Eberle Design Inc.

MMU-16E Series

Malfunction Management Unit

- Training Seminar -

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Introduction

- Goal: Better Understand Monitor & Cabinet System Operation.
- Topics
  - General Signal Monitor Concepts
  - TS2 MMU Features
  - EDI MMU-16E Installation
  - TS2 Trouble Shooting

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Not all symptoms of cabinet equipment malfunctions lead to the most obvious remedy.

These topics are intended to give an overall view of the important concepts needed to understand the operation of a basic signal monitor and in particular the EDI MMU-16E series Malfunction Management Unit.

These skills are needed to quickly and effectively trouble shoot a malfunctioning intersection.

Motivation

- Signal Monitors help ensure proper intersection operation.
- Signal Monitors help trouble shoot malfunctioning equipment.
- Liability risks have increased dramatically.
- Costs of trouble shooting & repairing malfunctions has increased.

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The purpose of the signal monitor is to detect and respond to improper and potentially dangerous operating conditions resulting from the malfunction of the cabinet equipment, field wiring, or signal heads.

The diagnostic tools built into modern signal monitors can be used to quickly diagnose the cause of the malfunction and document the details. The signal monitor should be considered a tool just as a voltmeter or laptop computer would.

STOP - LOOK - THINK - ACT

In order to help reduce liability risks, the first defense is to ensure that any malfunction is properly detected and responded to. A working and correctly installed signal monitor provides this function. Because of the many built in diagnostics of the MMU-16E, a continuous test is being made to ensure that the signals match the controller outputs.

The sooner an intersection is returned to operation the better, both from a safety perspective and moving traffic perspective. Maintenance budgets are getting tighter putting more emphasis on quick and effective repair.

MMU-16E series Overview

- Exceeds all requirements of NEMA TS2-2003 including additional monitoring functions beyond TS1-1989
- High speed, real time communications with the Controller Unit (CU)
- EDI MMU-16E enhanced functions
  - Full Intersection Display
  - True Rms Voltages
  - Full Event Logging

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The MMU-16E provides all the same functions that a NEMA TS1 Conflict Monitor (CMU) provided. Enhancements have been made to provide a broader fault coverage as well as more diagnostic capabilities.

Dual Mode Operation

- TS2 16 Channel Mode (Type 16)
  - Red / Dont Walk, Yellow, Green / Walk
- TS1 12 Channel Mode (Type 12)
  - Red, Yellow, Green, Walk
- The *Type Select* input programs the mode.

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The TS2 Standard defines only one type of MMU. This helps to eliminate the inventory problems related to 3, 6, 12, and 18 channel models of TS1.

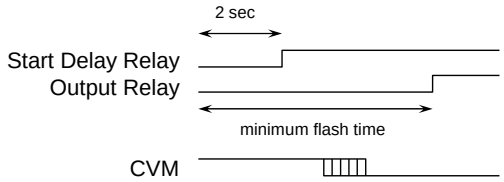
Type 16 - Utilizes separate channels for full pedestrian monitoring. This provides a broader fault coverage and separates the pedestrian functions from vehicle functions.

Type 12 - Downward compatible with a TS-1 12 channel CMU. No communications in this mode. This mode provides some level of interchangeability for inventory and maintenance purposes.

The *Type Select* input is wired to *Logic Ground* for Type 16 mode and left open for Type 12 mode. This pin was a spare pin in TS1. The Type 12 LED indicates the mode of operation.

Power-up & Flash Operation

- The monitor *Output* Relay controls the mercury contactor and flash transfer relays.
- The monitor *Start Delay* Relay controls AC power to the CU.



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The monitor Output Relay has the ultimate control of flashing operation. The relay provides the AC Line voltage to the mercury contactor and flash transfer relays when signal operation is desired. It usually is wired in series with the Police Flash switch.

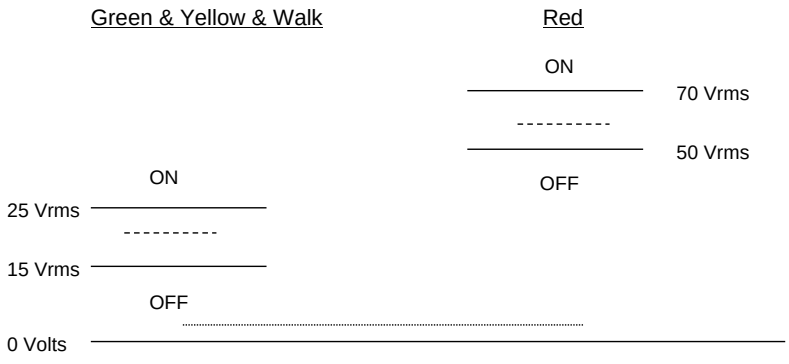
The Minimum Flash period is designed to provide up to 16 seconds of hardware flash following a power-up, power interruption, or low voltage condition. All equipment in the cabinet should be operational before the minimum flash interval times out.

