



GAI-TRONICS®
A HUBBELL COMPANY

Elemec3

MIM (Monitored Input Module) and MRM (Monitored Relay Module)

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MIM (Monitored Input Module) and MRM (Monitored Relay Module)

Confidentiality Notice

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Models

Elemec3 MIM (Monitored Input Module) models:

- 030-02-0096-001 CAN BUS MIM
- 030-02-0098-001 Ethernet MIM

Elemec3 MRM (Monitored Relay Module) models:

- 030-02-0097-004 CAN BUS MRM 4 Circuits Standard Relay Mount
- 030-02-0097-014 CAN BUS MRM 4 Circuits Alternate Relay Mount
- 030-02-0097-008 CAN BUS MRM 8 Circuits Standard Relay Mount
- 030-02-0097-018 CAN BUS MRM 8 Circuits Alternate Relay Mount
- 030-02-0099-004 Ethernet MRM 4 Circuits Standard Relay Mount
- 030-02-0099-014 Ethernet MRM 4 Circuits Alternate Relay Mount
- 030-02-0099-008 Ethernet MRM 8 Circuits Standard Relay Mount
- 030-02-0099-018 Ethernet MRM 8 Circuits Alternate Relay Mount

Definitions

High Voltage—An electrical potential greater than 42.4 V peak or 60 V dc

Low Voltage—An electrical potential less than or equal to 42.4 V peak or 60 V dc

Abbreviations

CPU —central processing unit	PCBA —printed circuit board assembly
EOL —end of line	LOC —local

MIM (Monitored Input Module) Assemblies

Application

The Model 030-02-0096-001 and 030-02-0098-001 *Elemec3* MIMs provide inputs to *Elemec3* PAGA (public address and general alarm) systems. MIM's receive up to eight inputs from field devices, monitor the integrity of the input cabling for trouble conditions or activation, and report these conditions to the *Elemec3* controller.

MIMs have two components: a CPU PCBA and a Monitored-In-8 PCBA. The CPU on the Model 030-02-0096-001 MIM uses a CAN bus communication protocol; the Model 030-02-0098-001 MIM uses an Ethernet based communication protocol. Both assemblies mount on 4-inch snap track (see [Figure 1](#) and [Figure 2](#)).

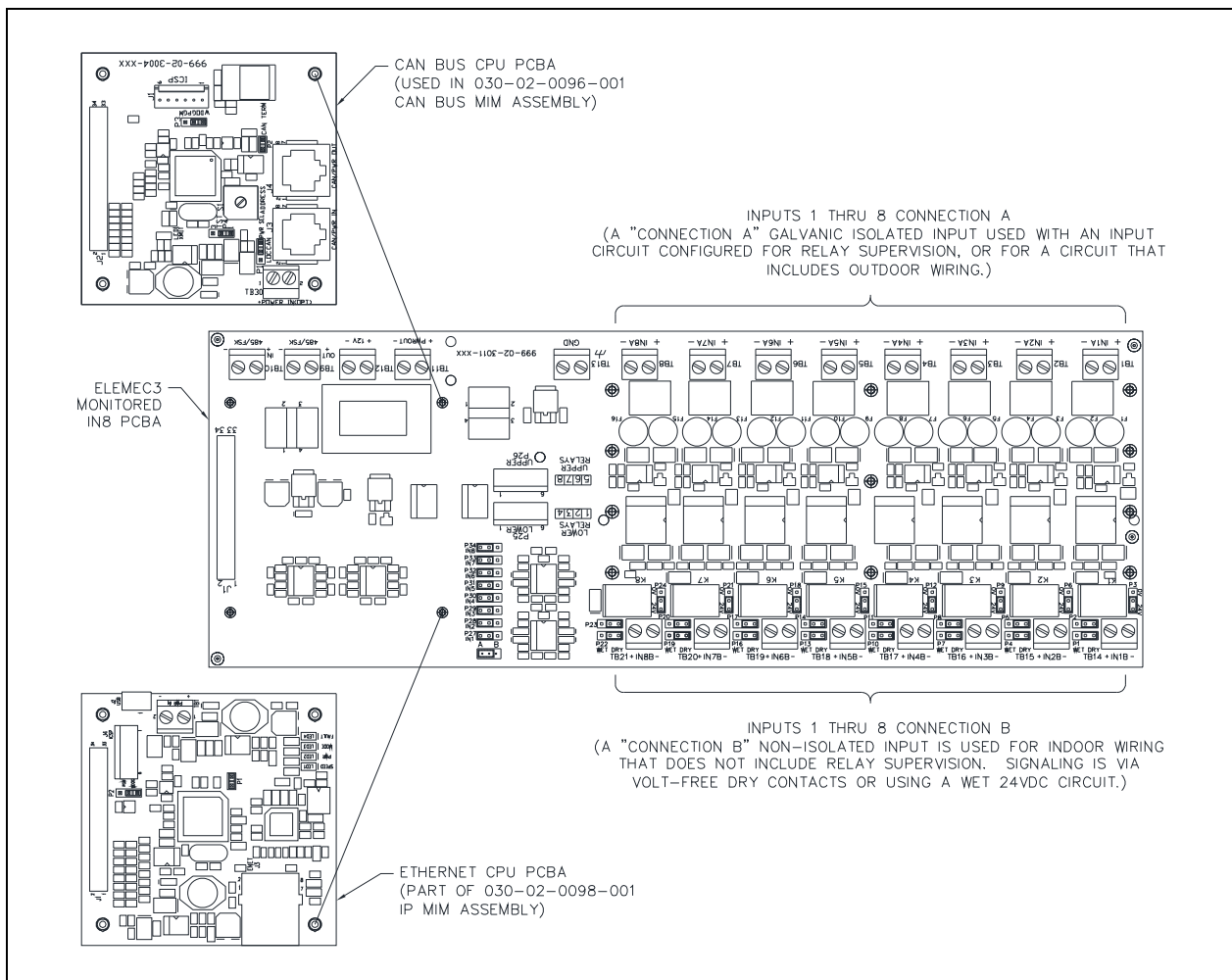


Figure 1. Model 030-02-0096-001 and 030-02-0098-001 Monitored Input Modules

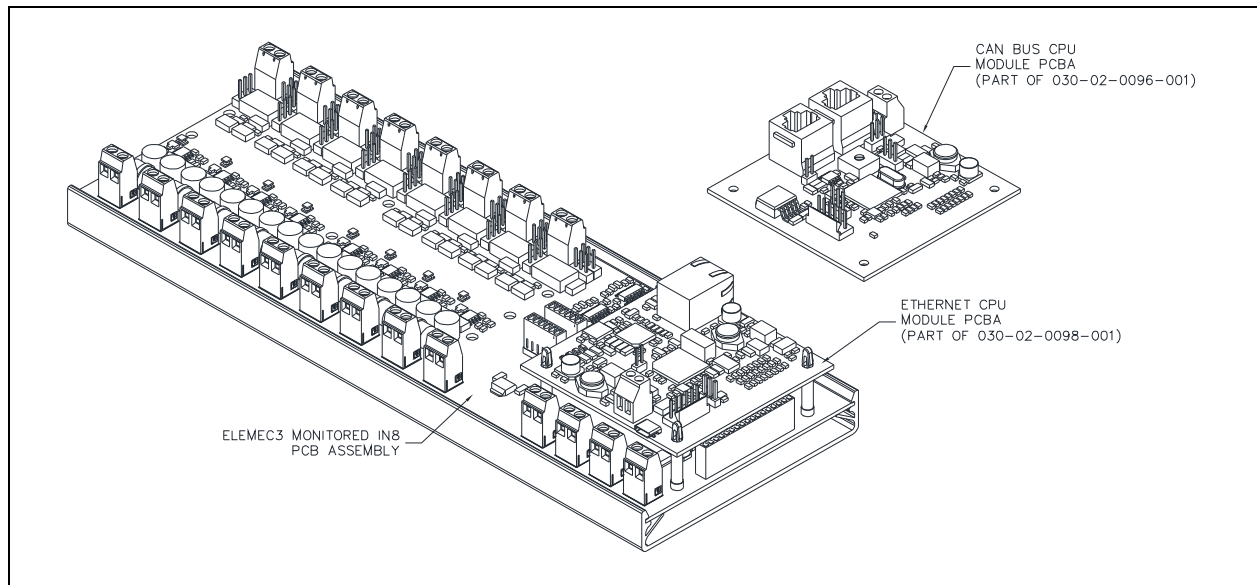


Figure 2. Models 030-02-0096-001 and 030-02-0098-001 Monitored Input Modules—Mounting Configuration

Data Interfaces

Data communication between the MIM and the *Elemec3* controller takes place over a CAN bus interface or an Ethernet interface (see [Figure 1](#) showing each MIM type with corresponding CPU card).

The Model 030-02-0096-001 *Elemec3* MIM interfaces to the *Elemec3* controller via the I/O port (CAN bus). The *Elemec3* controller monitors the MIM devices (via the CAN bus cable). Assign each MIM a unique address by setting the hexadecimal switch on the MIM's CPU card (see the [CAN Bus Address Setting](#) section). The MIM reports input circuit activations and input cable fault conditions to the controller. *Elemec3* controllers sense interruptions in data communication between each MIM and the controller as a device fault condition.

The Model 030-02-0098-001 *Elemec3* MIM interfaces to the *Elemec3* controller cabinet via an Ethernet connection. The *Elemec3* controller monitors the MIM devices via Ethernet connection. Assign each MIM its device address and network parameters (see the [Ethernet MIM/MRM Module Settings](#) section). The MIM reports input circuit activations and input cable fault conditions to the controller. *Elemec3* controllers sense interruptions in data communication between each MIM and the controller as a device fault condition.

Inputs

The MIM contains eight individually configurable inputs to interface with field devices. Configure each input via a series of jumper settings on the PCBAs and specifically selected configuration modes in the *Elemec3* Console configuration utility.

The input circuit type determines which connection (**A** or **B**) to use for each input circuit. Use an input's **A** connection ONLY for supervision of high voltage devices (i.e. supervised beacons) or outdoor field wiring. Use an input's **B** connection for all other input applications. Use jumpers P27 (IN1) through P34 (IN8) to set the connection of each input to **A** or **B** (see [Figure 3](#), [Table 1](#), and [Table 2](#)). Setting an input to connection **B**, requires additional jumper settings to set the contact input to wet or dry and configure the active condition for wet contacts to either 0-volts or 24-volts (see [Figure 4](#), [Table 3](#), [Table 4](#), and [Table 5](#)).

Set the jumper to position **A** and connect the input to one of the connection **A** terminals (TB1 thru TB8) for supervision of high voltage devices. Set the jumper to the **B** position and connect the input to one of the **B** terminals (TB14 to TB21) for all other input applications.

! WARNING ! —Failure to comply with these instructions could result in death or serious injury.

1. Terminals TB1 to TB8 (**A** connections) are galvanically isolated inputs **ONLY** used for outdoor wiring or the supervision of high voltage devices (i.e. supervised beacons). **DO NOT connect any other inputs to these terminals. Failure to comply with these instructions could result in death or serious injury.**
2. Terminals TB14 to TB21 (**B** connections) are non-isolated inputs for indoor wiring low voltage inputs **ONLY**. **DO NOT connect supervised high voltage inputs to these terminals. Failure to comply with these instructions could result in death or serious injury.**

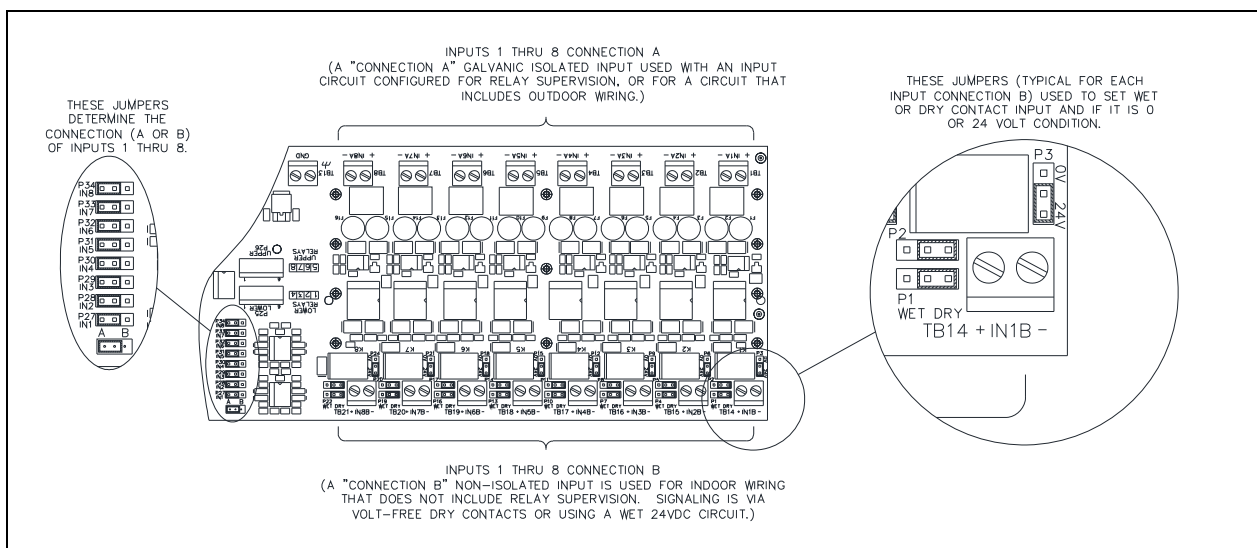


Figure 3. Jumper Locations on the Monitored-In-8 PCBA

Dry/Wet Input Selection

Each connection **B** input contains two jumpers to select between *dry* (voltage-free) or *wet* (24 V dc) inputs. For dry inputs, place both jumpers in the **DRY** position. For wet inputs, place both jumpers in the **WET** position. When in the *wet* mode, the 24 V/0 V jumper must also be set (see [Table 3](#), [Table 4](#), and [Table 5](#) for input jumper configuration details).

24 V/0 V Input Selection

Each connection **B** input contains a jumper to select between 24 V and 0 V when using wet inputs. The input activates with the application (24V setting) or removal (0V SETTING) of 24 V to the input (see [Table 4](#) and [Table 5](#) for input jumper configurations).

NOTES:

- Inputs are polarity sensitive. Ensure the polarity of each input connection is correct.
- Fault monitoring does not occur for circuits configured for *wet* mode.

