the pending changes will be lost and the original settings will be used on power up.

4.9 FIRMWARE UPGRADE

The firmware for the main microprocessor in the monitor can be upgraded via the front panel COM port or Ethernet port (on the MMU-1600GE). The most current version of firmware is available on the Reno A&E web site (www.renoae.com) in the support section. Firmware upgrades to the monitor are accomplished through the use of the RaeComM software, version 3.0.6 or greater.

There are three separate firmware files that can be upgraded for the main microprocessor in the monitor.

Main Code: This is the code (firmware) that runs the monitor under normal conditions. In most cases, this is the only file that must be upgraded and ends with BOOTCODE.RAE if more than one file is in the downloaded file.

Secondary Boot Loader: This is the code that is responsible for allowing firmware upgrades if the main code (boot code) is corrupt or becomes corrupt during the programming process and ends with BOOTLD2.RAE.

Primary Boot Loader: This is the code that is responsible for allowing firmware upgrades if the secondary boot loader is corrupt and ends with BOOTLD1.RAE. This file can only be upgraded by a user with factory level privileges.

The two boot loaders exist to allow the monitor to recover from problems during the upgrade process (power fail during programming, computer crash during programming, etc.). They should not need to be upgraded, but provisions to do so have been made in case they need to be upgraded.

To upgrade the main code:

- 1) Ensure that RaeComM version 3.0.6 or greater is installed on the computer to be used during the upgrade process.
- 2) Download the latest file for the monitor to be upgraded from the Reno A&E web site (www.renoae.com).
- 3) Connect the monitor to the computer through the **COMM PORT** or **ETHERNET 10/100** port (on the MMU-1600GE).
- 4) Start the RaeComM program.
- 5) Ensure that the RaeComM software can communicate with the monitor to be upgraded by clicking on **IDENTIFY** in the menu and observing that the monitor is correctly identified by the program.
- 6) On the **CONFIG** menu choose **UPGRADE FIRMWARE**.
- 7) On the Code Loader form that appears, click on the file folder icon after the file name.
- 8) Select the file that was just downloaded from the Reno A&E web site. If more than one file was in the downloaded file, select the one ending with BOOTCODE.RAE.
- 9) If the file you selected is the correct file for the attached monitor, the Upgrade Firmware form will show the current version of firmware in the monitor and the version that is about to be transferred.
- 10) If this is correct, click on the **UPGRADE FIRMWARE** button and the process will begin.
- 11) If an error is encountered once the transfer has begun, RaeComM will automatically retry the transfer process up to five times. Do not cycle power to the monitor if an error is encountered. Attempt the transfer again by closing the Upgrade Firmware form and repeating Steps 6 through 10.
- 12) Wait a few seconds to ensure that the RaeComM software does not automatically start another upgrade process (this will happen if the boot loaders need to be upgraded and is automatic). Once the transfer is complete, cycle power to the monitor to begin running the new code.

IMPORTANT *Do not interrupt power to the monitor during the programming process. This will corrupt the firmware being transferred !*

Each firmware file is encrypted and contains information identifying what model monitor it can be used in and what type of firmware it is. This ensures that the user cannot inadvertently upgrade a monitor with the incorrect firmware and that the firmware file has not been tampered with.