The Start Delay Relay is wired to provide AC Line to the Controller Unit (CU). A 2 second delay will occur following a power-up, power interruption, or low voltage condition, before power is restored to the CU. This helps ensure that the AC service has stabilized and the CU has been initialized.

The CVM output may be asserted False by the CU until it has completed power-up diagnostics. This ensures that the intersection will not leave flash mode before the CU is ready.

Field Input Thresholds

- The MMU-16E is a voltage sensing device



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Signal monitors are voltage sensing devices. The thresholds for sensing a signal as ON or OFF are set differently for Green and Yellow colors than Red. This is due to the nature of the fault monitoring for each color set.

For Conflicts the monitor should sense a signal ON when the bulb first becomes visible as the voltage is increased. The Conflict fault exists when a signal is On when it should be Off. For Red Fail, the monitor should sense a signal OFF when the bulb first starts to become not visible as the voltage is decreased. The Red Fail fault exists when a signal is Off when it should be On.

A monitor shall sense a signal as OFF when its RMS voltage is below the lower threshold (15v / 50v). A monitor shall sense a signal as ON when its RMS voltage is above the upper threshold (25v / 70v). A monitor may or may not sense a signal as ON when the voltage lies between the upper and lower thresholds (15-25 / 50-70).

MMU-16E Faults

- Conflict
  - Detects two or more active *proceed* channels which are programmed to be incompatible.
  - Program Card jumpers provide permissive programming input to monitor.
  - Timing: 200 ms to 450 ms, 350 ms typical.

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Conflict

The Conflict function detects two or more active *proceed* channels which are programmed to be incompatible.

A proceed color is a Green, Yellow, or Walk. Conflicts are usually caused by a load switch output shorted ON, a short circuit in the field, or loss of load in the field. Improper programming of the CU or the monitor Program Card can also cause conflicts.

MMU-16E Faults

- Red Fail
  - Detects a channel which has no active inputs (R or Y or G).
  - Timing: 700 ms to 1000 ms, 800 ms typical.
  - Enabled by Red Enable input.

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Red Fail

The monitor senses voltage across the load. In most cases a Red Fail is caused by the CU not turning on a load switch, a faulty load switch not turning on an output, or improper CU programming.

A “dark” signal head may have voltage present at the monitor inputs due to other causes such as loss of the load. A loss of load will NOT cause a Red Fail. Load switch leakage current will usually provide enough voltage that the monitor will sense an active signal. A loss of load typically results in a Conflict or Dual Indication fault rather than a Red Fail.

MMU-16E Faults

- Controller Voltage Monitor (CVM)
  - The CU will use this logic signal output to indicate a CU problem or to force the monitor to the flash state.
  - Timing: 150 ms typical, non-latching.
- 24 Volt Monitor (24V-1 & 24V-2)
  - Monitors two 24 Vdc power supplies.
  - Voltage: <18 Vdc = fault, >22 Vdc = operate
  - Timing: 150 ms typical, non-latching.

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Controller Voltage Monitor (CVM)

This logic level signal is normally used by the CU to indicate a malfunction in the CU or improper programming or operation. It may also be used to force a hardware flash state in the monitor for events such as time-of-day flash. CVM may also be False during a start-up sequence while the CU is initializing.

24 Volt Monitor (24V-1 & 24V-2)

These inputs monitor 24V power supplies for proper operation. Proper operation is defined as greater than 22 Vdc. Improper operation is less than 18 Vdc.

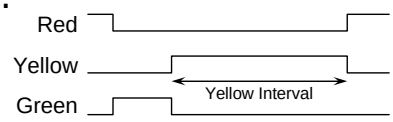
Non-Latching vs Latching

Both functions are defined as non-latching. They may each be programmed to a latching mode using jumpers on the Program Card.

Caution should be taken when latching CVM faults as they are not always indicative of a *fault* condition.

MMU-16E Faults

- *Minimum Yellow* Clearance Fail
  - Measures the Yellow Change interval for an MUTCD 3 second minimum.
  - Timing: 2.6 to 2.8 seconds
  - The MMU-16E will indicate the channel(s) with a short or skipped Yellow Change interval with solid Channel Status LED.
  - Enabled by Red Enable input and MYCD jumpers.