Table 1. (High Voltage) Connection A Input Supervision Configuration

Input	Input Terminal	Input Type Jumper	Factory Default Setting
1	TB1 (IN1A)	P27—A	YES
2	TB2 (IN2A)	P28—A	YES
3	TB3 (IN3A)	P29—A	YES
4	TB4 (IN4A)	P30—A	YES
5	TB5 (IN5A)	P31—A	YES
6	TB6 (IN6A)	P32—A	YES
7	TB7 (IN7A)	P33—A	YES
8	TB8 (IN8A)	P34—A	YES

Table 2. (Low Voltage) Connection B Input Configuration

Input	Input Terminal	Input Type Jumper	Factory Default Setting
1	TB14 (IN1B)	P27—B	NO
2	TB15 (IN2B)	P28—B	NO
3	TB16 (IN3B)	P29—B	NO
4	TB17 (IN4B)	P30—B	NO
5	TB18 (IN5B)	P31—B	NO
6	TB19(IN6B)	P32—B	NO
7	TB20 (IN7B)	P33—B	NO
8	TB21 (IN8B)	P34—B	NO

Table 3. (Low Voltage) Connection B Dry Contact Input Configuration

Input	Input Type Jumper	Factory Default Setting	24V/0V Jumper
1	P1—DRY P2—DRY	YES	P3—N/A
2	P4—DRY P5—DRY	YES	P6—N/A
3	P7—DRY P8—DRY	YES	P9—N/A
4	P10—DRY P11—DRY	YES	P12—N/A
5	P13—DRY P14—DRY	YES	P15—N/A
6	P16—DRY P17—DRY	YES	P18—N/A
7	P19—DRY P20—DRY	YES	P21—N/A
8	P22—DRY P23—DRY	YES	P24—N/A

Table 4. (Low Voltage) Connection B Wet Contact Input Configuration (Active State for 24 V)

Input	Input Type Jumper	Factory Default Setting	24V/0V Jumper
1	P1—WET P2—WET	NO	P3—24V
2	P4—WET P5—WET	NO	P6—24V
3	P7—WET P8—WET	NO	P9—24V
4	P10—WET P11—WET	NO	P12—24V
5	P13—WET P14—WET	NO	P15—24V
6	P16—WET P17—WET	NO	P18—24V
7	P19—WET P20—WET	NO	P21—24V
8	P22—WET P23—WET	NO	P24—24V

Table 5. (Low Voltage) Connection B Wet Contact Input Configuration (Active State for 0 V)

Input	Input Type Jumper	Factory Default Setting	24V/0V Jumper
1	P1—WET P2—WET	NO	P3—0V
2	P4—WET P5—WET	NO	P6—0V
3	P7—WET P8—WET	NO	P9—0V
4	P10—WET P11—WET	NO	P12—0V
5	P13—WET P14—WET	NO	P15—0V
6	P16—WET P17—WET	NO	P18—0V
7	P19—WET P20—WET	NO	P21—0V
8	P22—WET P23—WET	NO	P24—0V

Input Configuration

Use the *Elemec3* Console application to configure each input to operate in one of five input modes. Determine the mode to select by the type and quantity of switch contacts in each circuit and the circuit's line supervision requirement. Install end of line resistors for circuits with line supervision enabled (see Figure 4–Figure 8 for wiring diagrams).

- Disabled—Deactivates the circuit.
- N.O. Multi (Supervised)—Multiple normally open switches with line supervision enabled.
- N.O. (Supervised)—Single normally open switch with line supervision enabled.
- N.C. (Supervised)—Single normally closed switch with line supervision enabled.
- N.O. Multi (Unsupervised)—Single or multiple normally open switches with line supervision disabled.

Each mode requires a unique connection scheme between the external field device(s) and the appropriate input terminal block on the MIM. The following subsections provide the connection scheme for each mode.

Disabled:

Use this mode to disable the monitoring of a selected input circuit. The MIM does not monitor the input in this mode.

NOTE: It is good practice to set all spare inputs (without field wiring connections) to this mode.

N.O. Multi (Supervised):

Use this mode for circuits with any number of NO contacts (see Figure 4) and monitor the circuit for:

- ground faults
- open circuits

1. Install any number of NO (normally open) dry contacts in parallel in the circuit.
2. Install a 20-kilohm, 5% tolerance resistor across the end-of-line device terminals (*see note below*).

The circuit resistance is 20 kilohms when all contacts are inactive (open). The MIM detects this resistance across the contacts, indicating a healthy circuit.

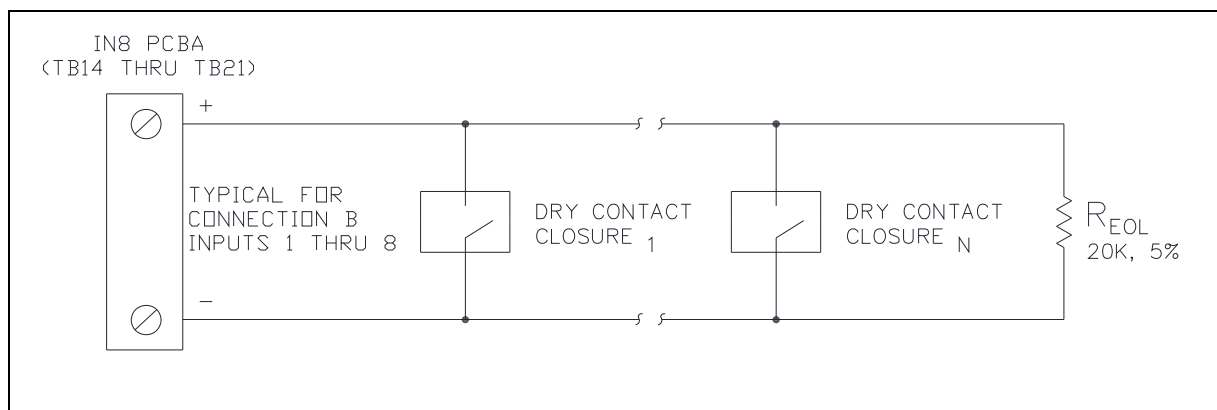


Figure 4. Multiple Normally Open Switches (with line supervision)

When any contact activates (closes), it bypasses the 20-kilohm resistor (R_{EOL}). The input detects the circuit resistance without the terminating resistor, indicating a contact closure (active). The MIM signals ground faults and opens on either leg to the E3 controller.

NOTE: The Model 030-02-0096-001 and Model 030-02-0098-001 MIMs do not include the 20-kilohm, 5% tolerance resistor. Kit 12509-003 (purchased separately) includes this resistor.

N.O. (Supervised):

Use this mode for circuits with a single NO dry contact (see [Figure 5](#)) to monitor for:

- open circuits
- wire-to-wire short circuits (across + and -)
- ground faults

1. Install only one NO contact in the circuit.
2. Install the terminating resistors in series and parallel with the device terminals (see [Figure 5](#)) (*see note below*).

The circuit resistance is 20.1 kilohms (15 kilohms in series with 5.1 kilohms) when the contact is not active (open). The MIM detects this resistance, indicating a healthy circuit.

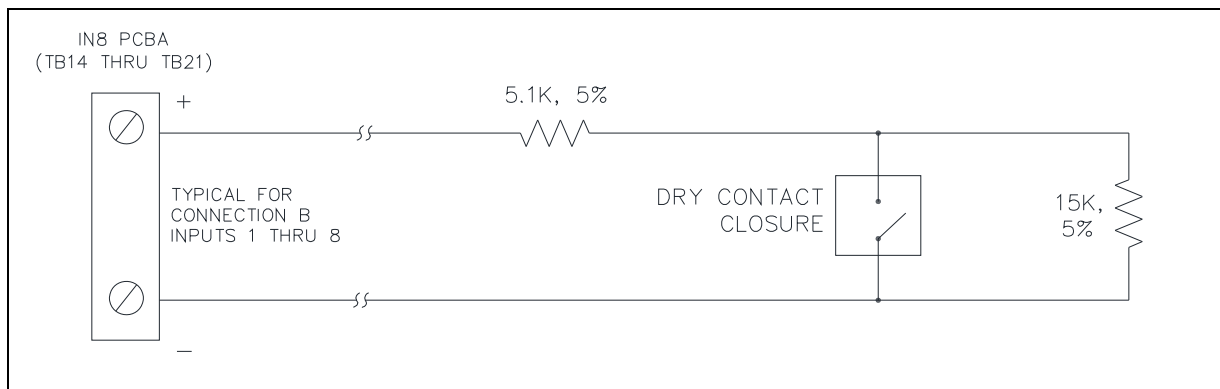


Figure 5. Single Normally Open Switch (with line supervision)

When the contact activates (closes), it bypasses the 15-kilohm resistor. The input detects the 5.1-kilohm load, indicating the contact closed (active). The MIM reports a fault condition to the E3 controller if there is a wire-to-wire short (across + and -), a ground fault on either leg, or an open on either leg.

NOTE: The 030-02-0096-001 and 030-02-0098-001 MIM's do not include the terminating resistors. Kit 12509-003 (purchased separately) includes the resistors.

N.C. (Supervised):

Use this mode for circuits with a single NC dry contact (see [Figure 6](#)) to monitor the circuit for:

- open circuits
- wire-to-wire short circuits (across + and -)
- ground faults

1. Install only one NC contact in the circuit.
2. Install the terminating resistors in series and parallel with the device terminals (see [Figure 6](#)).

When the contact is inactive (closed), it bypasses the 15-kilohm resistor, and the circuit sees only the 5.1-kilohm load. The MIM detects this resistance, indicating a healthy circuit.

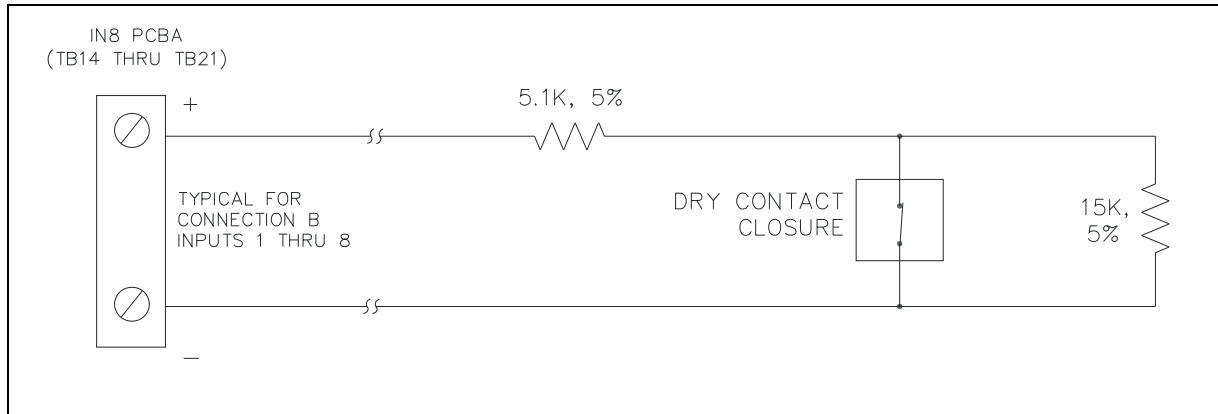


Figure 6. Single Normally Closed Switch (with line supervision)

The circuit resistance is 20.1 kilohms when the contact activates (opens) (15 kilohms in series with 5.1 kilohms). The change in input resistance indicates the contact is open (active). The MIM reports a fault condition to the E3 controller if there is a wire-to-wire short (across + and -), a ground fault on either leg, or an open on either leg.

NOTE: The 030-02-0096-001 and 030-02-0098-001 do not include the terminating resistors. Kit 12509-003 (purchased separately) includes the resistors.

N.O. Multi (Unsupervised):

Use this mode for circuits with any number of NO dry contacts installed (see Figure 7). No circuit monitoring for fault conditions occurs in this mode.

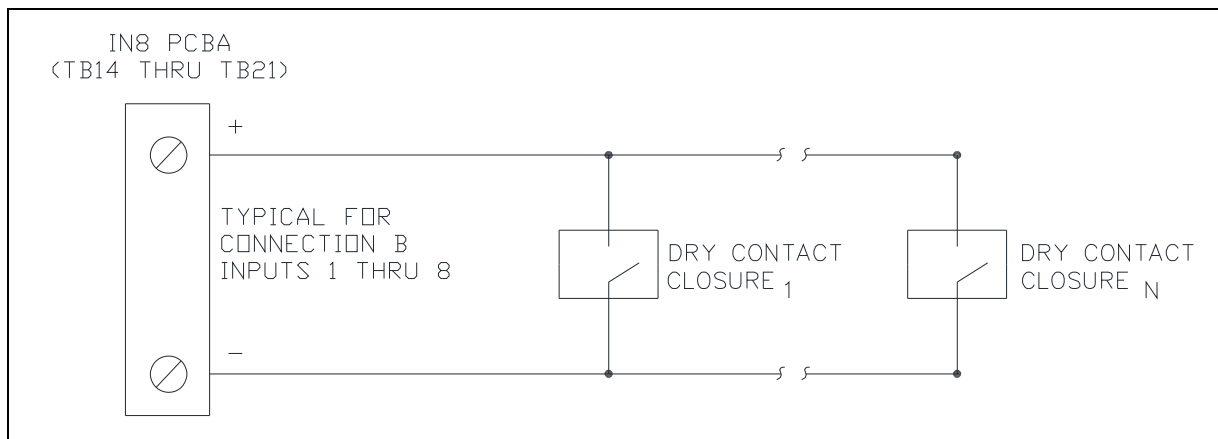


Figure 7. Multiple Normally Open Switches (without line supervision)

24V DC Wet Inputs

Use the *Elemec3* Console application to set the input circuit to N.O Multi (Unsupervised) when connecting *wet* inputs to the MIM. Wire the input circuit as shown below (see Figure 8). No circuit monitoring for fault conditions occurs in this mode.

1. Move the shorting jumpers for the input from the factory default *dry* to *wet* contact mode (see Figure 3 and Table 2).
2. The input activates during a 0-volt condition or a 24-volt condition in *wet* contact mode.
The factory default setting is 24 V dc input when active (position 2-3).
3. Move the jumper from position 2-3 to position 1-2 for 0 V dc input active operation.
The input connection is polarity sensitive.

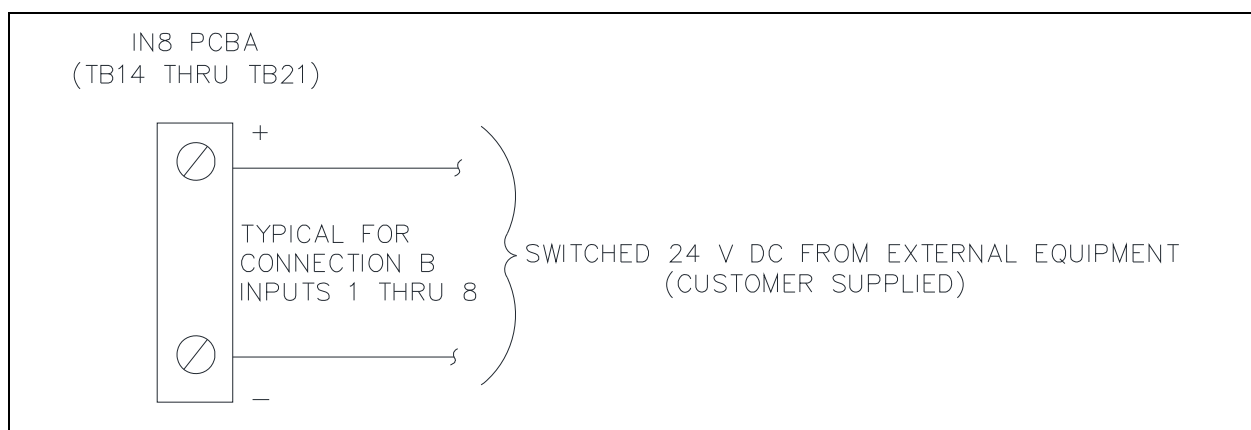


Figure 8. 24V DC Wet Input (without line supervision).

