Installation Guide

Micro Regulator Controllers

and I/STAT

for I/NET® Building Automation Systems

Control Systems® International

TCON126 — 04/98

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FCC Warning

The Federal Communications Commission (FCC) requirements prescribe certification of personal computers and any interconnected peripherals in the FCC rules and regulations.

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: this device may not cause harmful interference, and this device must accept any interference received, including interference that may cause undesired operation.

This equipment generates and uses radio frequency (rf) energy for its operation and, if not installed and used in accordance with the installation and operation manual, may cause interference to radio and television reception. It has been found to comply with the limits for a Class A computing device pursuant to the aforementioned regulations. These are designed to provide reasonable protection against such interference when operated in a residential area. Only peripherals (computer input/output devices) certified to comply with the Class A limits may be connected to this device. Operation with noncertified computer peripherals is likely to result in interference with radio and television reception. If this equipment does cause interference to radio or television reception, the user is encouraged to correct the situation by one or more of the following measures.

- Relocate the receiver with respect to the computer.
- Move the computer away from the receiver.
- Plug the equipment into a different outlet, so that the computing device and receiver are on different branch circuits.
- Disconnect and remove any unused cables that may be acting as a transmission source.
- Make certain that the computing device is plugged into a grounded outlet receptacle.

If necessary, contact CSI for additional suggestions.

Overview

The Micro Regulator (MR) family of distributed intelligent controllers function within the I/NET integrated network system, providing an extremely flexible array of user-programmable control functions within an economical price and point range. Similar in organization to the Unitary Controller family, the MR family uses the Micro Regulator Interface (MRI) or Micro Control Interface (MCI) to connect to the I/NET LAN and communicate with I/NET workstations and other controllers. The Micro Regulator models reside on the subLAN controlled by the MRI/MCI. The MR family includes multiple models of controllers with different input/output point capabilities.

The family includes the Micro Regulator Interface (MRI/MCI), which is the connection between the I/NET system and the Micro Regulators, the Micro Regulator controllers MR88 (MRF), MR632 (MRG), MR160 (MRH), MR88R (MRK), and a Micro Regulator Thermostat (I/STAT) or Maintenance Thermostat (M/STAT). Each controller model is aimed at a specific application environment although they can migrate to other applications that can be handled through the Micro Regulator's DDC and calculated point capability.

Note: *The M/STAT is a portable version of the I/STAT, with a plug-in jack connection. The keypad, displays, and functions of the M/STAT are identical to the I/STAT. All references to I/STAT displays and operation in this document also apply to the M/STAT. As this is a hand-held model, installation instructions are not given for the M/STAT unit.*

I/STAT

The I/STAT is an intelligent space sensor with local temperature and setpoint display, override select and setpoint adjustment. The I/STAT has three 7-segment LED digits, each with a decimal point, and five discrete LEDs.

The 7-segment LED digits display alphanumeric data, such as local temperature and setpoint information, as well as programming information input at the I/STAT keypad. The bank of four discrete LEDs located at the bottom of the I/STAT provide an indication of which user-selected parameter is currently being displayed. The legends on the current (standard) I/STAT indicate a selection of temperature setpoint, fan speed, room temperature, and outside temperature. The user has total control of the actual value/point displayed on the 7-segment LEDs and may choose to vary the indication to other parameters in the system.

The I/STAT may be programmed from the I/NET software using the MR parameters editor. Additionally, the I/STAT may be controlled using the keypad on the I/STAT.

Micro Regulator Controllers

The family of micro regulator controllers provide stand-alone DDC control of a collection of several input and output points. Both discrete and PWM modulated control is supported by the micro regulators. The micro regulators have a 32 KB EPROM chip for processing and look-up table data. The downloaded database resides in NOVRAM.

Communication

The micro regulator controllers provide two communication ports: a standard asynchronous RS485 subLAN port, and a port for the I/STAT sensor.

Reset

Upon power loss/restoration, the micro regulator executes a self-test, checking the microprocessor, a checksum on EPROM contents, a checksum on NOVRAM contents, and the operation of the analog-to-digital (A/D) convertor.

MR88 Input/Output Terminals

The MR88 has seven universal inputs that are user-configured as 0–5 V, 0–10 V, 0–20 mA, thermistor or discrete, and the I/STAT. All seven input terminals are configured (selected) using plug-in resistor banks. It has eight low-voltage (24 VAC) triac outputs. The outputs operate in PWM (AO) proportional or latched (discrete) mode.

MR88R Input/Output Terminals

The MR88R has seven universal inputs that are user configured as 0–5 V, 0–10 V, 0–20 mA, thermistor or discrete, and the I/STAT. All seven inputs are configured (selected) using plug-in resistor banks. The MR88R provides eight low-voltage, single form-C relay outputs.

MR160 Input Terminals

The MR160 has fifteen universal inputs. These inputs are user-configurable as 0–5 V, 0–10 V, 0–20 mA, thermistor, or discrete, using plug-in resistor banks. The MR160 also has one limited-function I/STAT input, which can used as a thermistor or I/STAT input. The MR160 provides no output points or MR-resident DDC modules.

MR632 Input/Output Terminals

The MR632 has five universal inputs that are user-configured as 0–5 V, 0–10 V, 0–20 mA, thermistor, or discrete, and the I/STAT. All five input terminals are configured (selected) using plug-in resistor banks. It has three-low-voltage (24 VAC) triac outputs and two 0–10 V analog outputs. The triac outputs operate in PWM (AO) proportional or latched (discrete) mode.

Physical Description

Each micro regulator is a single printed circuit board. All I/O connections are accomplished through plug-in terminal blocks. The micro regulator controller board measures 4.0" W × 7.0" H (10.16 × 17.78 cm) and is mounted on a baseplate that measures 5.5" W × 8.5" H (13.97 × 21.59 cm) which may then be mounted inside the CSI Universal Enclosure (see Figure 3). The perforated backplane should be used to mount the baseplates. All controllers or interface units are attached to a baseplate for mounting in a Universal Enclosure. Universal Enclosures are available in varying capacities and sizes (refer to Table 3 on page 16).

Power Supply

Electrical power connections are provided at terminal block TB1 on the top left edge of the board (see Figures 1 through 4). The power provided must be 24 VAC, 50/60 Hz. The power supply must be capable of providing sufficient current for the base board plus the current required by the low-voltage triac outputs. The maximum power requirements are given in Table 1.

Table 1. Transformer VA Limits

Controller	Transformer VA Limit
MR 88	55 VA maximum
MR 88R	7 VA maximum *
MR 160	7 VA maximum
MR 632	42 VA maximum
* If the power supply must also provide current for the controlled devices, the power supply must be capable of providing up to 103 VA maximum.	