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The MMU-16E has two Clearance monitoring functions.

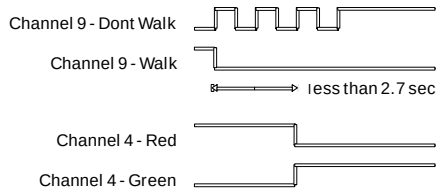
The Minimum Yellow Clearance mode ensures that a Green to Yellow to Red sequence has an MUTCD three second Yellow clearance interval. It is measured on vehicle channels which have a true Yellow signal.

To disable this function for a channel which does not have a true Yellow signal, the Minimum Yellow Change Disable (MYCD) jumper must be in place on the Program Card. This would be the case for pedestrian and in some cases protected-permissive left turn channels for example.

This problem is usually related to a controller malfunction, preemption problem, or programming error. In TS1 monitors Clearance Fail detection was defined by the manufacturer and different results could be obtained depending on the product type.

MMU-16E Faults

- *Minimum Yellow + Red* Clearance Fail
  - Measures the interval from a terminating Green to the next active conflicting Green.
  - Timing: 2.6 to 2.8 seconds
  - Provides clearance protection for ped channels or channels with no Yellow.



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This Clearance function ensures that **all** channels have a minimum clearance time of three seconds. It is mainly intended to detect violations on pedestrian channels.

The MMU-16E times from the end of a terminating Green channel to the beginning of any non-permissive Green channel. If the minimum timing is violated, the MMU-16E responds with a Yellow Plus Red Clearance Fail.

Field Check status can also help isolate whether the problem was a result of a CU malfunction, or problem in the load bay or field.

MMU-16E Faults

- Dual Indication Fault
  - Detects more than one active input (color) on a channel.
  - Can *anticipate* Conflict malfunctions before they are displayed on the signals.
  - Enabled by Red Enable input and Dual Enable switches (per channel).
  - Dual Indication is the <u>only</u> way to detect the Red no-load condition.

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<u>Dual Indication Fail</u>

This monitoring function will detect more than one input of a channel active at the same time. This may be caused by a load switch output stuck ON, a short circuit in the field, or a loss of load (burned out bulbs or open field wire).

If a Green (or Yellow) signal stays ON due to short circuit or load switch failure it will be detected as a Dual Indication fault when the Yellow (or Red) signal on that channel activates. This will put the intersection to flash before the next conflicting phase is active, preventing a conflict display in the field.

Similarly, a loss of the Red load will be detected when that channel cycles to Green.

This function also works in conjunction with Red Fail to ensure that all channels are being monitored (e.g. harness problem).

Timing: 700 ms to 1000 ms, 800 ms typical on Ped channels

Timing: 300 ms to 450 ms, 400 ms typical on Vehicle channels

MMU-16E Faults

- Port 1 Fail
  - Detects that no Type 0 message has been received on the SDLC port from the CU.
  - Timing: 300 ms, latching after 3rd occurrence in a 24 hour period
- Diagnostic Fail
  - Internal MPU watchdog circuit
  - ROM, RAM, or EEPROM failure
  - Internal power supply failure

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Port 1 Fail

The MMU-16E monitors the SDLC link to ensure that communications with the Controller Unit are functioning. TS2-1998 changed this fault to latch only after the 3rd occurrence in a 24 hour period.

A Port 1 failure indicates that the MMU-16E is not receiving data from the CU. If the MMU-16E is not transmitting data to the CU, the CU will respond with a CVM fault.

This fault is usually caused by a bad cable or termination, a configuration error in the CU, a bad device on the SDLC bus, or loss of power to the CU.

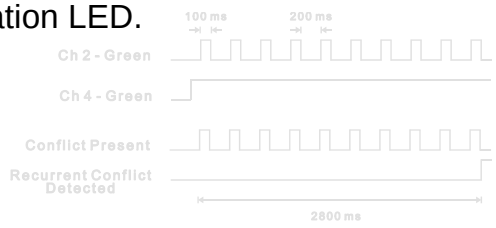
Diagnostic Fail

The MMU-16E has many internal diagnostic tests that ensure proper operation of the monitor. THIS DOES NOT TAKE THE PLACE OF REGULAR MONITOR TESTING! If the Diagnostic Fail LED has illuminated, other LEDs may not be valid. The unit should be tested before returning to service.

An exception is the Diagnostic LED ON and the Type 12 LED flashing. This indicates a Type Fault, meaning the Type Select input has changed state since the last reset.