Monitored Relay Module (MRM) Assemblies

Application

Models 030-02-009X-0X4 (four output) and 030-02-009X-0X8 (eight output) MRM (Monitored Relay Modules) are for use in *Elemec3* PAGA (Public Address and General Alarm) systems. MRM modules provide either four or eight relay-contact outputs. Typical applications include switching power to signaling devices (i.e. beacons) or providing contact closure signaling to external systems/devices. The *Elemec3* controller controls each relay individually based on system configuration settings and system conditions.

The MRMs contain eight input circuits as described in the MIM (Monitored Input Module) section of this manual. In addition to the MIM input functions mentioned above, the MRM inputs can supervise the field wiring connected to the relay outputs. A typical application is monitoring the power cable connecting beacons to the MRM output relays. A MRM input monitors the field wiring for open-circuit, wire-to-wire short circuit, and ground fault conditions. An end-of-line resistor is required at the last device on the field cable run.

The MRM assemblies have alternate relay mounting arraignments so that the relay terminal blocks face either the connection **A** input terminal side or the connection **B** input terminal side of the circuit board. Refer to figures [Figure 10](#) and [Figure 11](#) (Models 030-02-009X-00X) and [Figure 12](#) and [Figure 13](#) (Models 030-02-009X-01X).

Data Interfaces

The MRM connects to the *Elemec3* controller via CAN bus or Ethernet network for data communication (see [Figure 9](#)).

CAN Bus

The Model 030-02-0097-0X1 *Elemec3* MRMs interface to the *Elemec3* controller via the I/O port CAN bus.

The *Elemec3* controller monitors the MRM inputs and controls the MRM relays via the CAN bus cable. Assign each MRM a unique address using the hexadecimal switch on the MRM's CPU card (see the [CAN Bus Address Setting](#) section). The *Elemec3* controller reports a device fault condition for any interruption in data communication between the *Elemec3* controller and the MRM.

Ethernet

The Model 030-02-0099-0X1 *Elemec3* MRMs interface to the *Elemec3* controller via an Ethernet local area network connection.

The *Elemec3* controller monitors the MRM inputs and controls the MRM relays via Ethernet connection. Assign each MRM its device address and network parameters (see the Ethernet MIM/MRM Module Settings section). The *Elemec3* controller reports a device fault condition for any interruption in data communication between the *Elemec3* controller and a MRM.

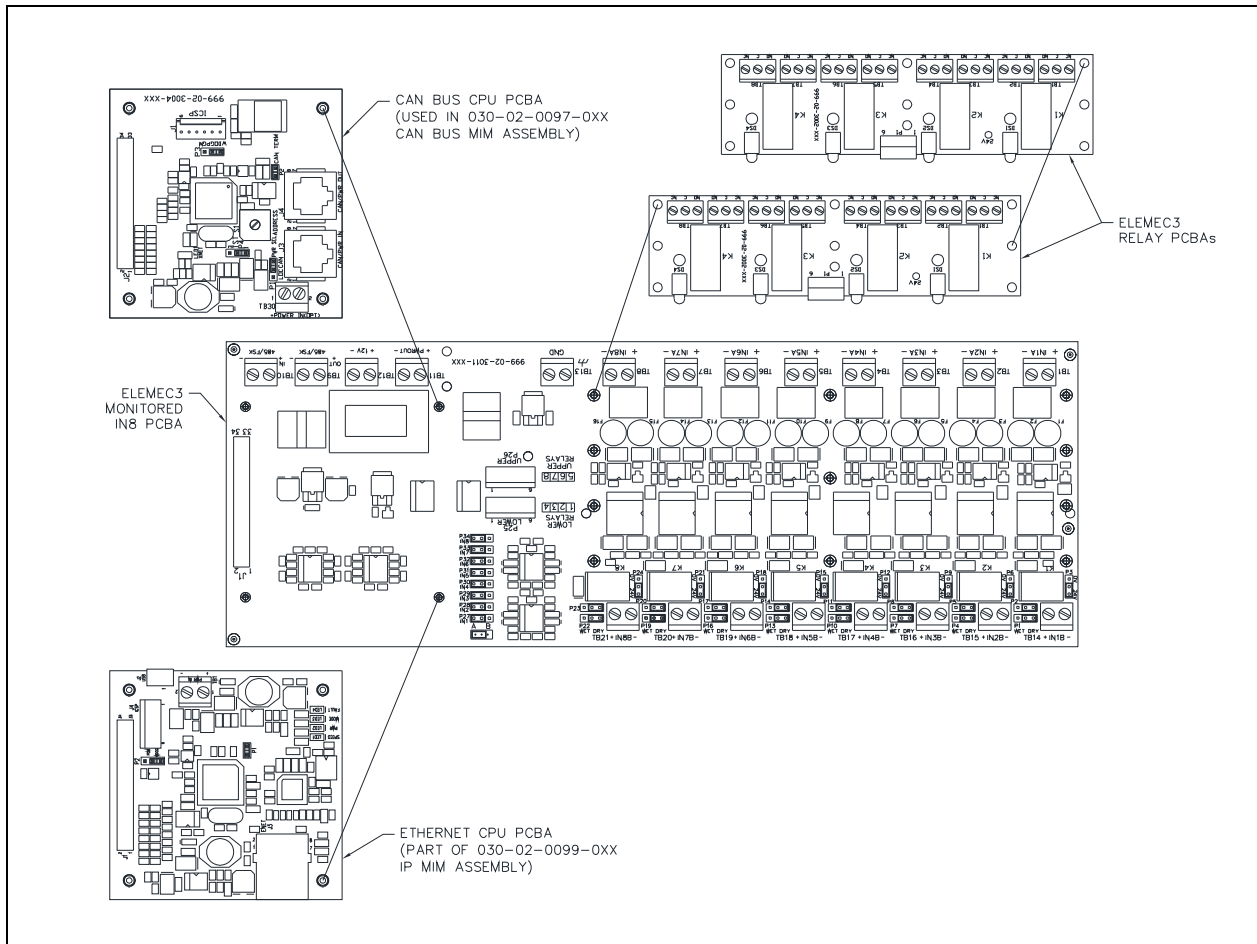


Figure 9. Models 030-02-0097-0XX and 030-02-0099-0XX Monitored Relay Modules

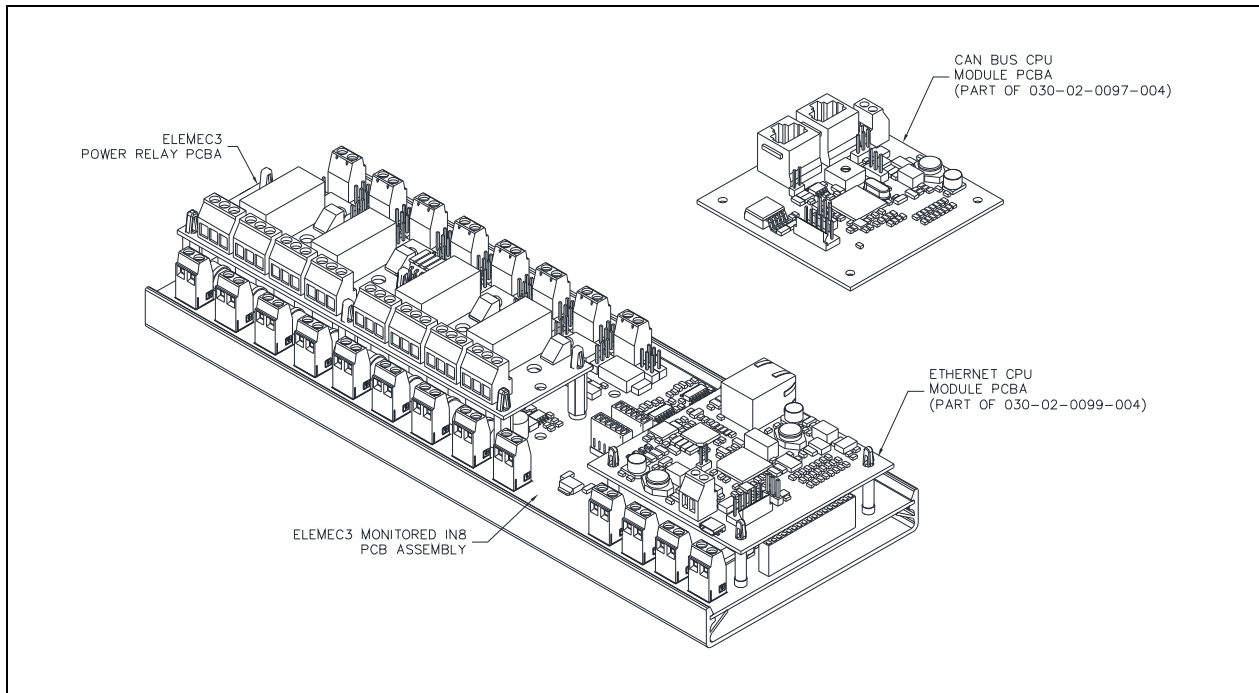


Figure 10. Models 030-02-0097-004 and 030-02-0099-004 Monitored Relay Modules (Standard Mounting Configuration)

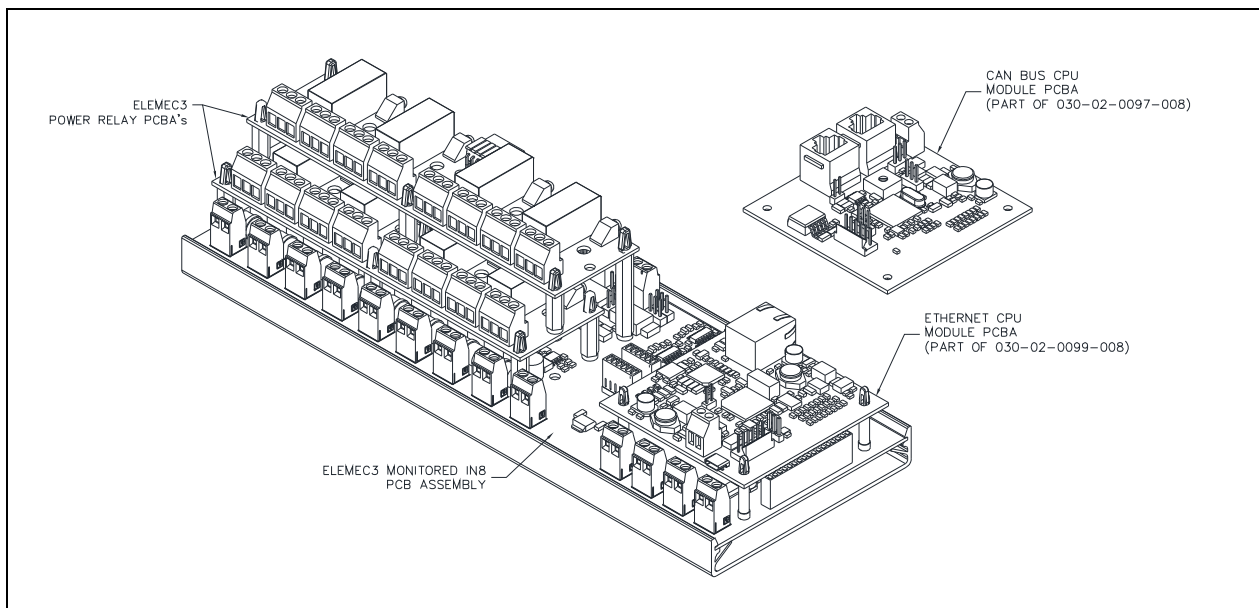


Figure 11. Models 030-02-0097-008 and 030-02-0099-008 Monitored Relay Modules (Standard Mounting Configuration)

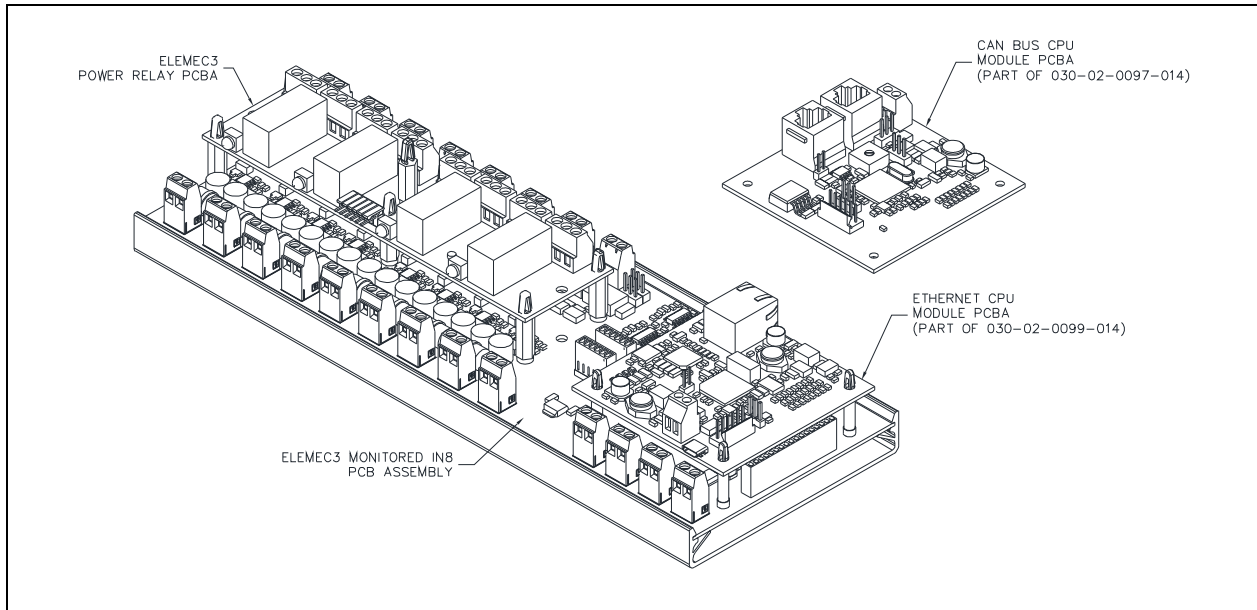


Figure 12. Models 030-02-0097-014 and 030-02-0099-014 Monitored Relay Modules (Alternate Mounting Configuration)