Input/Output Terminals

The micro regulator's input and output terminals are located along the left and right sides of the board. The input terminals, including the sensor port, are on the left side and the outputs are on the right side. The MR88 and MR632 have low-voltage triac outputs. The MR160 has no outputs. The MR88R has eight low-voltage single form-C relay outputs.

Input Terminations

Signal inputs are provided for a thermistor (I/STAT or 10K ohm thermistor sensor), 0–5 V, 0–10 V, 0–20 mA analog and discrete contact or pulsed inputs. The I/STAT sensor port (TB3) is located on the left edge of the micro regulators.

Inputs are located on terminal blocks on the edges of the MRs. The universal inputs (UI-1, UI-2, etc.) are located on terminal blocks on the bottom edges of each board and are configured with plug-in resistor banks.

MR88

On the MR88, the ten-position terminal block TB4 contains the universal input terminals 1 through 7, labeled UI-1 through UI-7. These inputs are configured for 0–5 V, 0–10 V, 0–20 mA, thermistor, and discrete contact or pulse input using plug-in resistor banks.The MR88 has eight low-voltage triac outputs on TB5.

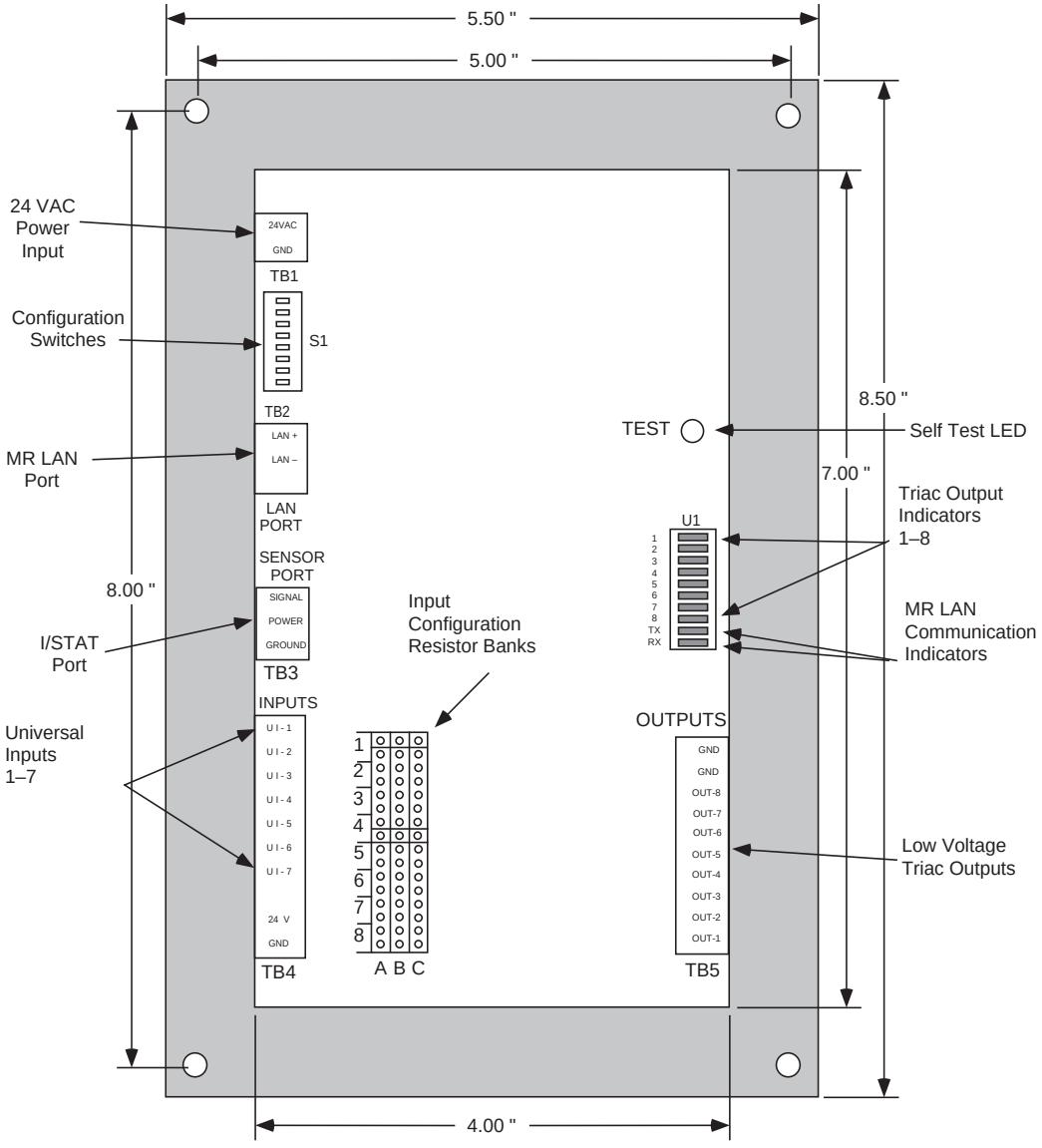

Figure 1. MR88 Controller Board

MR88R

The MR88R has eight relay outputs, each providing a single form-C relay contact with three screw terminations. The outputs are arranged in groups of four on TB5 and TB6. The ten-position terminal block, TB4, contains the universal input terminals 1 through 7, labeled UI-1 through UI-7 (see Figure 2). These inputs are configured using the plug-in resistor banks.