MMU-16E Faults

- Recurrent Pulse Detection
  - Detects intermittent or pulsing signal conditions which may not meet the requirements of typical continuous fault detection algorithms.
  - The RECURRENT PULSE STATUS LED will illuminate with the Conflict or Red Fail or Dual Indication LED.



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The Recurrent Pulse detection (RP DETECT) function is designed to respond to fault conditions which are intermittent in nature and do not meet the continuous timing requirements of the normal detection algorithms, yet may still produce improper signal displays. These input conditions are differentiated by their longer time constant and fault response times.

The figure shows an example of a recurrent Conflict fault. Channel 2 Green is detected active due to a malfunction of the load switch which caused the output to “flicker” On for 100 ms approximately every 200 ms. Since normal Conflict detection requires a continuous fault of at least 350 ms typical, this event could go undetected. The Recurrent Pulse detection algorithm will combine these pulses into one event and trigger a Conflict fault once the longer recurrent timing threshold is exceeded.

AC Line Power Failure

- TS2 Power Failure is defined for all devices as AC+ voltage less than 89 Vac.
- MMU-16E will respond if failure is greater than 500 ms.
  - Start Delay and Min Flash sequence
- MMU-16E will not respond if failure is less than 450 ms.
- The MMU-16E restore voltage is 98 V max.

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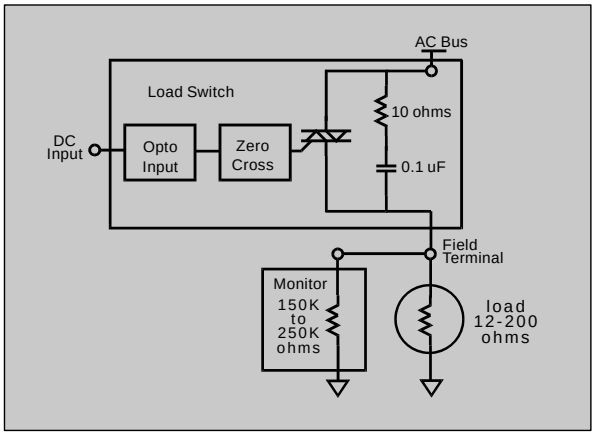
In TS1, an AC interruption was defined as zero volts. Early monitors would not differentiate between a true interruption and a low voltage condition (AC < 95 Vac). Because of a lack of definition in the Standard, power-up, power-down, and low voltage operation often resulted in nuisance faults requiring a service call to reset the monitor.

TS2 has a better definition of a power failure and low voltage operation for ALL components within the cabinet. The MMU-16E is the first device to recognize a low voltage condition (resulting in flash) and the last device to recognize proper operating voltage (resulting in colors).

Factory levels for the MMU-16E thresholds are typically set for 92 Vac drop-out and 96 Vac restore.

Load Switch Leakage Current

- Load Switch Block Diagram



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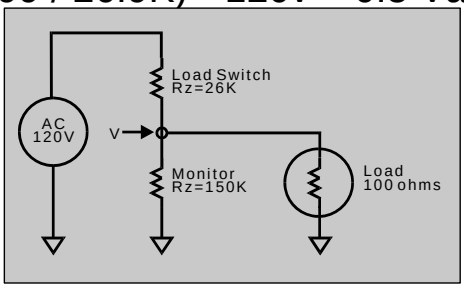
Because a monitor only senses voltage across the signal load and not current, the effect of driving the load with a solid state Load Switch can produce unexpected results when a component malfunctions. The effect of leakage current is important to understand for trouble-shooting reasons and proper system design especially as new signal technologies become available.

The load switch has a DC input which is optically isolated from the AC Line voltage. When a voltage less than 6 Vdc is applied to the input the input circuit will activate. The zero-cross circuit synchronizes the turn-on to the AC Line. The triac device will only conduct in one half cycle periods.

The triac needs to be protected against transient voltages by the resistor / capacitor snubber circuit shown. Off-state leakage current does not come through the triac switch, but through this snubber.

Load Switch Leakage Current

- AC impedance of snubber capacitor
  - 1/(2*pi*f*C) = 26 Kohms (C=0.1 uf, f=60 hz)
- Leakage current approximation
  - 120v / 26K = 5 ma
  - Vm = (99 / 26.9K) * 120v = 0.5 Vac



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The leakage current can be easily estimated by knowing the value of the snubber components. A capacitor looks resistive to an ac voltage. The equivalent *impedance* is calculated as shown. Typical values for snubber capacitors range from 0.05uf to 0.1uf.