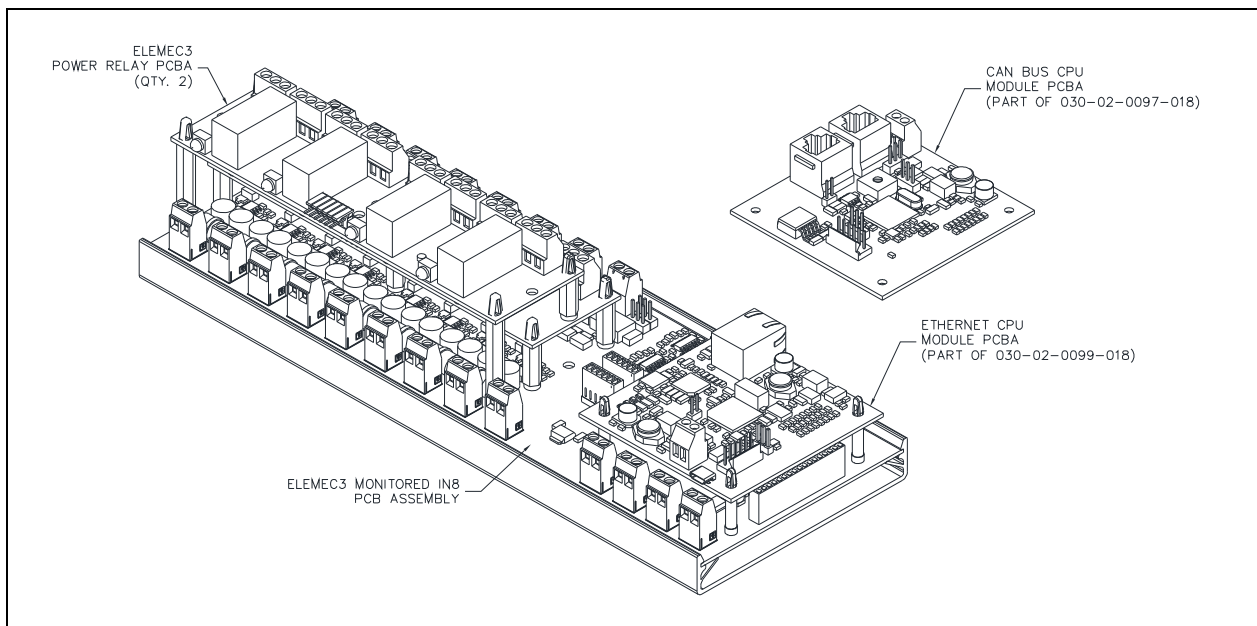


Figure 13. Models 030-02-0097-018 and 030-02-0099-018 Monitored Relay Modules (Alternate Mounting Configuration)

Inputs

Inputs not used for relay output cable supervision are available to monitor dry or wet contact inputs as described in the MIM section of this manual

Outputs (Relay Contacts)

The MRM contains either four or eight individually configurable relay-contact outputs (depending on the model) with status indicators; allowing it to control field devices such as beacons. Make the connections for these field devices at terminal blocks TB1 through TB8 on the power relay modules.

There are two terminal blocks on each DPDT (Double Pole Double Throw) output contact on the power relay module (i.e. TB1 and TB2 are for output #1, TB3 and TB4 are for output #2, etc.) Additional details on the output contact terminals and status indicators is provided below (see [Table 6](#)).

To ensure proper wire termination, crimp ferrules on the ends of all conductors terminated at the terminal blocks. The size of the ferrule is dependent upon the size of the conductor used. Source the ferrules from any supplier such as Phoenix, Altech, or Weidmuller.

Table 6. Relay Contact Outputs

Output	Power Relay Module	Terminals	Relay Contact	Status LED
1	Lower	TB1 TB2	1 2	DS1
2	Lower	TB3 TB4	1 2	DS2
3	Lower	TB5 TB6	1 2	DS3
4	Lower	TB7 TB8	1 2	DS4
5	Upper	TB1 TB2	1 2	DS1
6	Upper	TB3 TB4	1 2	DS2
7	Upper	TB5 TB6	1 2	DS3
8	Upper	TB7 TB8	1 2	DS4

Unsupervised Relay Output Wiring

The *Elemec3* system uses the relay contacts to switch power to one or more signaling devices (i.e. flashing beacons) using the normally open and common relay contacts. This mode supports both ac-powered (see [Figure 14](#)) and dc-powered (see [Figure 15](#)) signaling devices (both figures use OUT1 (Output 1) as an example). The system does not supervise the cable supplying power to the signaling device.

***NOTE:** The MRM does not contain any current limiting for the signaling device power. GAI-Tronics recommends installing an external fuse or circuit breaker for each output circuit with the appropriate voltage and current ratings. Fuses should be of the slow-blow variety.

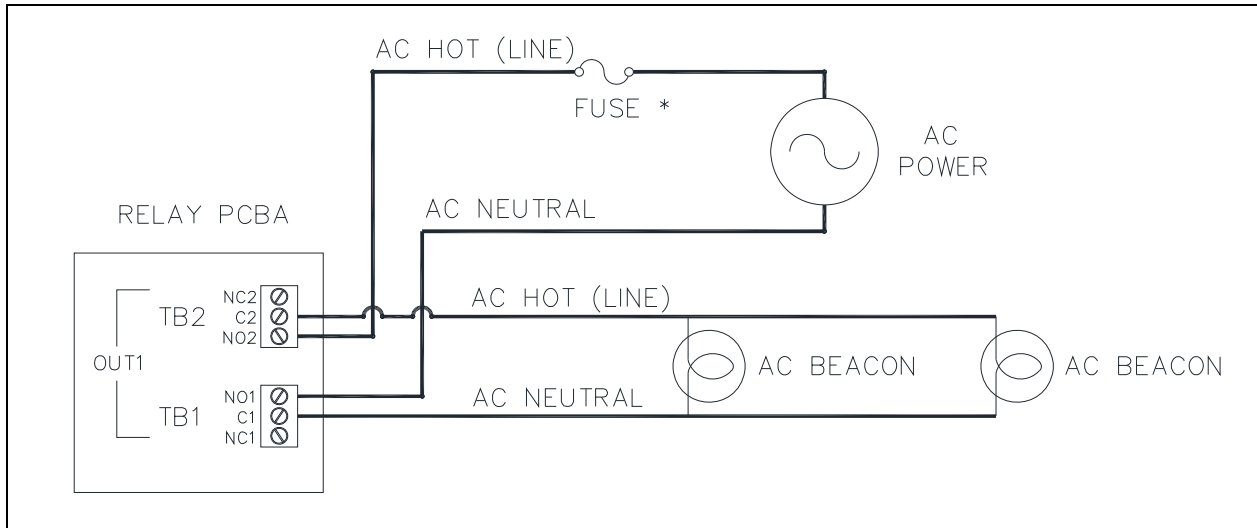


Figure 14. Unsupervised AC-Powered Beacons

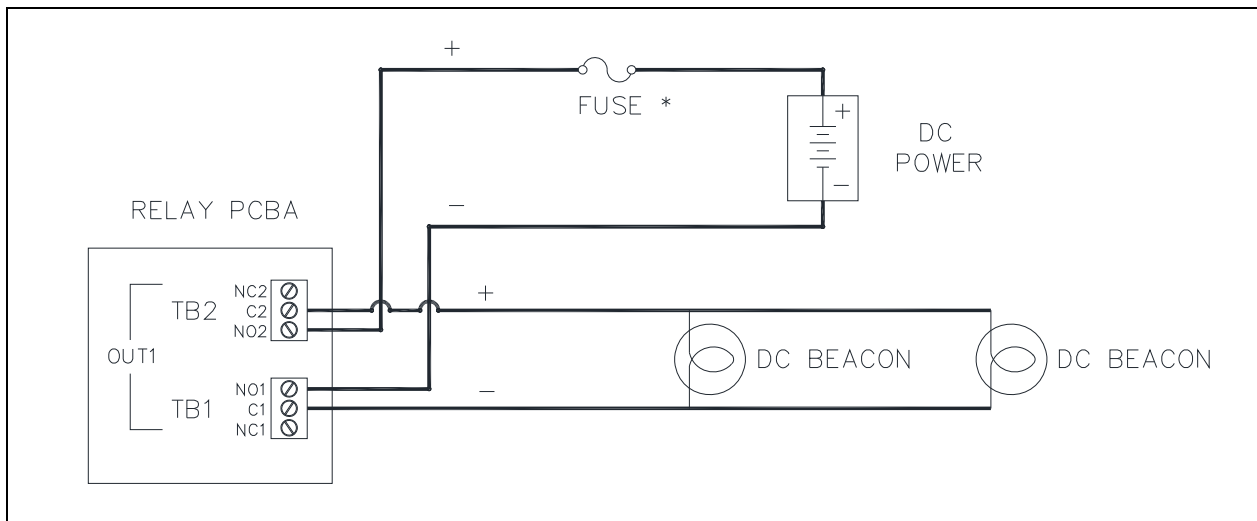


Figure 15. Unsupervised DC-Powered Beacons

Supervised Relay Output Wiring

Supervise the field cables connected to relay-contact outputs 1–8 using the corresponding **A** input circuit and install a 20-kilohm end-of-line resistor on the field cable. Relay output #1 wiring is shown below for dc-powered signaling devices (see [Figure 16](#)) and for ac-powered signaling devices (see [Figure 17](#)). Outputs 2–8 are identical to outputs 1–8 using the appropriate terminals on the MRM. Configure the MRM input circuits for RELAY SUPERVISION using the *Elemec3* Console configuration utility.

***NOTE:** The MRM does not contain any current limiting for the signaling device power. GAI-Tronics recommends installing an external fuse or circuit breaker for each output circuit with the appropriate voltage and current ratings. Fuses should be the slow-blow type.

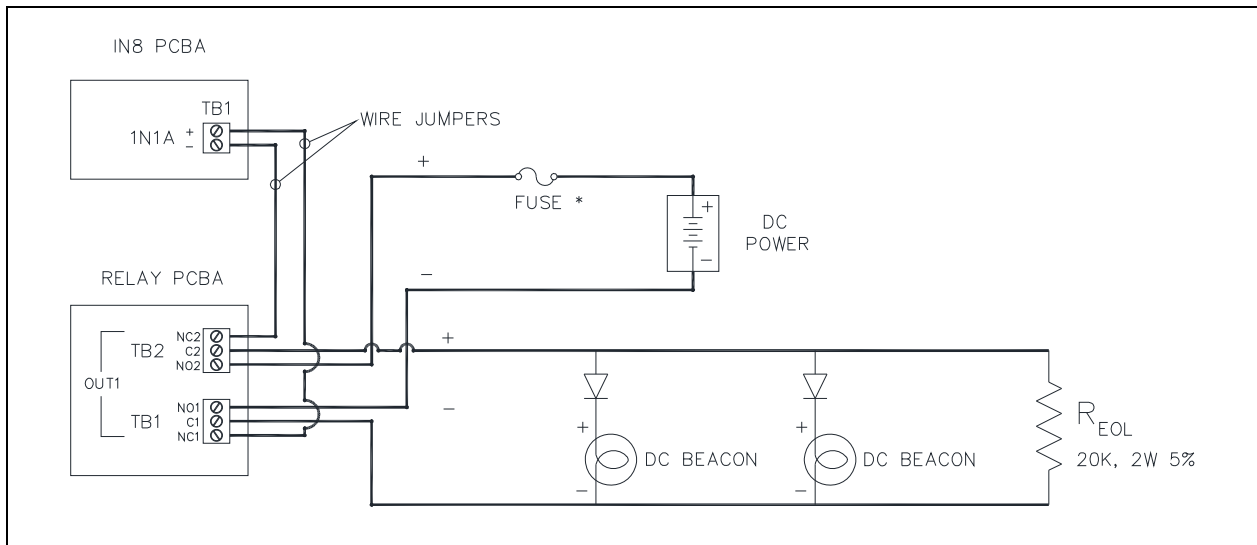


Figure 16. Supervised DC-Powered Beacons

Install one blocking diode for each dc signaling device connected to the power cable. The end-of-line resistor (R_{EOL}) is a 20-kilohm, 2-watt, 5% tolerance resistor. Observe all polarities (see Figure 16).

NOTE: Some signaling devices already include a blocking diode in the unit. Do not install an additional blocking diode in this case.

NOTE: The MRM does not include the blocking diodes, wire jumpers, or the 20-kilohm, 2-watt, 5% tolerance resistor. Order these items separately.

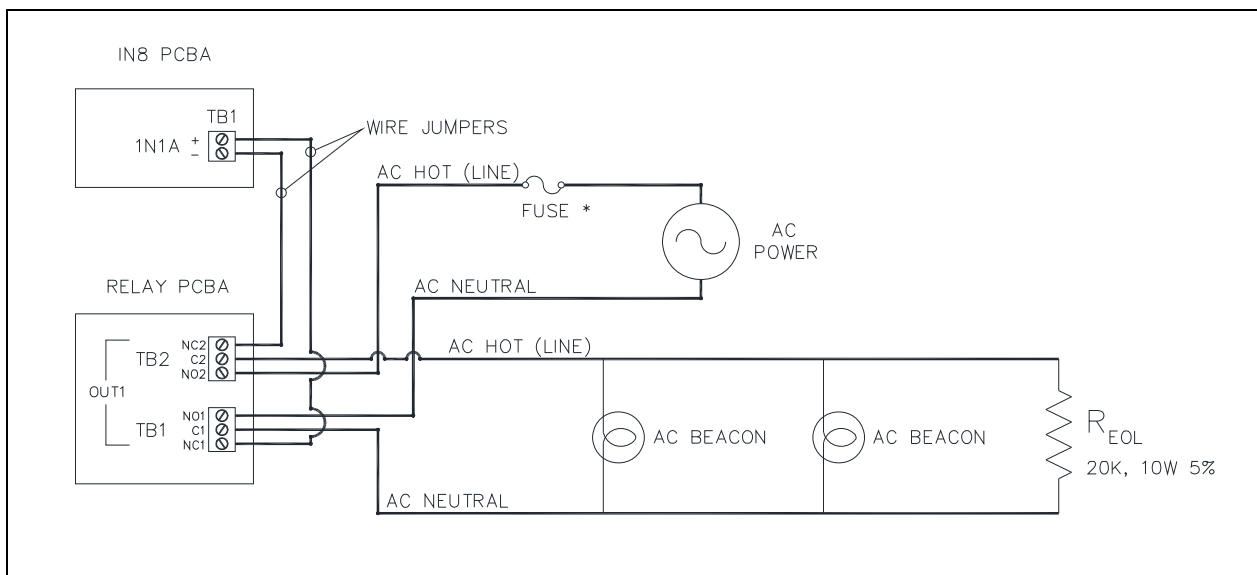


Figure 17. Supervised High Voltage AC-Powered Beacons

NOTE: The MRM does not include the wire jumpers or the 20-kilohm, 10-watt, 5% tolerance resistor. Order these items separately.