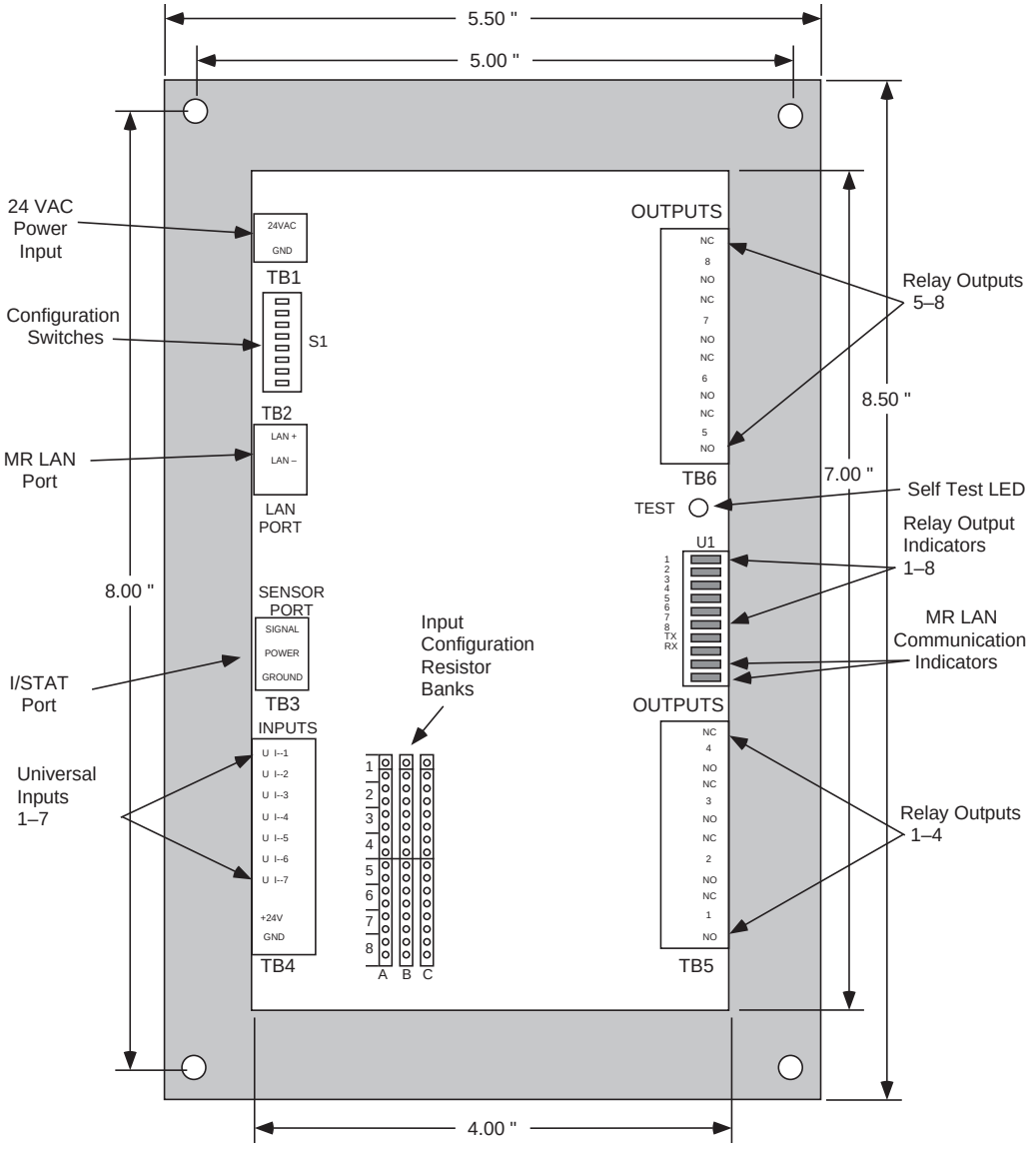

Figure 2. MR88R Controller Board

MR160

The MR160 has fifteen universal inputs, eight on TB5 and seven on TB6 (see Figure 3). These are configured for 0–5 V, 0–10 V, 0–20 mA, thermistor, and discrete contact or pulse input using plug-in resistor banks. The MR160 also has one limited-function I/STAT input, which can be used as a thermistor or I/STAT input. The MR160 provides no output points or MR-resident DDC modules.

Note: *The resolution of sensing devices should be evaluated to determine acceptability for the application.*

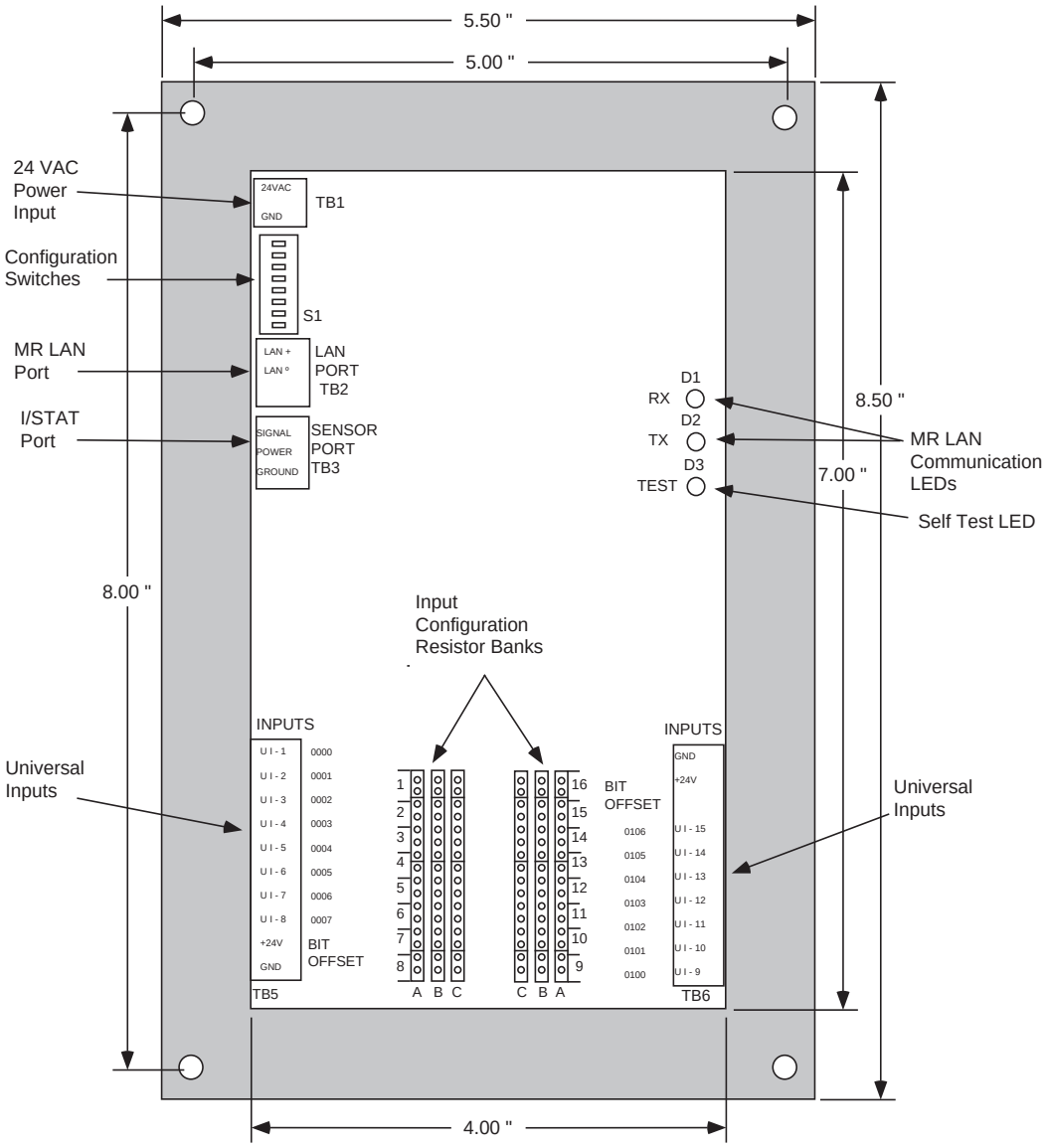

Figure 3. MR160 Controller Board

MR632

The MR632 has five universal inputs on TB4 (UI-1 through UI-5). These are configured for 0–5 V, 0–10 V, 0–20 mA, thermistor, and discrete contact or pulse input using plug-in resistor banks. It has two analog outputs on TB6 and three low-voltage triac outputs on TB5 (see Figure 4).