Most off-state signals will have a residual voltage due to this leakage current on the order of 0.5 Vac to 3 Vac depending on the value of the snubber and load. Since this value is less than the 15 V and 50 V thresholds, they are sensed as OFF.

The off-state voltage can be estimated by the leakage current (5ma) multiplied by the load resistance (100 ohms). When this off-state voltage increases to the 15 V to 25 V range on a Green or Yellow or Walk input, the monitor may incorrectly sense it as ON.

The maximum TS2 load impedance can be shown to be 2100 ohms for Green, Yellow, and Walk, and 7000 ohms for Red. New technologies using solid state power supplies and LEDs must accommodate this *parameter*.

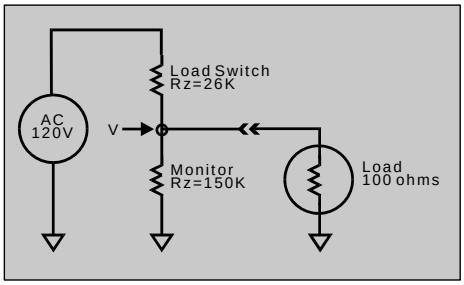
Capacitors can also be used as loads where power dissipation is an issue. Care should be taken since capacitor discharge times will skew the monitor sensing point and may cause Conflict or Dual Indication faults.

Example calculation for a 2000 ohm equivalent capacitor:

C = 1 / (2*pi*f*R) = 1.3 uf

Load Switch Leakage Current

- Loss of load does *not* produce a Red Fail!
  - Vm = (150K / 176K) * 120V = 102 Vac
- The Monitor will detect a loss of load as an <u>active</u> signal.



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When the load is removed from the load switch output, the <u>monitor</u> becomes the load. Recalculating the off-state voltage shows a residual voltage of 102 Vac. This will be sensed as an *active* signal by the monitor whether it is a Green, Yellow, Walk, or Red.

Thus, a loss of load will not cause a Red Fail, but will be detected as a Conflict fault (for Green, Yellow, or Walk) or a Dual Indication fault (for Green, Yellow, Walk or Red).

A good trouble shooting practice is to measure the off-state voltage of each input and ensure that is is less than the monitor minimum threshold.

NEMA TS2 Standard

- Higher level of functionality and better specification detail
- Standardized high-speed communication bus
- Less cabinet wiring
- More powerful diagnostic tools to prevent and diagnose problems
- Safer - Redundant monitoring, MMU compatibility check, etc in CU

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The NEMA TS2 Standard takes many functions which existed in TS1 equipment as an *enhanced* feature and makes them standard in TS2. Many ambiguities and problems were resolved in TS2 as well.

The high speed bus makes communication between devices standard to eliminate many different proprietary protocols. Many safety and diagnostic functions as well as better status functions are made possible by this link between devices.

Less cabinet wiring means less cost as well as less opportunity for malfunction.

Besides continuously running diagnostics, more information for effectively diagnosing problems is available.

Many safety issues are addressed by the communication between the MMU-16E and controller unit such as programming incompatibility and redundant monitoring.

SDLC Communications (Port1)

Data interchange between the MMU and CU every 100 ms:

- MMU-16E Compatibility Programming
- MMU-16E Field Status
- MMU-16E Fault Status
- CU Load Switch Command Status
- Time and Date

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Five main pieces of data are exchanged between the MMU-16E and the controller unit 10 times per second.

MMU-16E Compatibility Programming

Controller Unit verifies the compatibility of its phase programming with the MMU-16E program card to prevent unsafe intersection operation. The MMU-16E cannot be programmed more permissive than the CU.

MMU-16E Field Signal Status

Real-time field status allows the Controller Unit to perform a redundant monitoring function (e.g. conflict, color check, etc.) should the MMU-16E or associated flash circuitry become disabled.

Fault Status

The MMU-16E fault status is available for the Controller Unit to log or transmit for remote trouble shooting and archiving.

Controller Unit Load Switch Command Status

Real-time Controller Unit load switch command status allows the MMU-16E to perform additional diagnostic functions (Field Check Status) for a continuous test of the field versus CU.

Time and Date

MMU-16E event log time-stamps will be synchronized with the Controller Unit.

EDI Field Check Monitoring

- The MMU-16E continuously compares the CU output data to the field status.
- This diagnostic data can isolate whether the fault was due to a CU malfunction OR a failure in the load bay or field.
- The channel(s) which malfunctioned are also directly identified.