Block Diagrams

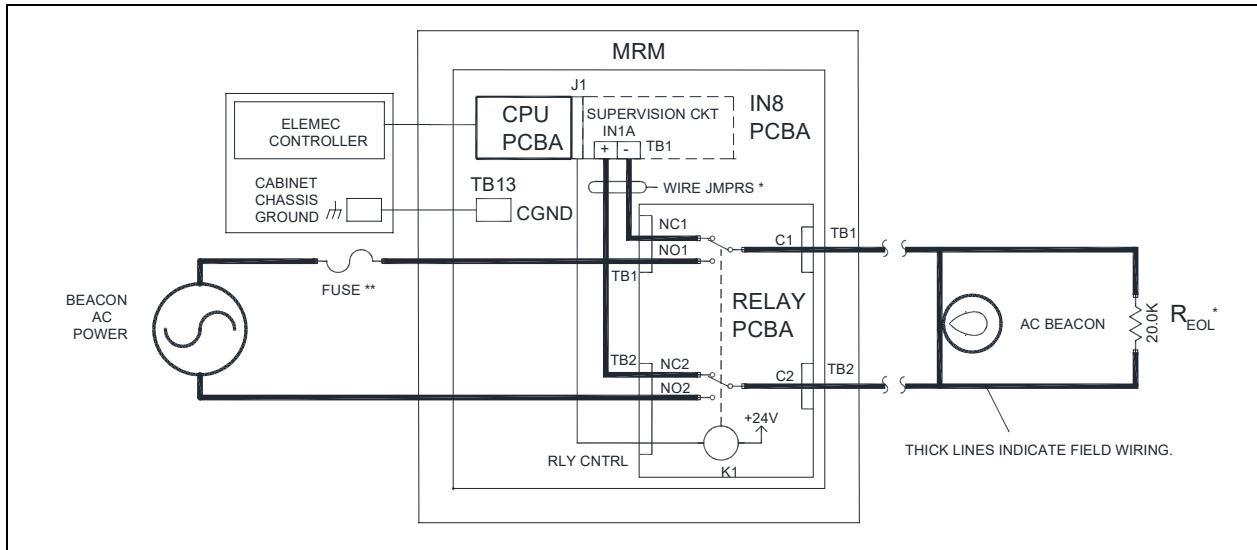


Figure 18. *Elemec3* MRM Block Diagram—Typical Supervised High Voltage AC Beacon

***NOTE:** The MRM does not include the wire jumpers, blocking diode, or end-of-line resistor (R_{EOL}). Order these items separately.

****NOTE:** The MRM does not provide current limiting capability for signaling device power. Install an external slow-blow fuse for each output circuit with the appropriate voltage and current ratings.

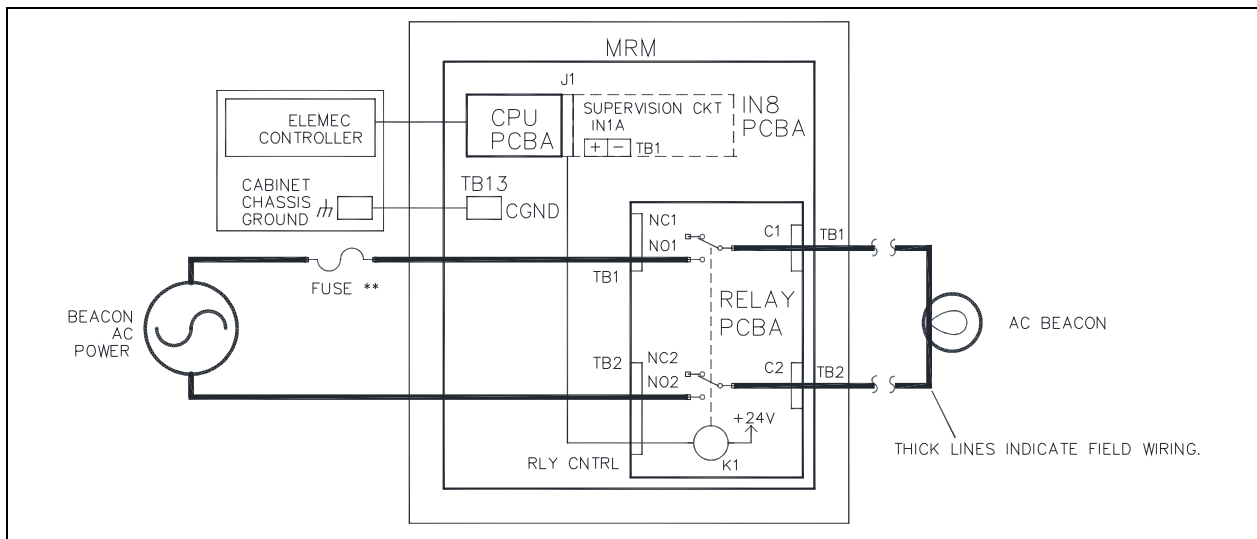


Figure 19. *Elemec3* MRM Block Diagram—Typical Unsupervised High Voltage AC Beacon

****NOTE:** The MRM does not provide current limiting capability for signaling device power. Install an external slow-blow fuse for each output circuit with the appropriate voltage and current ratings.

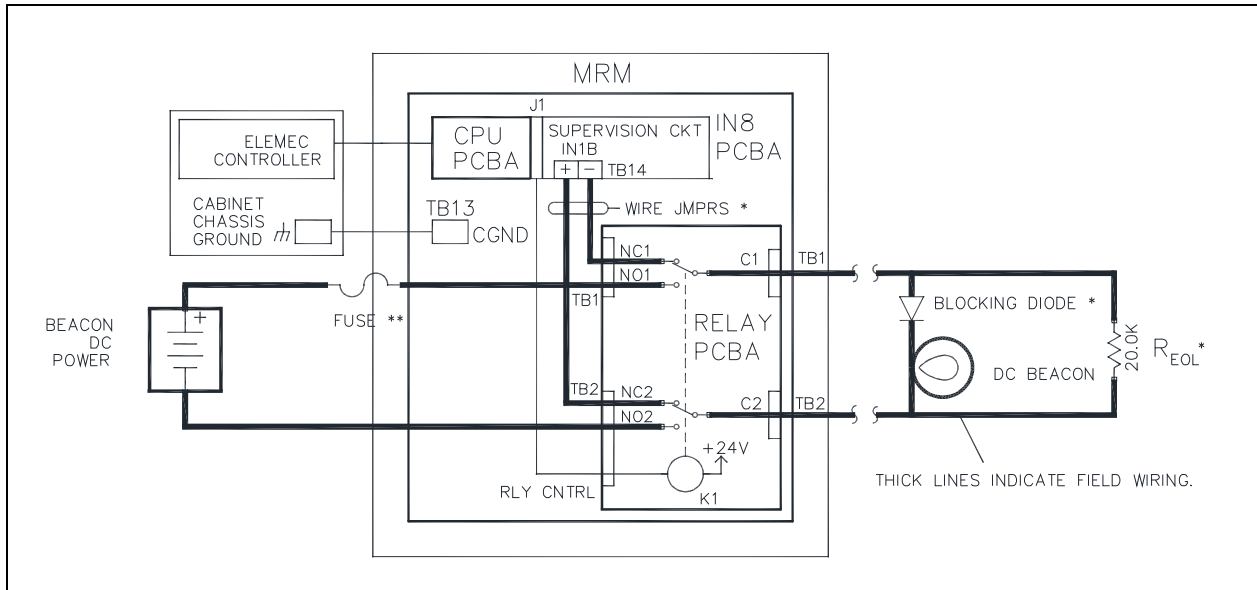


Figure 20. Elemec3 MRM Block Diagram—Typical Supervised Low Voltage DC Beacon

***NOTE:** The MRM does not include the wire jumpers, blocking diode, or end-of-line resistor (R_{EOL}). Order these items separately.

****NOTE:** The MRM does not provide current limiting capability for signaling device power. Install an external slow-blow fuse for each output circuit with the appropriate voltage and current ratings.

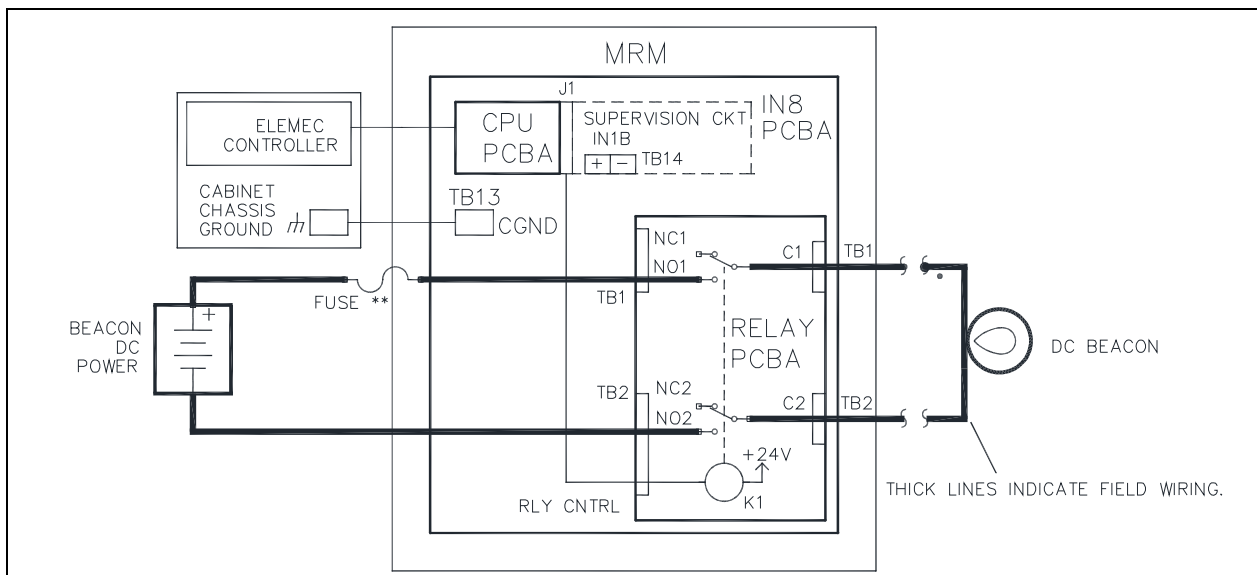


Figure 21. Elemec3 MRM Block Diagram—Typical Unsupervised Low Voltage DC Beacon

****NOTE:** The MRM does not provide current-limiting capability for signaling device power. Install an external slow-blow fuse for each output circuit with the appropriate voltage and current ratings.

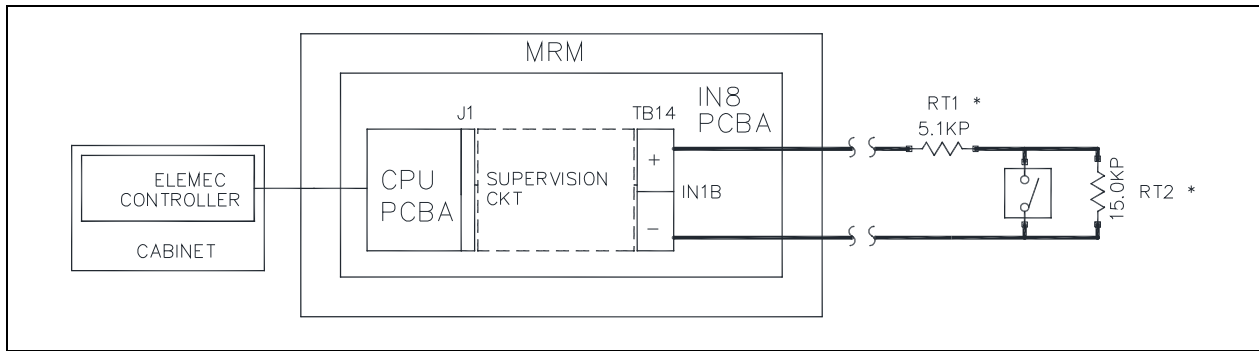


Figure 22. Elemec3 MRM Block Diagram—Typical Supervised Single DRY Contact Input

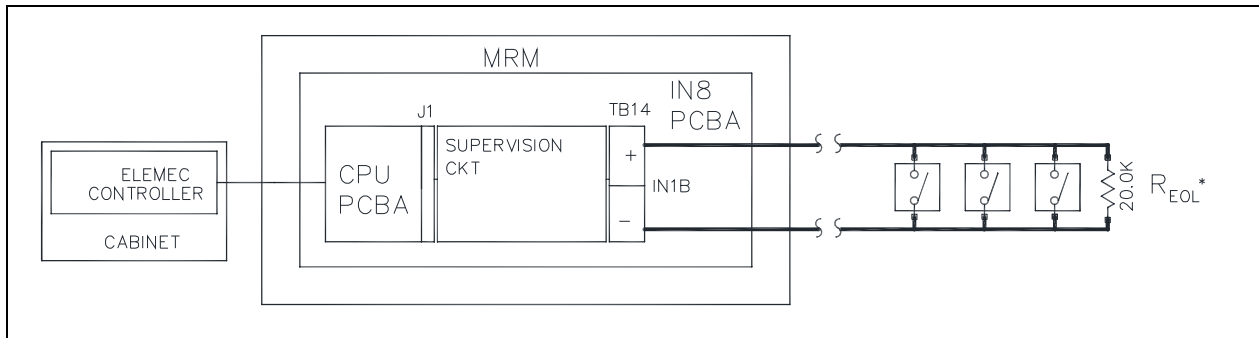


Figure 23. Elemec3 MRM Block Diagram—Typical Supervised Multi-Switch DRY Contact Input

***NOTE:** The MRM does not include the wire jumpers, blocking diode, or end-of-line resistor (R_{EOL}). Order these items separately.

****NOTE:** The MRM does not provide current-limiting capability for signaling device power. Install an external slow-blow fuse for each output circuit with the appropriate voltage and current ratings.

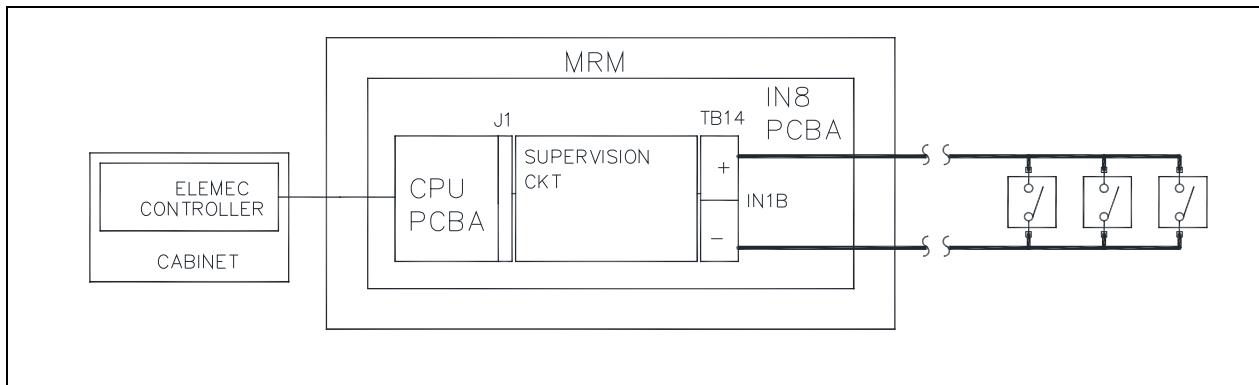


Figure 24. Elemec3 MRM Block Diagram—Typical Unsupervised DRY Contact Input

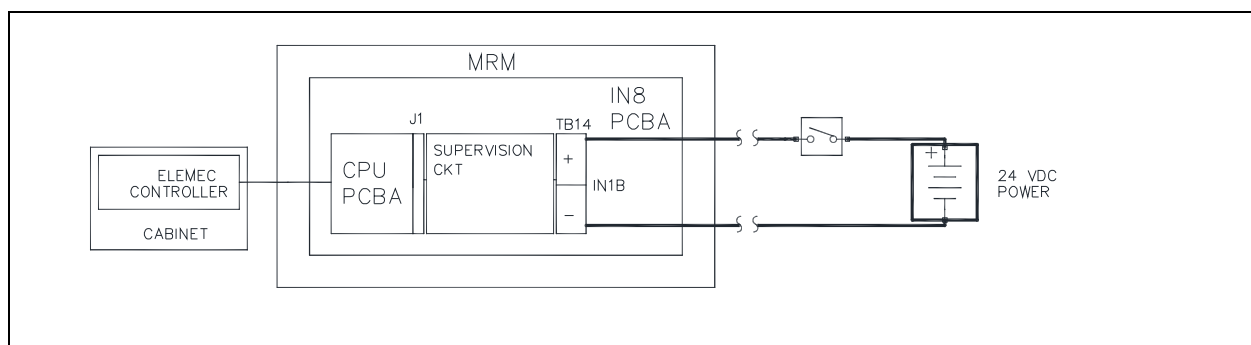




Figure 25. Elemec3 MRM Block Diagram—Typical Unsupervised WET Contact Input

Installation

Installation Safety Guidelines

Please adhere to all warnings, safety, and operating instructions on the unit and in the installation manual.