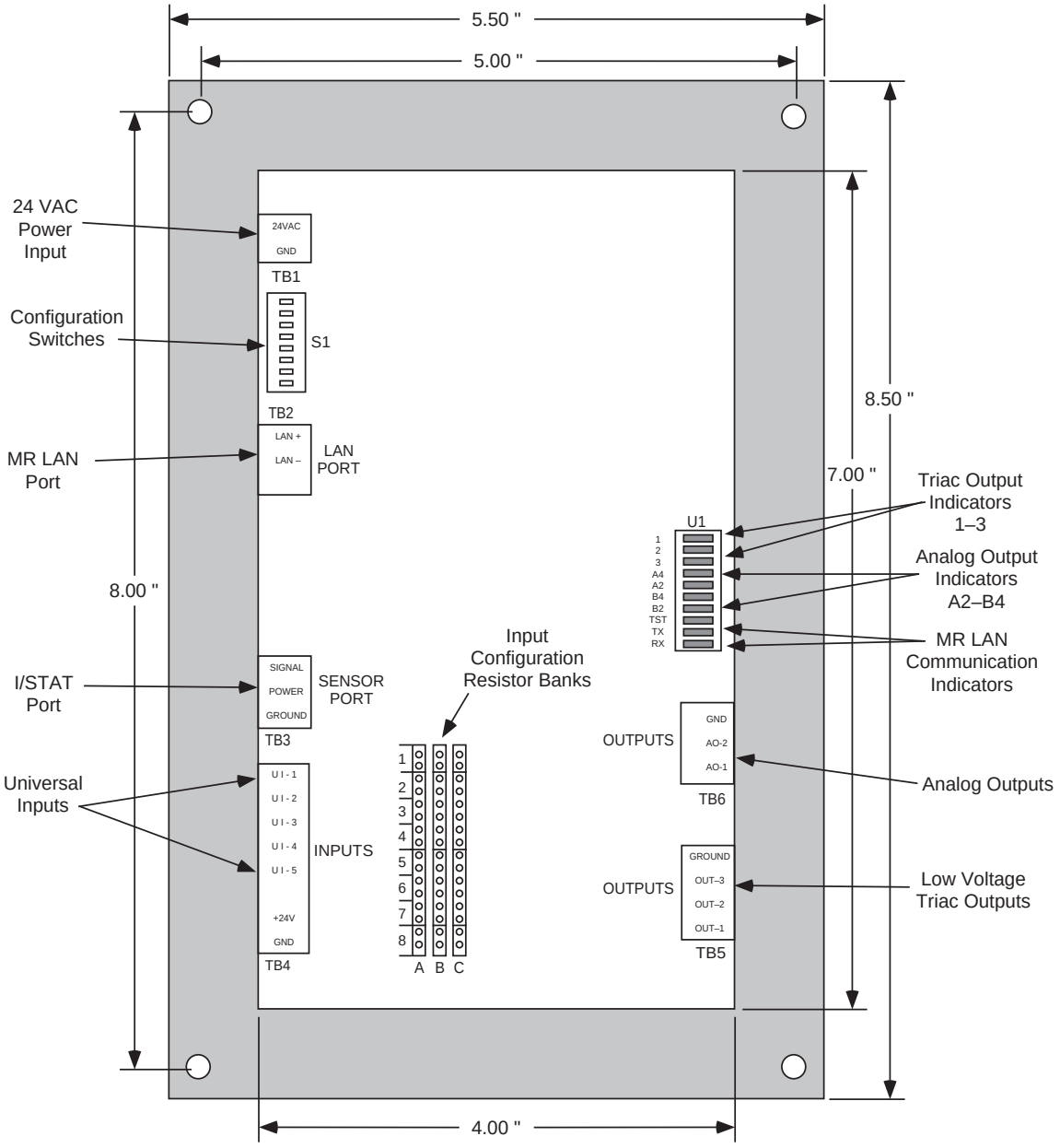

Figure 4. MR632 Controller Board

Output Terminations

MR 88

The MR88 has eight low-voltage sourcing (24 VAC) triac outputs on TB5. The outputs are configured as voltage sourcing using the controller's 24 VAC input power after it has been passed through a 4 A fuse. The triac outputs supply a maximum continuous current of 0.5 A each (2 A maximum).

MR 88R

The MR88R has eight relay outputs, four each on TB5 and TB6. These outputs are single form-C relay contacts with three screw terminations. Each contact may be wired to the output device as Normally Open (NO) or Normally Closed (NC). The center terminal of each group (the terminal output number) is the common terminal (see Figure 2 on page 11). Contacts are rated at 24 VAC/DC @ 0.5 A maximum each output.

MR 160

The MR160 has no outputs.

MR 632

The MR632 has three low-voltage sourcing (24 VAC) triac outputs on TB5 and two 0–10 V analog outputs on TB6. The triac outputs are configured as voltage sourcing using the controller's 24 VAC input power after it has been passed through a 2.5 A fuse. The triac outputs supply a maximum continuous current of 0.5 A each.

LAN Communication Port

There is one communication port on the MR board. This is TB2, the connection to the subLAN. The subLAN communications port is located along the upper left side of the controller, below the DIP switch block S1.

A terminal block provides connection of the RS485 shielded, twisted pair cable on the standard controller. See Figure 3 on page 12 for port location. The communication speed on the subLAN is 9,600 baud.

Memory

The MR provides support for several types of memory that is currently organized as follows:

Table 2. Micro Regulator Memory

Amount	Memory type
236 bytes	RAM storage internal to the microprocessor
32 KB	EPROM
1024 bytes	NOVRAM

I/STAT

The I/STAT controller board is installed in a small plastic enclosure measuring 2.75" W × 4.5" H × 0.9" D (6.99 × 11.43 × 2.29 cm) as shown in Figure 5. Three 7-segment LEDs are located along the top edge of the board, and four discrete LEDs are located along the right side of the keypad area.