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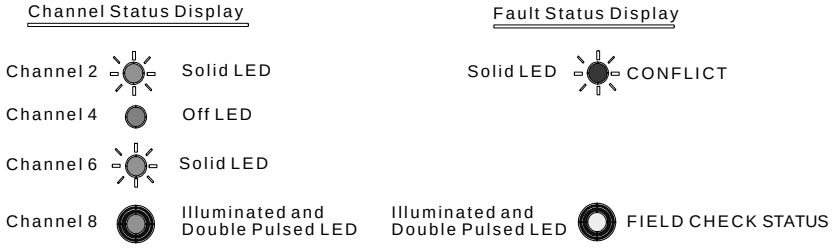
When operating in the Type 16 mode the MMU-16E unit will receive the Type 0 message from the Controller Unit (Type 1 or Type 2 CU) which contains an image of the controller output commands to the load switches. When a fault condition triggers the MMU-16E unit, the Type 0 message information received while the fault condition was being timed will be analyzed by the MMU-16E unit to determine whether the sensed field signal input status corresponded to the Controller Unit output commands.

This diagnostic information may then be used to isolate whether the fault condition was caused by a Controller Unit malfunction, or a failure in the load switch and/or field wiring. The channel(s) which malfunctioned are also directly identified.

EDI Field Check Status Mode

- Conflict Fault with Field Check Status on Channel 8 example.
  - Channels 2 & 6 are set active by the CU.
  - Channel 8 is sensed active due to Load Switch short.



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In this example channels 2 and 6 are set to active Green by the controller. Channel 8 Green is not permissive with channels 2 and 6, and becomes active due to a short circuit in the field wiring. The MMU-16E will detect a Conflict Fault with Field Check Status on channel 8.

The CONFLICT indicator is illuminated and the FIELD CHECK STATUS indicator is **double pulsed** for 2 seconds. Channel indicators 2, 6, and 8 are illuminated to indicate the proceed channels active at the time of the fault. Channel indicator 8 will **double pulse** at the same time as the FIELD CHECK STATUS indicator to indicate that the field signal input state did not correlate properly with the Controller Unit output command.

This diagnostic information directly shows that the malfunction on Channel 8 was due to a field problem rather than a Controller Unit failure.

EDI Field Check Fault Mode

- The field inputs did not correspond to the CU Output commands for 1000 ms.
- The field status also did not result in a normal Conflict, Red Fail, Clearance Fail, or Dual Indication fault.
- The Field Check LED will be ON solid
- This fault is typically due to a cabinet wiring error or programming error.

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When the field signal input states sensed as active or inactive by the MMU-16E unit do not correspond with the data provided by the Controller Unit in the Type 0 message for 10 consecutive messages, the MMU-16E unit will enter the fault mode and illuminate the FIELD CHECK FAIL indicator.

The Channel Status Display will indicate the channels on which the Field Check error was detected.

This fault is usually caused by a wiring error in the cabinet or programming error in the MMU-16E or CU.

Fault Display Mode

- Signals ACTIVE at the time of the fault for 6 seconds,
- Then, Channels at fault for 2 seconds,
- Then, Inputs with Field Check Status for 2 seconds (if any)
- Then, Inputs with Recurrent Pulse Status for 2 seconds (if any)