 **WARNING**  —Disconnect power before servicing. Do not disconnect the equipment while circuit is energized.

- Avoid servicing the unit during electrical storms.
- Do not touch uninsulated wires.
- The maximum permissible switching voltage is 35 V (peak) ac or 60 V dc when the relay board's output terminals face the connection **B** input terminals.
- The power feed connections to the relay outputs should be via all pole mains isolators with clearance greater than 3mm so that the supply can be safely disconnected for maintenance and installation purposes.
- If applying hazardous voltages and safe voltages to adjacent relays, pay particular attention to the routing, terminating, insulation and supporting of incoming cables to ensure that there is no possibility of reducing the necessary separations in the event of a fault (e.g. loose wire) occurring.

Installation Guidelines



Warning: Observe precautions for handling electrostatic sensitive devices.

1. Notify plant personnel of a system shutdown prior to servicing the unit.
2. Disconnect power before installing or removing the MIM or MRM or any of the individual PCBs.

Mounting

Mount the MIMs and/or MRMs in Tyco 6TK2 Snaptrack[®] installed in an equipment rack. The track is a grooved plastic channel designed to allow PCBAs to securely *snap* into the groove. It provides flexible installation; install the track inside a rack wherever it is convenient.

Data Communication Connection

CAN bus communication between the *Elemec3* controller and the MIM/MRM module is via a Category-5 cable assembly. Add additional modules by connecting a Category 5 cable assembly from the CAN OUT (J4) connector of this module to the CAN IN (J3) of the next module.

Ethernet communication between the *Elemec3* controller and the MIM/MRM module via an Ethernet LAN (Local Area Network) at 100 Mbps.

CAN BUS MIM/MRM Modules—Power and Settings

Power—System

The Category 5 cable assembly connected to the *Elemec3* controller provides power to the MRM modules. The Category 5 cable can supply up to 1.6 amps to power multiple MRM modules. Use the local power connection for additional modules if chaining additional modules using the CAN/PWR IN and CAN/PWR OUT causes the load current to exceed the 1.6-amp CAN bus capability.

Power—Local (Optional)

If necessary, supply 24 V dc power from an auxiliary power supply terminated to terminal block TB30 (located on the CPU PCBA). Connect the positive leg to TB30-1 (+) and the return leg to TB30-2 (-). When using the local power option, install jumper P3 between pins 1 and 2 (LOC).

NOTES:

- When daisy-chaining external local power (LOC) between MRMs and other modules, install a jumper between pins 1 and 2 of P3 (LOC) on the first module in the daisy-chain. For the remaining modules in the external local power daisy-chain, install a jumper between pins 2 and 3 of P3 (CAN). P3 is on the CPU PCBA.
- When daisy-chaining power, sourced by the *Elemec3* controller on the I/O CAN port connector, between MRMs and other modules, connect a Category 5 cable assembly from the CAN OUT (J4) connector of this module to the CAN IN (J3) of the next module.
- Although external local power may be daisy-chained between MRMs and other modules, the preferred method of power delivery to these modules is by a dedicated cable run between each module and the auxiliary power supply.
- Connect the local power supply return leg to earth ground in the cabinet for proper operation. Make the physical connection at the local power supply terminals.
- The ground reference for this assembly must be identical to that of the cabinet.
- The MRM does not contain any current limiting for local power. Installation of an external fuse with the appropriate voltage and current ratings is recommended. The fuse should be of the slow-blow variety.

Ground

Connect ground TB13 (CGND) to chassis ground in the cabinet. Connect the local power supply return leg to earth ground in the cabinet for proper operation when using a local power supply.

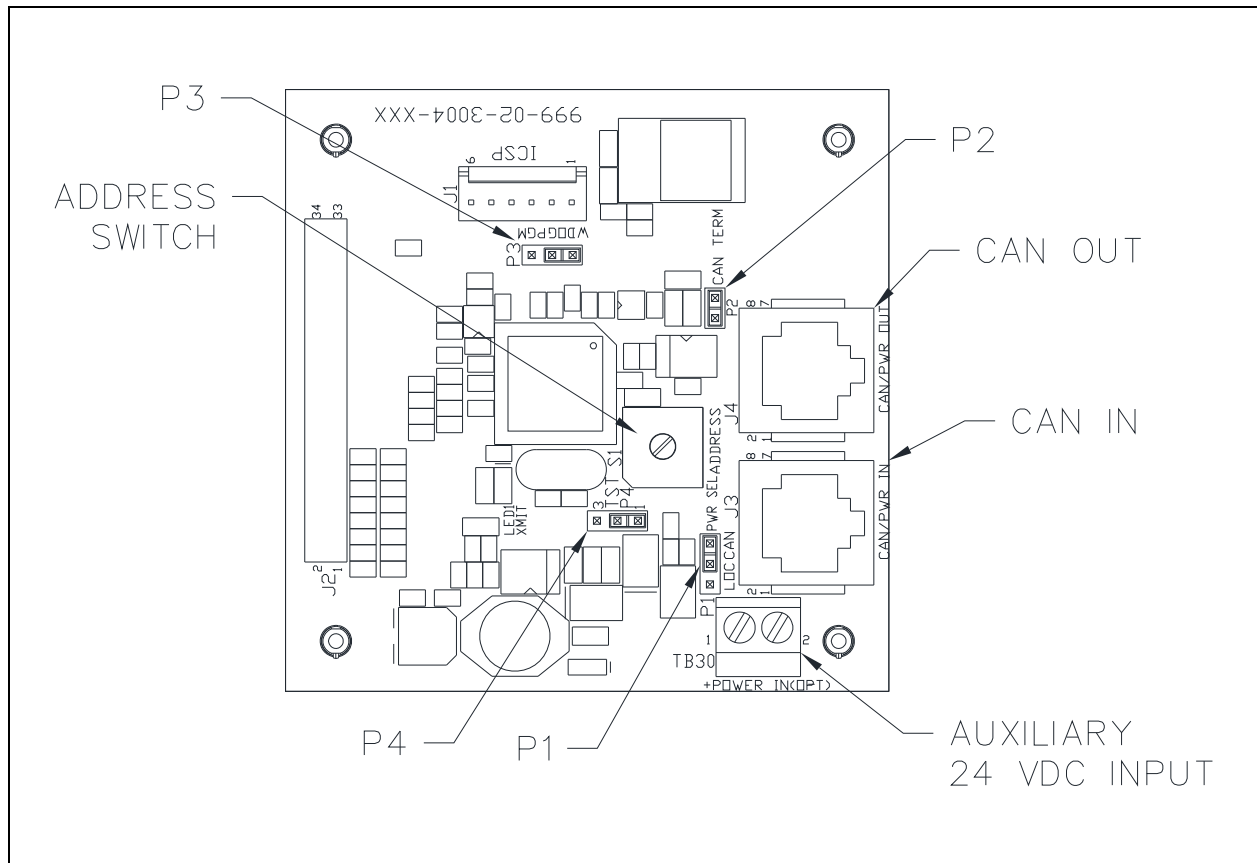


Figure 26. CAN BUS CPU PCBA

CAN Bus Address Setting

The controller identifies each MIM/MRM on the CAN bus by its module address. Set the module address using the rotary hex switch **S1** on the MIM/MRM (located on the CPU PCBA.) The range of valid settings is from 0 to F (hex). Refer to the *Elemec3* controller configuration for the address setting.

CPU PCBA Jumper Settings

Power Select (P1)

To receive power from the *Elemec3* controller, place the *power select* shorting clip in the CAN position (P3-2 & P3-3 shorted). The CAN bus current limit is 1.6 amps to power all modules. After reaching the maximum current draw of the CAN bus, add additional modules by providing local power (24 V dc) to terminal block TB30 and installing the power select jumper to LOCAL (P3-1 and P3-2 shorted).

CAN Termination (P2)

Jumper P4, on the CPU PCBA, is the EOL (end of line) termination for the CAN bus. Install jumper P4 ONLY on the last CAN device in the chain. Remove jumper P4 on all other CAN devices.

PGM / WDOG MODE (P3)

Factory/service technicians only: Insert the jumper between P3-1 & P3-2 to disable the watchdog timer protection to properly program the firmware into the CPU assembly. For normal operation, insert the jumper between P3-2 & P3-3 to enable the external WDOG. Remove the jumper from P3 to disable the external WDOG.

TEST (P4)

Factory/service technicians only: Insert the jumper between P4-1 & P4-2 for normal operation. Insert the jumper between P4-2 & P4-3 to enable test mode.

Ethernet MIM/MRM Modules—Power and Settings

Power

Terminate 24 V dc power to terminal block TB1, on the CPU PCBA. Connect the positive leg to TB1-1 (+) and the return leg to TB1-2 (-).

Ground

Connect ground TB13 (CGND) to the chassis ground in the cabinet. When using a local power supply, connect the local power supply return leg to earth ground in the cabinet for proper operation.

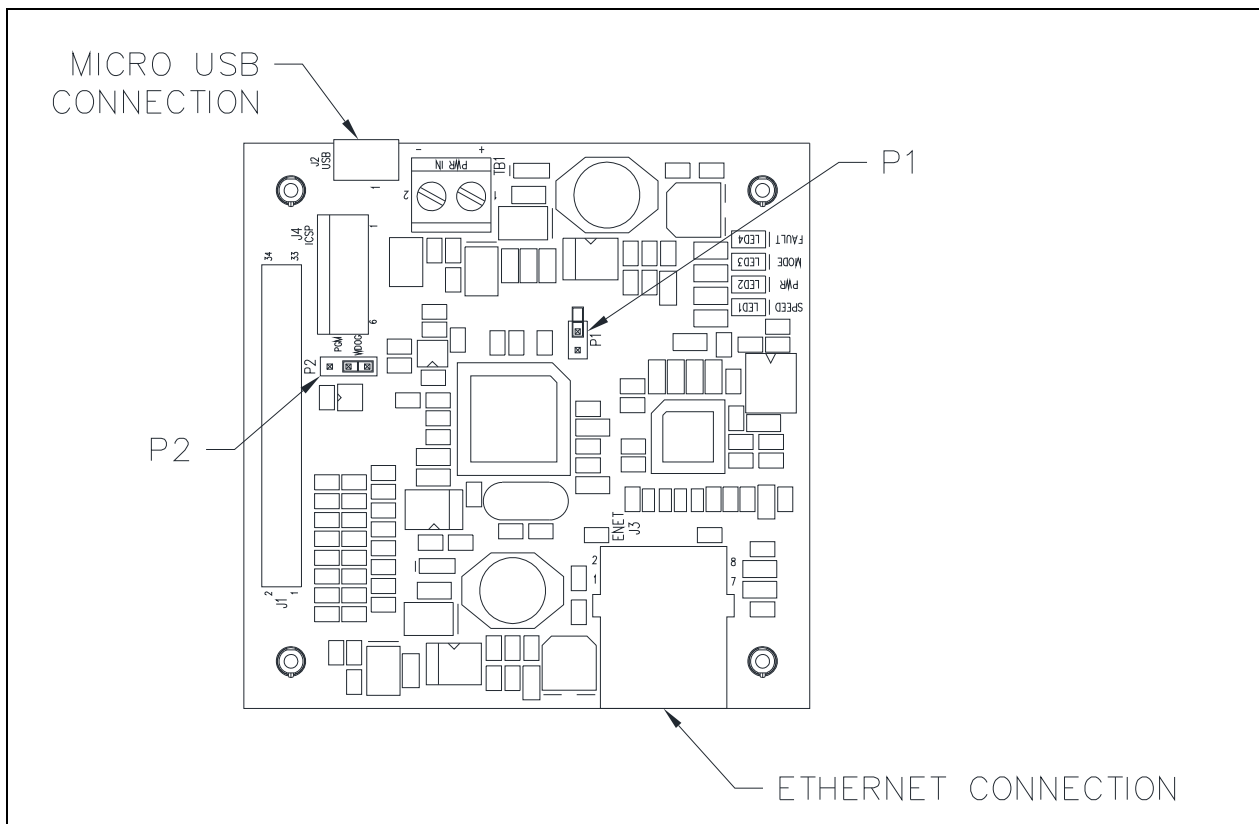


Figure 27 Ethernet CPU PC Board

Ethernet MIM/MRM Module Settings

To manage the settings of the Ethernet MIM/MRM, obtain information from the *Elemec3* system administrator and from the Ethernet network administrator. It is also necessary to know if the *Elemec3* system is standalone or redundant (A-B or N+1) to correctly set the I/O CONTROL SOCKET address.

CPU PCBA Jumper Settings

Factory Reset

Factory/service technicians only: Short jumper P1 to reset the MIM/MRM to the factory default configuration. Default: *open*.

PGM / WDOG MODE (P2)

Jumper set to WDOG position for normal operation.

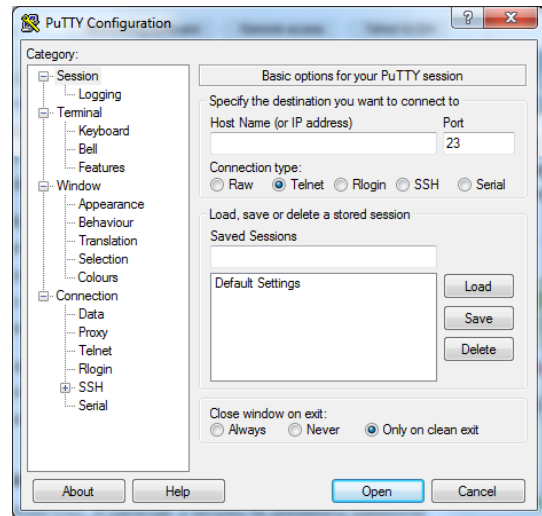
Using PuTTY for Ethernet MIM/MRM

Administration

Use PuTTY to configure the communication parameters that the terminal emulator, serial console application, and *Elemec3* controller use to communicate with the Ethernet MIM/MRM. PuTTY displays and enables editing the Ethernet MIM/MRM communication settings via a PC serial connection.