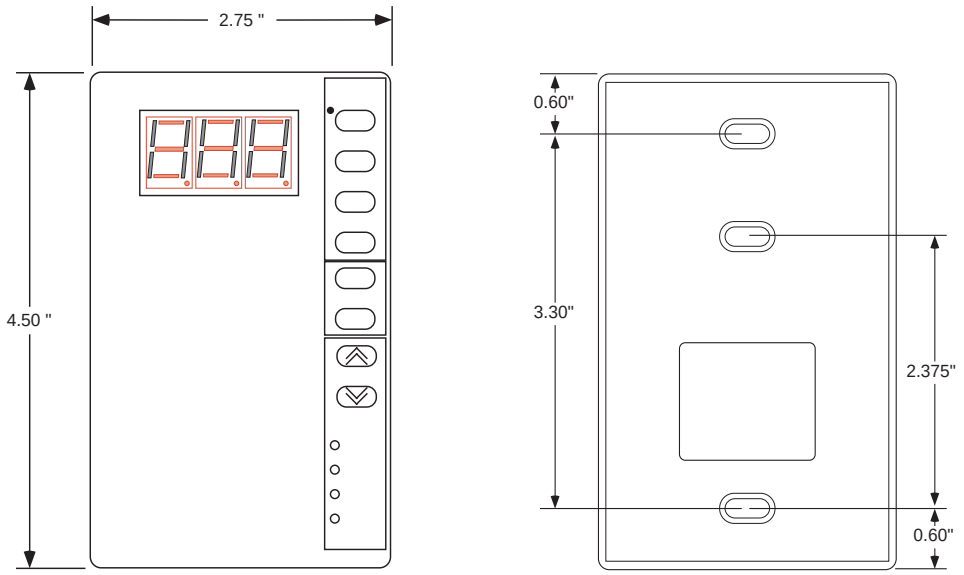

Figure 5. I/STAT

A keypad is located on the right side of the I/STAT. There are three groups of keys on the I/STAT keypad: Function, Change, and Select. The Function keys are labeled On/Off, Call, and Service, while the fourth has a graphic (↵) indicating the Enter key. The Change keys have + or – keys. The Select keys are an up arrow and a down arrow.

Communications Port

The I/STAT communication port is located on the back of the board. A shielded, twisted pair conductor cable of 22 AWG (0.324 mm^2) connects the I/STAT to the MR at TB3.

Power Supply

Electrical power for the I/STAT is provided solely from the MR controller. The I/STAT receives +12 VDC through the twisted pair cable connecting it to the MR controller.

Universal Enclosure

CSI's Universal Enclosure provides a protected environment in locations where dirt, dust, or other contaminants may exist. CSI Universal Enclosures are available in several sizes designed to house various combinations of CSI control units and interfaces. The model used for the MR controllers is the ENCL1813, measuring 13.25" W × 18.25" H × 4.2" D (33.66 × 46.36 × 10.67 cm). The enclosure includes a door key lock.

The MR boards come mounted on a 5.5" W × 8.5" H (13.97 × 21.59 cm) baseplate. That baseplate/PCB assembly is then mounted into the Universal Enclosure. The perforated backplane should be used to mount the baseplates. All controllers or interface units are attached to a baseplate for mounting in a Universal Enclosure. Universal Enclosures are available in varying capacities and sizes.

Table 3. ENCL1813 Universal Enclosure

Model	Panel Dimensions			Standard Door Mounting Baseplate Qty	Perforated Panel Backplane Dimension		Panel Backplane w/studs	Door Key Lock
	W	H	D		W	H		
ENCL 1813 w/ Knockouts and Gasketed Door	13.25" (33.66 cm)	18.25" (46.36 cm)	4.2" (10.67 cm)	1 (Any CSI baseplate unit)	12.5" (31.75 cm)	16.5" (41.91 cm) (# 8–32 hard-ware for optional panel mounting)	Mount one (max.) CSI baseplate unit Options: 1 – Transformer 1 – Junction box	Yes

Installation Procedures

This section provides installation instructions for the I/STAT and Micro Regulator controllers' input, output, LAN, and power connections.

Note: *Operational errors may occur if equipment is inadequately grounded. Symptoms may include, but are not limited to: intermittent LAN or subLAN communications, improper control actions, or loss of NOVRAM contents. Refer to "Grounding Requirements" on page 18 during equipment installation.*

Installing the I/STAT

The three-pin terminal block (TB3) provides connection of the 18–24 AWG (0.897–0.206 cm^2), 3-conductor cable (see Figure 6). The I/STAT is designed to mount on a standard electrical utility box. Use the following steps to install the I/STAT.

1. Ensure power is disconnected to the I/STAT.
2. Disconnect power to all devices to be connected to the I/STAT.

Warning: *Failure to disconnect power from all interconnected equipment when performing electrical installation may result in electrical shock or burns.*

3. Mount the I/STAT base to a wall-mounted, standard electrical utility box no more than 100 feet (30 m) from the MR controller.
4. Connect the three-conductor cable from the MR to the pigtail leads on the I/STAT.
   a. Connect the I/STAT terminal 1 (white/signal) to TB3, terminal 1.

Note: *If the white signal wire is not properly connected to terminal 1, the I/STAT will display a flashing "CSI".*

   a. Connect the I/STAT terminal 2 (red/+12 VDC power) to TB3, terminal 2.
   a. Connect the I/STAT terminal 3 (black/ground) to TB3, terminal 3.

Note: *When using shielded cable, the drain/shield wire may be used to connect the black (ground) lead from the I/STAT. In retrofit applications, the three conductors of the existing I/STAT cable may be used in most cases for a distance up to 100 feet (30 m).*

5. Reconnect power to the MR that is connected to the I/STAT.
6. Program the I/STAT from the host workstation (details in the I/NET Operator Guide).