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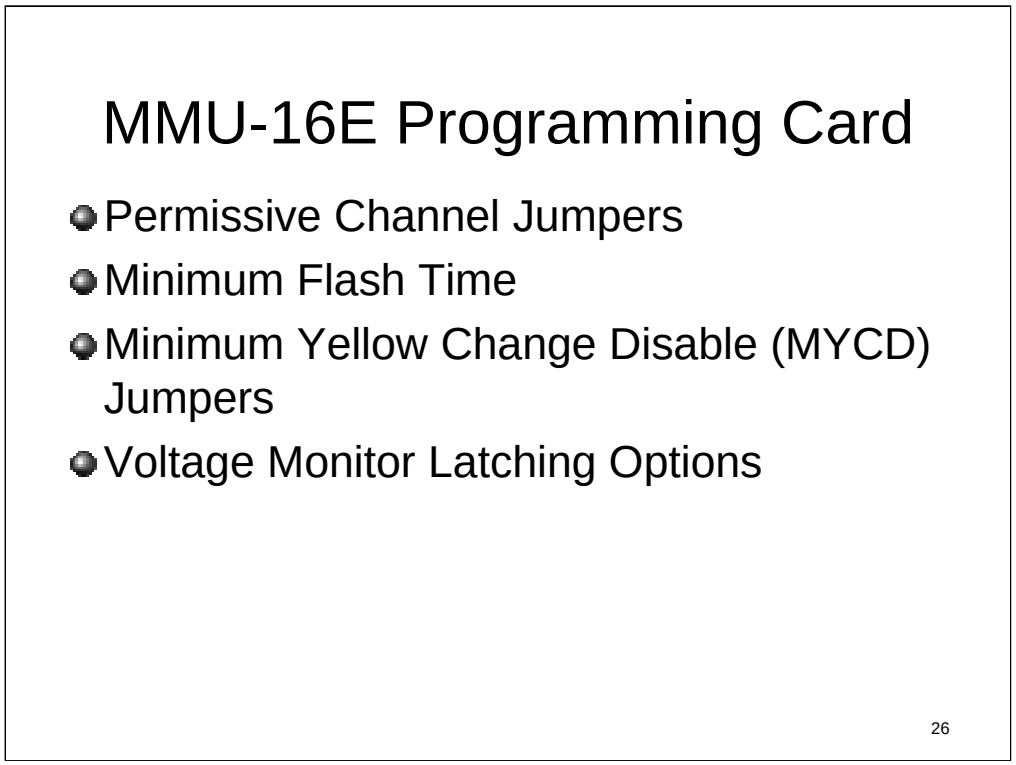
During a fault, the Channel display will show the *field signals* active at the time of the fault for 6 seconds and then flash (4Hz) the RYG indicators for the *channels* that were involved in the fault for 2 seconds.

If Field Check Status was sensed, the inputs with Field Check Status will flash their respective indicators simultaneously with the FIELD CHECK STATUS indicator at a 4 Hz rate for 2 seconds.

If Recurrent Pulse Status was sensed, the inputs with Recurrent Pulse Status will flash their respective indicators simultaneously with the RECURRENT PULSE STATUS indicator at a 4 Hz rate for 2 seconds.

The display will cycle through this series until reset.



The Program Card is not interchangeable with cards from TS1 CMUs. It has all the configuration settings required for standard NEMA functions and defines the configuration of the cabinet to the MMU-16E.

The *Permissive Channel* jumpers use a soldered wire jumper to indicate a channel pair is permissive (i.e. both may be active simultaneously).

The *Minimum Flash* jumpers program the start-up hardware flash time from 6 to 16 seconds. No jumper defaults to 6 seconds.

The *Minimum Yellow Change Disable* jumpers turn off Minimum Yellow Change Clearance monitoring for each channel. These jumpers should be in place for channels that do not have a true Yellow load, or have the Red input tied to AC+ such as pedestrian channels without the Dont Walk being monitored or protected-permissive left turn channels.

The *CVM Latch* and *24V Latch* jumpers change the CVM and 24V monitor functions to a latching mode. Once triggered, the Reset input will be required to reset the MMU-16E. Caution should be taken when latching CVM faults as they are not always indicative of a *fault* condition.

EDI Option Switches

- GY ENABLE
  - Provides G-Y Dual Indication monitoring for 5 section heads
- RP DISABLE
  - Disables Recurrent Pulse Monitoring for test purposes
- WD ENABLE
  - Activates the External Watchdog Monitor

continued

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GY ENABLE

This function may be used for 5 section signal heads with the missing Red arrow input tied to AC Line.

If the GY ENABLE switch is in the ON position, then all channels will detect a Green and Yellow Dual Indication fault on that channel.

If the GY ENABLE switch is in the OFF position, then any channel that has its DUAL ENABLE Switch in the OFF position will not detect any Dual Indication fault on that channel.