Download PuTTY from various Internet sites. After downloading, install PuTTY on the administrative computer and run the application.

Upon start-up, the PuTTY configuration screen appears as shown:



Setup connections on the **SERIAL** page, located under the **CONNECTION** group of the **CATEGORY** panel, in the PuTTY configuration window.

Serial Port Connection

With the Ethernet MIM/MRM station energized, connect a USB cable between the administrative PC (Windows 7 or later) and the Ethernet MIM/MRM CPU PCBA. Use a USB-A to Micro-B type USB cable as shown.

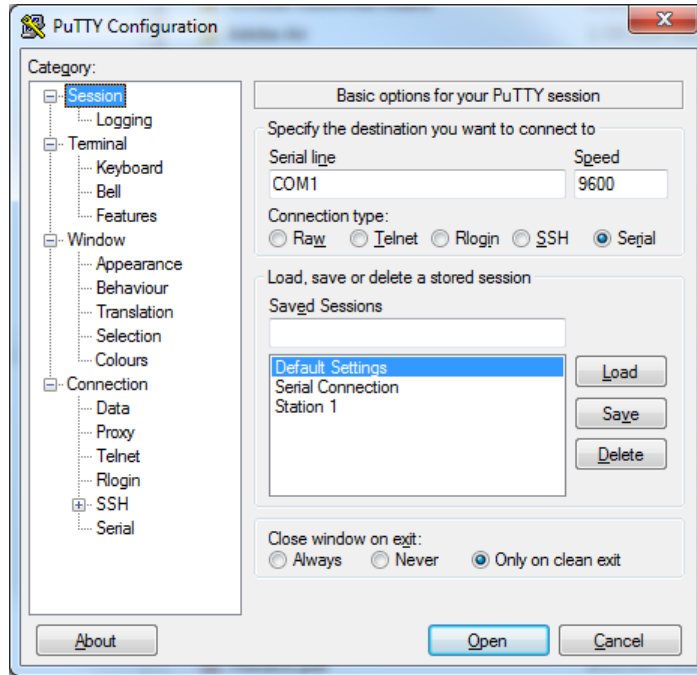


Upon connection to the Ethernet MIM/MRM station, the serial port drivers automatically load and a COM port number is assigned by the Microchip driver to the USB port on the administrative PC. Find the COM port number assigned to this connection by looking it up in *Device Manager* located in the Windows control panel. Enter the COM port number into the PuTTY application in the next steps.

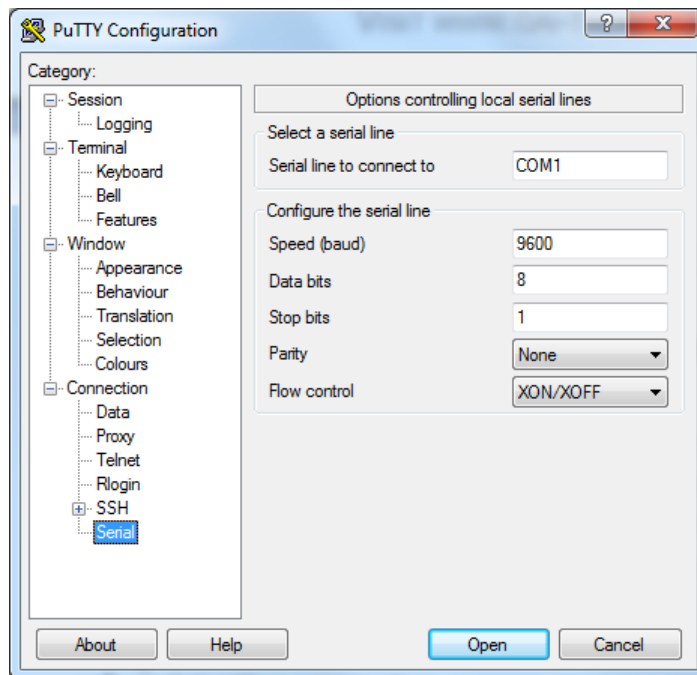
NOTE: Windows may assign a new COM port for each Ethernet MIM/MRM station connected to the administrative PC.

1. Run the PuTTY software.
2. In the **SESSION** settings page in the **CATEGORY** panel select **SERIAL** for the connection type. the remaining serial port settings here can remain unchanged; they will be set in the next screen.

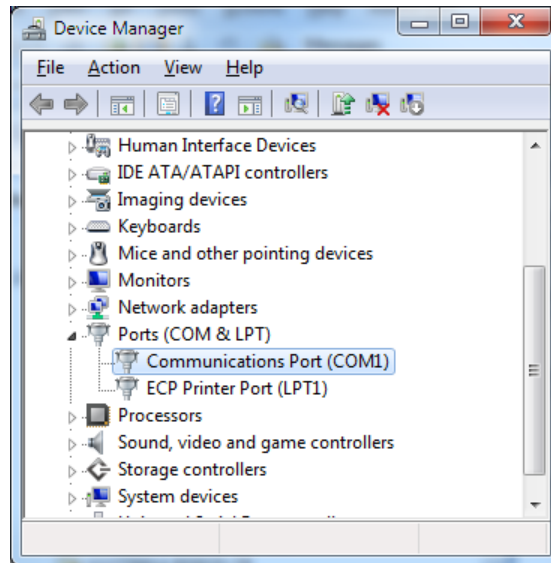
NOTE: Create names for sessions and save them for future use when connecting to Ethernet MIM/MRM stations.



3. Navigate to the SERIAL settings page under the CONNECTION group in the CATEGORY panel.



4. Enter the COM port number in the SERIAL LINE TO CONNECT TO field of the PuTTY SERIAL configuration screen. Locate the COM port information in Windows® Device Manager.

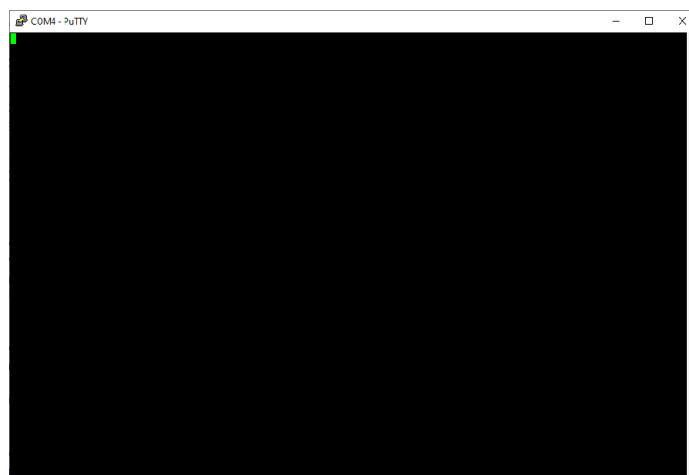


5. Enter the serial line parameters in the PuTTY configuration screen as follows:

NOTE: These values must match the values found on the port settings tab in the COM port properties dialog box in device manager.

- Speed (Baud): 9600
- Data Bits: 8
- Stop Bit: 1
- Parity: None
- Flow Control: None

6. Select **OPEN**. The following screen appears upon successful connection to the Ethernet MIM/MRM station.



7. Press **Enter**, the following screen appears (Command Line Interface).

```

COM4 - PuTTY
TCP/IP Stack: Initialization Started
Address: 1
Multicast Settings:
  address: 239.237.237.237
  port: 50650
TCP/IP Stack: Initialization Ended - success
Joining multicast group: address: 239.237.237.237 - port: 50650
Server Connection was closed
Waiting for Client Connection on port: 50650

***** Network Settings *****
Hostname:      Test
IP address:    192.168.1.65 (If Static Addressing)
Netmask:       255.255.255.0
Gateway:       192.168.1.1
DNS Server:    192.168.1.1
DHCP:          OFF
*****
>

```

The Command Line Interface (CLI)

Alter a station's configuration parameters using the CLI after connecting to an Ethernet MIM/MRM station via a USB serial connection. Enter commands for the Ethernet MIM/MRM to execute via the command line. The Ethernet MIM/MRM attempts to carry out all commands that it understands. The syntax of the Ethernet MIM/MRM commands can have two or more parts: 1) the configuration parameter name, 2) the command name, and if required 3) the parameter values.

Manage two categories of settings through the CLI; *Elemec3* addressing and general network settings.

The examples below show the command line syntax for all Ethernet MIM/MRM commands. All valid commands, parameters, and settings are listed and described (see [Table 7](#)). Enter all spaces, as shown in the examples, for proper syntax of these commands. The CLI provides the leading > character shown in the examples. Some of the examples show *placeholder* slant brackets < and >. Do not include the slant brackets when entering commands.

Elemec3 Addressing

1. Change the *Elemec3* I/O controller Ethernet MIM/MRM's device address (**NOTE**: use lower case)

ENTER:

>address set <?>

(? = 0 to 9, a to f. This should correspond to the value shown in *Elemec3* Console.)

2. Retrieve the *Elemec3* I/O controller Ethernet MIM/MRM's device address. (**NOTE**: Use lower case.)

ENTER:

>address get

3. Change the *Elemec3* I/O CONTROL SOCKET (Multicast Group address & port number). This is dependent upon the *Elemec3* system type (Standalone or Redundant) (see [Figure 28](#)).

ENTER:

>multicast set <?1>.<?2>.<?3>.<?4>:<?5>

(?1-?4 = Octets of the I/O control socket IP address) (?5 = 16-bit port number) example:

239.100.222.200:24000

NOTE: For a standalone system or for the primary *Elemec3* controller in a redundant system: Set the octets and port as displayed in the *Elemec3* Console application.

NOTE: For the secondary Elemec3 controller, in a redundant system: Set the octets as displayed in the Elemec3 Console but increase the port number by 1 from the value displayed in the Elemec3 Console application.

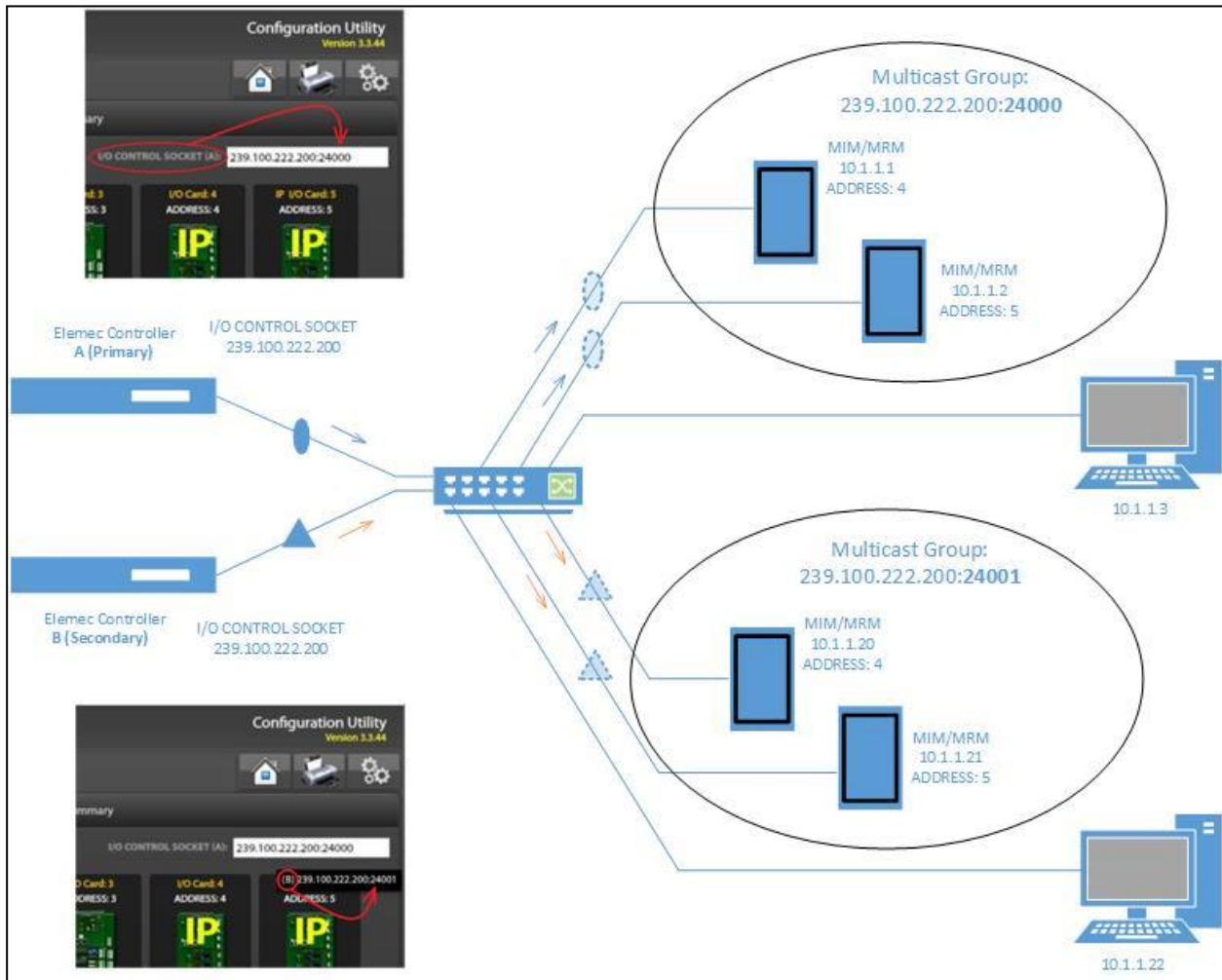


Figure 28. Multicast Socket Parameters

4. Retrieve the Elemec3 I/O control socket settings (Multicast Group address & port number).

ENTER:

> **multicast get**

General Network Settings

Option 1—Use DHCP to configure general network settings for the Ethernet MIM/MRM. Enter the following command in the CLI to automatically retrieve network settings.

ENTER:

> **netsettings set dhcp on**

(Enter command **netsettings get** to see all network settings in use. i.e. IPv4 address, hostname, netmask, gateway, DNS server, DHCP, and network link status)

Option 2—Use the CLI to manually set all the static network settings.

ENTER:

1. > **netsettings apply <Hostname> <IPv4> <Netmask> <Gateway> <DNS Server>**

i.e. **netsettings apply Device2-3 192.168.0.3 255.255.255.0 192.168.0.1 192.168.0.1**

NOTE: Please wait while new network settings apply. When complete, the response is *New network settings have now been applied.*

2. If any setting is invalid, the response will be: *New network settings failed to apply.* Recheck the values and reenter the netsettings command.