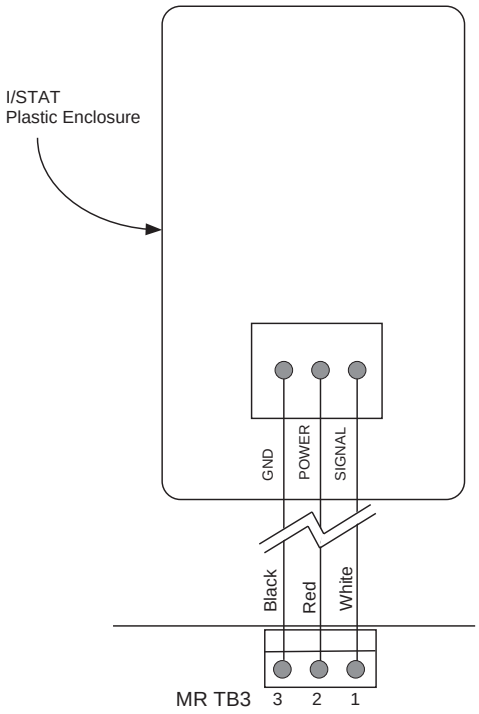

Figure 6. I/STAT Connection

Common Installation for the MRs

The MR88, MR88R, MR160, and MR632 are built from similar printed circuit boards and have universal input field connections. The following procedures show how to connect the I/STAT and other field connections, power, and LAN connections.

Grounding Requirements

To ensure proper operation of the controller, it is imperative that the unit be correctly grounded. Depending on the mounting location and mounting method used to install the unit, the controller chassis may not necessarily provide adequate ground for the input power circuit and interconnected sensors/devices: therefore, use the following grounding requirements during unit installation.

Earth Ground

Note: *You must establish a proper earth ground connection point prior to connecting ground wires to electrical equipment.*

- Electrical Service Earth Ground must be securely connected to the equipment chassis.
- The 24 VAC transformer secondary lead must be securely connected to the Electrical Service Earth Ground.
- The Electrical Service Earth Ground must then be connected to the ground terminal on the controller power input terminal block.

Baseplate Ground

Note: *Baseplate grounding requirements apply to all controllers having a baseplate.*

- Good contact must exist between the baseplate and chassis. Ensure that all mounting screws are tight.
- If you suspect that a good ground on the chassis is not present, attach a 12-AWG (3.331 mm^2) ground wire from the Electrical Service Earth Ground wire to the baseplate. Attach the ground wire between the PCB and the baseplate, using one of the mounting screws.

Caution: *Take care not to allow the ground wire or the washer to touch any components on the PCB.*

- If resolving a grounding issue with previously-installed equipment, use star-tooth lock washers to ensure a tight connection between the PCB and the baseplate.

LAN Ground

Note: *This procedure applies to all LAN and subLAN connections.*

- Ensure that the subLAN cable shield drain wire is **not** connected to the controller subLAN terminal block.
- Shield drain wire continuity must be maintained as the subLAN cable passes through each controller. Shield drain wires from each controller subLAN cable must be twisted together, insulated, and tied back such that wires do not come in contact with ground or any conductive surface within a controller.
- Connect the shield drain wire directly to Electrical Service Earth Ground at **only** one location on the cable (e.g., at the MCI, MRI, I/SITE™ LAN, or controller).

Installing the MR Input Field Connections

The MR88, MR88R, MR160, and MR632 provide universal inputs (UI) that are configured using plug-in resistor banks. Use the procedures shown below to connect the sensors you use to the MRs.

Caution: *The input, output and power wiring must be routed along the side of the controller. The wiring must not lay across the controller.*

The universal inputs support DI, AI or PI point types. The point type is selectable using plug-in resistors, as shown in Table 4. The inputs are shipped configured for 10K thermistor inputs with 10K ohm, 0.1%, $\frac{1}{8}$ W resistors in all positions of resistor bank B.

Table 4. Point Type Resistor Configuration

Point Type	Resistor Type	Resistor Bank	Factory Resistor Configuration
0–5 V (Normal span) or 2–4 V (Narrow span)	None	None	None
0–10 V (Normal span) or 4–8 V (Narrow span)	100K Ohm 1%, $\frac{1}{8}$ W	C1–C15 only	None
0–20 mA (Normal span) or 8–16 mA (Narrow span)	249 Ohm 0.1%, $\frac{1}{8}$ W	A1–A15 only	None

Table 4. Point Type Resistor Configuration (Continued)

Point Type	Resistor Type	Resistor Bank	Factory Resistor Configuration
10K Thermistor	10K Ohm 0.1%, 1/8 W	B1–B15 only	B1–B15
Discrete Contact or Pulse Contact	1K Ohm 1%, 1/8 W	B1–B15 only	None

Connecting Space Sensor (Thermistor) Inputs

A dedicated I/STAT space sensor thermistor input is provided on the left side of all MRs at TB3. This sensor port is a single terminal block with three screw terminations (signal, power, and ground). Refer to "Installing the I/STAT" on page 17 for connection procedures for the I/STAT. A 10K ohm discrete thermistor sensor may be used in place of the I/STAT sensor.

All MR universal inputs are configured for 10K ohm thermistors from the factory (10K, 0.1%, 1/8 watt resistor in the "Bx" resistor position). The "Ax" and "Cx" positions must be vacant (no resistors) for proper thermistor input operation. There are no resistor configurations for the dedicated I/STAT port TB3. See Figure 7 for thermistor connection diagrams.

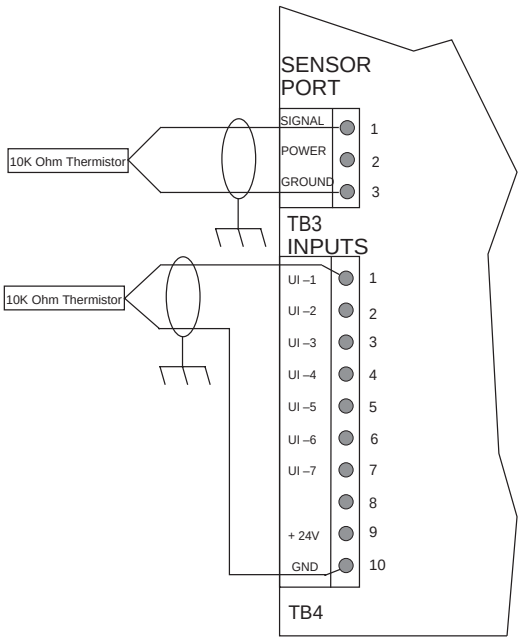

Figure 7. Space Sensor Connection — I/STAT and Universal

Connecting a Thermistor to the I/STAT Port

1. Connect one lead to pin 1 (signal) of TB3 (see Figure 7).
2. Connect the other lead to pin 3 (ground) of TB3.

Recommended CSI 10K ohm resistors are shown in Table 5.

Connecting a Thermistor to a Universal Input

1. Connect one lead of the thermistor to the appropriate UI-x signal input terminal.
2. Connect the other lead to the ground terminal on the input terminal block.