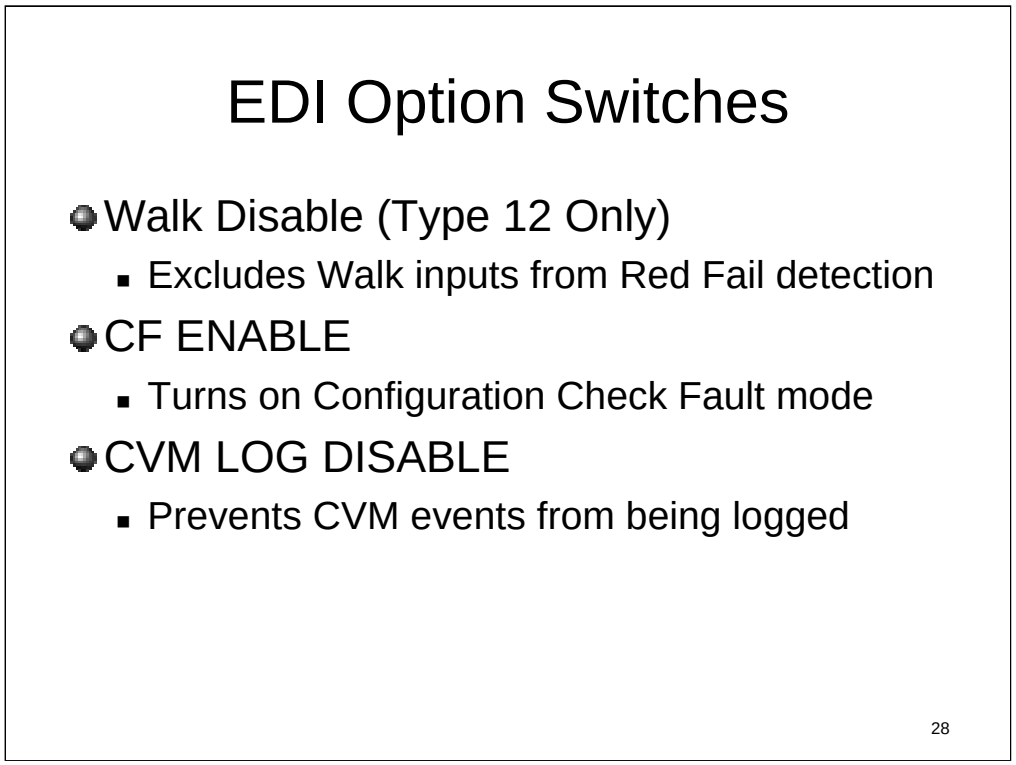
RP DISABLE

To facilitate monitor bench testing, it may be necessary to disable the RP detect function. Placing the switch in the ON position DISABLES RP monitoring.

WD ENABLE

Placing this switch in the ON position causes the unit to monitor a watchdog output from another device. It must be correctly harnessed by the factory to operate. If this option is not used then the switch should always be in the OFF position.

For all EDI monitor products, the *name* of the option switch is what happens when the switch is in the ON position.



WALK DISABLE

Placing this switch in the ON position removes the Walk inputs from the Red Fail calculation in Type 12 mode only. Red Fail -> G=Off and Y=Off and R=Off.

CF ENABLE

Placing this switch in the ON position forces the monitor to the fault mode if any monitor configuration programming changes. This includes all program card jumpers and dip switches.

CVM LOG DISABLE

If CVM events are not intended as fault events (such as TOD flash), placing this switch in the ON position will prevent all CVM events from being placed in the event log.

For all EDI monitor products, the *name* of the option switch is what happens when the switch is in the ON position.

EDI Field Check / Dual Enable Switches

- Field Check / Dual Enable switches enable both Field Check Monitoring and Dual Indication monitoring when in the ON position.
- The switches should be in the ON position for vehicle channels and other channels which have a true Red, Yellow, and Green load.

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Field Check / Dual Enable Switches in the ON position enable the Field Check and Dual Indication monitoring functions on an individual channel basis.

An Enable switch should be OFF for channels that have the Red input tied to AC Line such as the left turn signal of a 5 section head, pedestrian channel, or any unused channels. An Field Check / Dual Enable switch should also be OFF for any channels that do not monitor all three outputs of the corresponding Load Switch such as a pedestrian channel with no Yellow load.

EDI *ECcom* Software

- Displays RMS field status, cabinet voltages and temperature, time clock, ID
- Retrieves, displays, stores event logs:
  - Previous Fail events
  - Fault Reset events
  - AC Line events
  - Configuration Change events
  - Chronological event sort
- Signal Sequence history of signals 30 s prior to fault

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The EDI *ECcom* software package interfaces a Computer to the MMU-16E. All events are time stamped with the time and date of the event. A monitor ID number and description may be assigned to the monitor.

RMS Field status and control input status can be obtained from the monitor in real time. Current configuration is displayed as well as time clock setting, monitor ID, cabinet voltage, temperature, and configuration check value.

Event logs may be uploaded, displayed, stored as Ascii files, and printed. Monitor logs may also be cleared individually. The following event logs are available: Previous Failures, AC Line Events, Manual Reset Events, Configuration Change Events.

A chronological sort displays all event types sorted together by time stamp value.

The Signal Sequence display will show all signal states for up to 30 seconds prior to the current fault. This buffer is retained after reset but is overwritten with the next fault. This display is extremely useful for diagnosing intermittent signal problems.

NEMA TS-2 STANDARD

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