Table 7. Command Line Interface Commands

Command Name	Description
address set <?>	Sets the device address of an Ethernet MIM/MRM, where <?> can be a value of 0 to 9, a to f. This should correspond to the value shown in <i>Elemec3Console</i> associated with the device.
address get	Displays the device address of the Ethernet MIM/MRM. This should correspond to the value shown in <i>Elemec3Console</i> associated with the device.
multicast set <?1>.<?2>.<?3>.<?4>:<?5>	Set the <i>Elemec3</i> IO CONTROL SOCKET (Multicast Group address & port number). This is dependent upon the <i>Elemec3</i> system type (standalone or redundant).
multicast get	Display the <i>Elemec3</i> IO CONTROL SOCKET (Multicast Group address & port number). This should correspond to the value shown in <i>Elemec3Console</i> associated with the device.
netsettings set dhcp on	Set the DHCP status of the Ethernet MIM/MRM. Directs the Ethernet MIM/MRM to use the network settings provided by the network's DHCP server.
netsettings set dhcp off	Sets the DHCP status of the Ethernet MIM/MRM. Use the device's static IP address settings.
netsettings set ipaddress <IPv4>	Change IPv4 address.
netsettings apply <Hostname> <IPv4> <Netmask> <Gateway> <DNS Server>	Sets all general network settings of the Ethernet MIM/MRM. All parameters except <Hostname> are in dotted decimal IPv4 format. <Hostname> can be a maximum of 32 characters consisting of a-z, 0-9 and -.
netsettings get	Displays all general network settings of the Ethernet MIM/MRM.
netsettings get hostname	Displays the hostname of the Ethernet MIM/MRM.
netsettings get ipaddress	Displays the IPv4 address of the Ethernet MIM/MRM.
netsettings get netmask	Displays the netmask of the Ethernet MIM/MRM.
netsettings get dns	Displays the IPv4 address of the network's DNS server.
netsettings get dhcp	Displays the DHCP status of the Ethernet MIM/MRM.
netsettings help	Displays a list of useful commands.

Table 8. IP Parameters

Parameter Name	Description & Valid Settings
ipv4 address	IPv4 format: 0.0.0.0–255.255.255.255 Refer to <i>Private IP Addresses</i> in the Glossary of Terms section of this manual for valid IPv4 addresses and formatting. NOTE: If DHCP is ON, the DHCP server provides the parameter.
ipv4 netmask	Identifies the netmask that the IP address belongs to. IPv4 format: 0.0.0.0–255.255.255.254. NOTE: If DHCP is ON, the DHCP server provides the parameter.
gateway	The IP Address of the subnet’s default gateway in IPv4 format. NOTE: If DHCP is ON, the DHCP server provides the parameter.
dns	The IP address of the domain name server in IPv4 format. NOTE: If DHCP is ON, the DHCP server provides the parameter.

Operation

The *Elemec3* controller controls all operation as set up in the configuration software. See the *Elemec3* controller configuration details in the system manual for all operation information.

Fault Diagnostics

Table 9. Troubleshooting Guide CAN BUS MIM/MRM

Symptom	Action
MIM/MRM does not communicate with <i>Elemec3</i> controller (fault type: I/O card data failure).	<ul style="list-style-type: none"> Verify that the MIM/MRM has power. Verify the CAN line connection to the MIM/MRM. Verify address of MIM/MRM agrees with the setup configuration. Verify the CPU PCBA connection at J1. Call for service of the MIM/MRM.
MIM/MRM does not recognize dry inputs.	<ul style="list-style-type: none"> Verify that the MIM/MRM has power. Verify the CAN line connection to the MIM/MRM. Verify proper installation of each input circuit’s end-of-line resistor(s). Verify total loop resistance is less than 100 ohms. Call for service of the MIM/MRM.
MIM/MRM does not activate an alarm with 24 V dc applied to input terminal. (Wet contact mode ONLY)	<ul style="list-style-type: none"> Verify that the jumper that selects the proper <i>__ V dc when active</i> mode is in the correct position (see the 24 V/0 V Input Selection section on page 4). Verify that the input jumpers have been repositioned for “wet” operation. Verify that input is within the acceptable dc voltage range (20–30 V dc). Verify that the proper voltage polarity has been observed for external connections to the input terminals. Call for service of the MIM/MRM.

Table 10. Troubleshooting Guide Ethernet MIM/MRM

Symptom	Action
MIM/MRM does not communicate with <i>Elemec3</i> controller (fault type: I/O Card Data Failure).	<ul style="list-style-type: none"> • Verify that the MIM/MRM has power. • Verify Ethernet connectivity to the MIM/MRM. Link LED is solid green to indicate proper connection to a network switch; Activity LED flashes yellow intermittently. • Verify address of MIM/MRM agrees with the setup configuration. • Verify IO CONTROL SOCKET settings match with the E3 controller. • Verify CPU PCBA connection via J1. • Consult with network administrator to confirm connectivity. • Call for service of the MIM/MRM.
MIM/MRM does not recognize dry inputs.	<ul style="list-style-type: none"> • Verify that the MIM/MRM has power. • Verify Ethernet connection to the MIM/MRM. • Verify each input circuit's end-of-line resistor(s) installation. • Verify total loop resistance is less than 100 ohms. • Call for service of the MIM/MRM.
MIM/MRM does not activate an alarm with 24 V dc applied to input terminal. (Wet contact mode ONLY)	<ul style="list-style-type: none"> • Verify that the jumper that selects the proper <i>__ V dc when active</i> mode is in the correct position (see the <u>24 V/0 V Input Selection</u> section on page 4). • Verify the input jumper's position is for <i>wet</i> operation. • Verify that the input is within the acceptable dc voltage range (20–30 V dc). • Verify the proper voltage polarity of external connections to the input terminals. • Call for service of the MIM/MRM.

Reference Documentation

Published By	Title	GAI-Tronics Ref. No.
GAI-Tronics	Power Relay Module Assembly Drawing	999-03-3002-001
GAI-Tronics	CAN Bus CPU Assembly Drawing	999-03-3004-002
GAI-Tronics	Ethernet CPU Assembly Drawing	999-03-1203-001
GAI-Tronics	Isolated HV Monitored IN8 Assembly Drawing	999-03-3011-001

Specifications

Electrical

Power requirements	24 V dc \pm 10%
Current draw	0.30 A maximum @ 24 V dc (does not include beacon power)
Maximum number of output/input loops	8 loops
Maximum devices on output/input loop	limited by maximum current draw (disabled)
	unlimited (N.O. multi (supervised))
	one (N.O. (supervised))
	one (N.C. (supervised))
	limited by maximum current draw (N.C. (supervised))
	unlimited (N.O. multi (unsupervised)) (dry)
	one (N.O. multi (unsupervised)) (wet)
Input/output.....	24 V power in
	CAN in
	CAN out
	Ethernet
	eight field outputs/inputs
Data communications.....	CAN or Ethernet
End-of -line device.....	20 k Ω (N.O. multi (supervised))
	5.1 k Ω in series with 15 k Ω across contact (N.O. supervised))
	5.1 k Ω in series with 15 k Ω across contact (N.C supervised))
	20 k Ω , 10 W resistor (N.O. (supervised)—up to 250 V ac)
	20 k Ω , 2 W resistor (N.O.(Supervised)—up to 30 V dc)

Field Outputs/Inputs

Disabled

Maximum current draw (per output).....	8 A @ 24 V dc or 250 V ac
Maximum dc switching voltage.....	30 V dc
Maximum ac switching voltage	250 V ac

N.O. Multi (Supervised)

Contact closure resistance (activated).....	1 k Ω maximum
Open fault detection.....	minimum 65 k Ω
Ground fault detection	less than 200 Ω to ground

N.O. (Supervised) and N.C. (Supervised):

Contact closure resistance (N.O. (Supervised): activated/N.C. (Supervised): deactivated) 3 kΩ maximum
 Open fault detection 65 kΩ minimum
 Ground fault detection less than 200 Ω to ground
 Wire-to-wire short fault detection less than 200 Ω

N.C. (Supervised):

Maximum current draw (per output) 8 A @ 24 V dc or 250 V ac
 Maximum dc switching voltage 30 V dc
 Maximum ac switching voltage 250 V ac
 Open fault detection 65 kΩ minimum
 Ground fault detection less than 200 Ω to ground
 Wire-to-wire short fault detection less than 1 kΩ

N.O. Multi (Unsupervised) (Dry)

Contact closure resistance 1 kΩ maximum

N.O. Multi (Unsupervised) (Wet)

DC input voltage range 20–30 V dc (24 V dc nominal)
 DC input power 200 mW nominal

Loop Supervision Limitations:

Cable limitations 100 Ω maximum loop resistance
 Resistance across loop (excluding end-of-line device) 100 kΩ minimum

Terminals:

Isolated NV Monitored IN8

Minimum conductor size 0.14 mm²
 Maximum conductor size 1.50 mm²

Power Relay Module/CAN Bus CPU

Minimum conductor size 0.20 mm²
 Maximum conductor size 2.50 mm²

Mechanical

Unit Dimensions

Models 030-02-009x-001 (MIM) 1.88 H × 11.00 W × 4.00 D in (47.8 × 279.4 × 101.6 mm)
 Models 030-02-009x-0x4 (MRM) 1.94 H × 11.00 W × 4.00 D in (49.3 × 279.4 × 101.6 mm)
 Model 030-02-009x-0x8 (MRM) 2.75 H × 11.00 W × 4.00 D in (69.9 × 279.4 × 101.6 mm)
 Unit weight 1.75 lb maximum

Environmental

Temperature range (operating/storage) –30 °C to 70 °C (–22 °F to 158 °F)
 Humidity 95% non-condensing relative humidity

Glossary of Terms

Term	Definition
MAC ADDRESS	A MAC (media access control) address, also called the physical address, provides addressing for communication on a physical network segment. NIC (network interface card) manufacturers assign unique MAC addresses to each NIC. The NIC stores the MAC address in its hardware. Each NIC must have a unique MAC address on a physical network.
IP ADDRESS	<p>Internet Protocol address (IP address) is a numerical label assigned to each device participating in a that uses the for communication.</p> <p>Two versions of the Internet Protocol (IP) are in use: IP Version 4 (IPv4) and IP Version 6 (Ipv6). Each version defines an IP address differently.</p> <ul style="list-style-type: none"> • An IPv4 address consists of 32 (4 octets). • Example: 192.168.1.100 • An Ipv6 address consists of 128 bits. Eight groups of four digits <p>Example: 2001:0db8:0:0:0:ff00:0042:8329</p>
PRIVATE IP ADDRESS	<p>IP Addresses reserved for use on private networks. These addresses cannot connect directly to the Internet.</p> <p>IPv4:</p> <ul style="list-style-type: none"> • 10.0.0.0–10.255.255.255 • 172.16.0.0–172.31.25.255 • 192.168.0.0–192.168.255.255
SUBNET MASK	<p>Used in conjunction with an IPv4 IP address, the subnet separates an IP address into its logical network and host address components. Every host on a unique logical network must have the same subnet mask.</p> <p>Subnet Mask format—xxx.xxx.xxx.xxx (where xxx = 0–255)</p>
DEFAULT GATEWAY	The IP address of the router where all packets for hosts not located on the same logical network are sent. This is the address of the network router that connects to devices on different networks.
HOSTNAME	Hostnames are human-readable nicknames that resolve to the IP address of a device connected to a network. They appear in computer browser lists, active directory lists, hostname resolutions, email headers, etc.
DHCP	Dynamic Host Configuration Protocol is a network service used to automatically assign IP address configuration data to hosts configured to request it upon boot-up. A DHCP server typically assigns an IP address, subnet mask, default gateway, and DNS server addresses.
DNS	Domain Name System is a network service used by IP network hosts to convert host names to IP addresses.
SNMP	Simple Network Management Protocol collects information from and sends configuration commands out to network devices.
SNTP	Simple Network Time Protocol is the method used by IP network devices to obtain standardized time from a time server.
CONFIGURATION	A named collection of settings that defines a station's behavior.

NETWORK SOCKET

A network socket is the endpoint address of a service used between hosts on a computer network. A port address is a number assigned to a service running on a particular host. A socket address is the combination of the IP address of the host and IP address and port number of the service, much like one end of a telephone connection is the combination of a phone number and a particular extension. Based on this address, Internet sockets deliver incoming data packets to the appropriate application IP address, process, or thread.

Revision History

ISS 2- MIM card 999-02-3009-001 replaced by 999-02-3011-001

ISS 3- CAN BUS CPU PCBA 999-02-3004-001 replaced by 999-02-3004-002

ISS 4- Added Ethernet versions of the MIM and MRM.

Warranty

Equipment. GAI-Tronics warrants for a period of one (1) year from the date of shipment, that any GAI-Tronics equipment supplied hereunder shall be free of defects in material and workmanship, shall comply with the then-current product specifications and product literature, and if applicable, shall be fit for the purpose specified in the agreed-upon quotation or proposal document. If (a) Seller's goods prove to be defective in workmanship and/or material under normal and proper usage, or unfit for the purpose specified and agreed upon, and (b) Buyer's claim is made within the warranty period set forth above, Buyer may return such goods to GAI-Tronics' nearest depot repair facility, freight prepaid, at which time they will be repaired or replaced, at Seller's option, without charge to Buyer. Repair or replacement shall be Buyer's sole and exclusive remedy. The warranty period on any repaired or replacement equipment shall be the greater of the ninety (90) day repair warranty or one (1) year from the date the original equipment was shipped. In no event shall GAI-Tronics warranty obligations with respect to equipment exceed 100% of the total cost of the equipment supplied hereunder. Buyer may also be entitled to the manufacturer's warranty on any third-party goods supplied by GAI-Tronics hereunder. The applicability of any such third-party warranty will be determined by GAI-Tronics.

Services. Any services GAI-Tronics provides hereunder, whether directly or through subcontractors, shall be performed in accordance with the standard of care with which such services are normally provided in the industry. If the services fail to meet the applicable industry standard, GAI-Tronics will re-perform such services at no cost to buyer to correct said deficiency to Company's satisfaction provided any and all issues are identified prior to the demobilization of the Contractor's personnel from the work site. Re-performance of services shall be Buyer's sole and exclusive remedy, and in no event shall GAI-Tronics warranty obligations with respect to services exceed 100% of the total cost of the services provided hereunder.

Warranty Periods. Every claim by Buyer alleging a defect in the goods and/or services provided hereunder shall be deemed waived unless such claim is made in writing within the applicable warranty periods as set forth above. Provided, however, that if the defect complained of is latent and not discoverable within the above warranty periods, every claim arising on account of such latent defect shall be deemed waived unless it is made in writing within a reasonable time after such latent defect is or should have been discovered by Buyer.

Limitations / Exclusions. The warranties herein shall not apply to, and GAI-Tronics shall not be responsible for, any damage to the goods or failure of the services supplied hereunder, to the extent caused by Buyer's neglect, failure to follow operational and maintenance procedures provided with the equipment, or the use of technicians not specifically authorized by GAI-Tronics to maintain or service the equipment. **THE WARRANTIES AND REMEDIES CONTAINED HEREIN ARE IN LIEU OF AND EXCLUDE ALL OTHER WARRANTIES AND REMEDIES, WHETHER EXPRESS OR IMPLIED BY OPERATION OF LAW OR OTHERWISE, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.**

Return Policy

If the equipment requires service, contact your Regional Service Center for a return authorization number (RA#). Equipment should be shipped prepaid to GAI-Tronics with a return authorization number and a purchase order number. If the equipment is under warranty, repairs or a replacement will be made in accordance with the warranty policy set forth above. Please include a written explanation of all defects to assist our technicians in their troubleshooting efforts.

Call 800-492-1212 (inside the USA) or 610-777-1374 (outside the USA) for help identifying the Regional Service Center closest to you.