Table 5. Recommended CSI 10K Ohm Thermistors

CSI Part Number	10K Ohm Thermistor Type
605525-0003	Sensor, Duct Probe
605525-0004	Sensor, Duct Probe
605525-0005	Sensor, Immersion Probe & well w/ 4" Thermowell
605525-0006	Sensor, Immersion Probe & well w/ 8" Thermowell
605525-0007	Sensor, Outside Air
605525-0008	Sensor, Steel Plate
605525-0009	Sensor, Strap-on, Handi-box
605525-0010	Sensor, Sealed Element only, 6' Lead
605525-0011	Sensor, Sealed Element only, 6" Lead

Caution: *Lini-Temp sensors should not be used on this input since the MR may not provide adequate or required resolution of temperature. Where the 2.732–3.332 volt output of the Lini-temp is connected to the 2–4 V Narrow input span of the MR, resulting resolution would be 1.42° F versus 0.3° F provided by a thermistor.*

Connecting 0–10 V Sensors

A 0–10 V sensor uses two leads to connect to an MR universal input.

1. Connect the sensor signal output lead of the 0–10 V sensor to a signal terminal (UI-x).
2. Connect the negative lead of the sensor to the GND terminal (TB4-10).

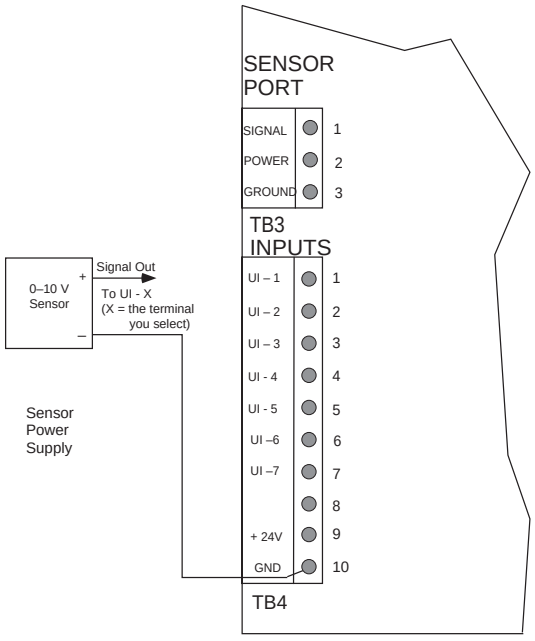

Figure 8. 0–10 Volt Sensor Connection

3. Plug a 100K ohm, 1%, ⅛ watt resistor into the appropriate "Cx" resistor bank location with the I/NET span set to **Normal**. Setting the span to **Narrow** results in a higher input resolution over a 4–8 volt input range. Refer to "Hardware Inputs" on page 28 for a discussion of the normal and narrow span settings.
4. The 0–10 V sensor is typically powered by a separate external power supply. Connect the appropriate leads from the sensor power supply to the sensor (see Figure 8).

Connecting Discrete or Pulse Input Points

For DI contact sensing on the MR, use one of the UI terminals and verify that there is a 1K, 1%, ⅛ watt resistor in the appropriate "Bx" position, and that the corresponding "Ax" and "Cx" positions are vacant (no resistors). These "Bx" positions provide a pull-up on the input to 5 VDC for dry contact excitation.

1. Connect one lead from the contact to the appropriate signal (UI-x) terminal on the terminal board (see Figure 9).
2. Connect the other lead of the contact to the GND terminal (TB4-10).

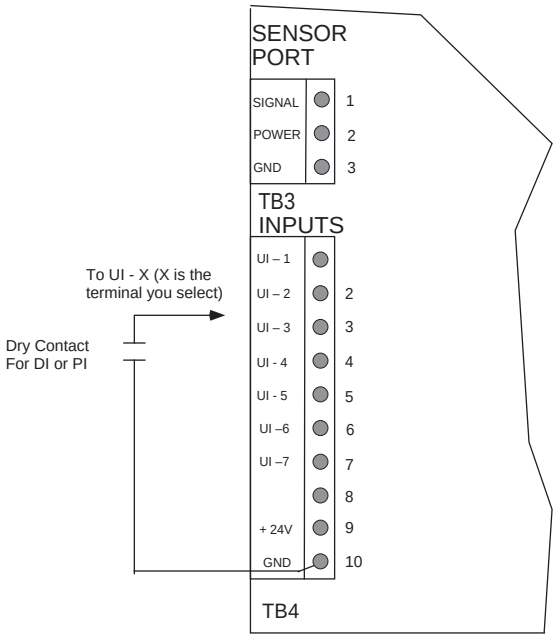

Figure 9. Dry Contact Connection

Connecting 0–20 mA Loop Sensors

When using a 0–20 mA loop sensor with the MR, select one of the UI-x input terminals and insert a 249 ohm, 0.1%, ⅛ watt resistor into the appropriate "Ax" resistor bank location. The corresponding "Bx" and "Cx" locations must be empty.

1. Connect the output lead from the 0–20 mA sensor to the selected UI-x input terminal (see Figure 10).
2. Connect the input lead from the 0–20 mA sensor to the UI +24 V terminal (TB4-9).

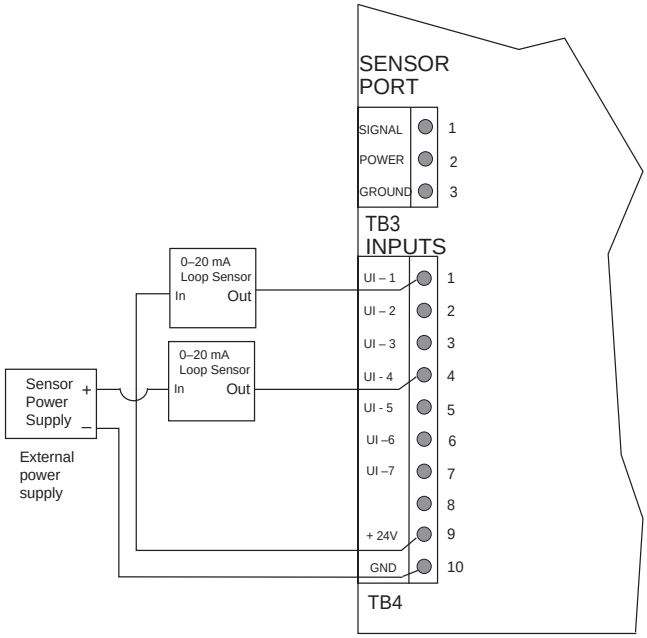

Figure 10. 0–20 mA Loop Sensor Connection

A +24 VDC supply terminal, located next to the ground terminal, is provided on all input terminal blocks, which may be used to power up to five 0–20 mA loop sensors.

Note: *If more than five 0–20 mA loop sensors are required, an external DC power supply* ***must*** *be used (see Figure 10).*

Connecting an MR Controller to the SubLAN

The LAN port is located along the upper left side of the controller. It provides asynchronous communications to the RS485 subLAN.

A three-pin terminal block provides connection of the RS485 shielded, twisted pair cable (see Figure 11).

1. Connect the Com + line to terminal 1.
2. Connect the Com – line to terminal 2.
3. Twist shield wires for all controllers together at each controller, and connect to a good earth ground at one location only. Ensure that shield wire continuity is maintained (see "LAN Ground" on page 19).

Caution: *Ensure that you connect terminal 1 to 1 and terminal 2 to 2 on all MR controllers. Also ensure that the subLAN shield is grounded at* ***only*** *one location (usually at the MRI/MCI controller). Refer to "Grounding Requirements" on page 18.*

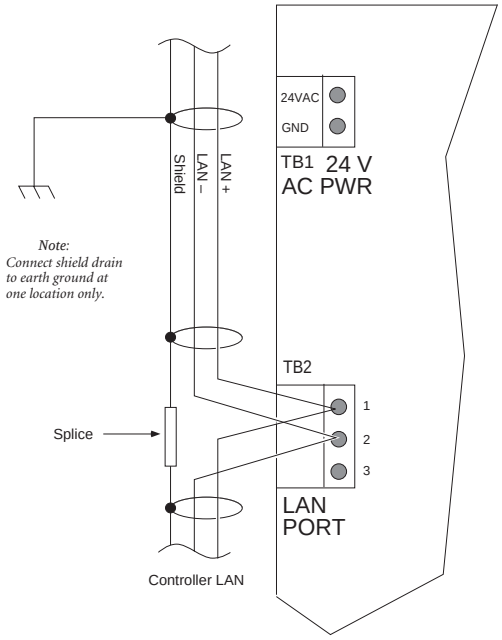

Figure 11. SubLAN Connection

Connecting the Power Supply

Electrical power connections for the 24 VAC input power are provided along the upper left side of all MRs (see Figure 12).

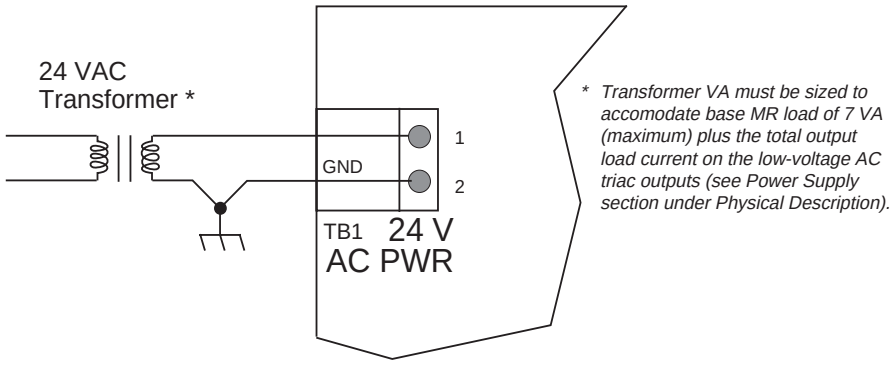

Figure 12. MR Controller Power Connection

Caution: *Before applying power, ensure that the two 24 VAC leads are connected to TB1. Connection to any other terminal block will damage the micro regulator controller!*

Warning: *Failure to disconnect power from all interconnected equipment when performing electrical installation may result in electrical shock or burns.*

1. Connect one of the 24 VAC input leads from a separate, isolated 24 VAC transformer, to pin 1 of terminal block TB1.
2. Connect the other 24 VAC input lead from the transformer to pin 2 of TB1.

Note: *Do not attempt to use the same AC transformer for any subLAN device (MR, DPU, UC, or transducer) and its associated LAN interface device (MRI, DPI, MCI, or UCI). This will result in improper operation, and may cause damage to one or both devices.*

3. The conductor connecting to pin 2 of TB1 (GND) must also be connected to a good earth ground (see Figure 12).

Installing the MR88 Output Field Connections

Output terminations are provided along the bottom right side of the MR88 controller. Each output consists of a solid state voltage sourcing AC triac output circuit capable of handling 0.5 A at 24 VAC. Each output provides discrete control of a field contactor or analog proportional control through pulse-width-modulation (PWM) of the output.

When connecting low-voltage triac outputs to the MR88, the devices are configured as voltage sourcing.

1. Connect one lead from the device to the desired output (OUT-1 through OUT-8) terminal at TB5 (see Figure 13).
2. Repeat as required for additional connections.
3. Twist the other lead wires for all output devices together, and connect to a good earth ground.

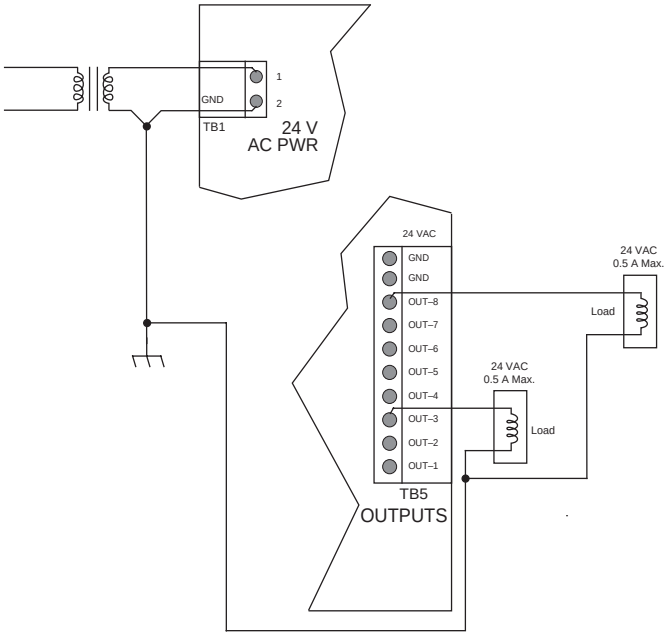

Figure 13. MR88 Triac Output Connections

Installing the MR88R Output Field Connections

Output terminations are provided along the right side of the controller.
Each output provides discrete (dry-contact) control of a field contactor or an analog proportional control of a transducer through pulse-width-modulation of the output contact.

Each low-voltage relay output (24 V) use a common low-voltage connection and a switched output. The outputs may then be configured as normally open (NO) or normally closed (NC).

1. Connect one lead from the relay to the NC or NO terminal on TB5 or TB6.
2. Connect the common lead to the corresponding terminal number (see Figure 14).
3. Repeat as required for additional connections.

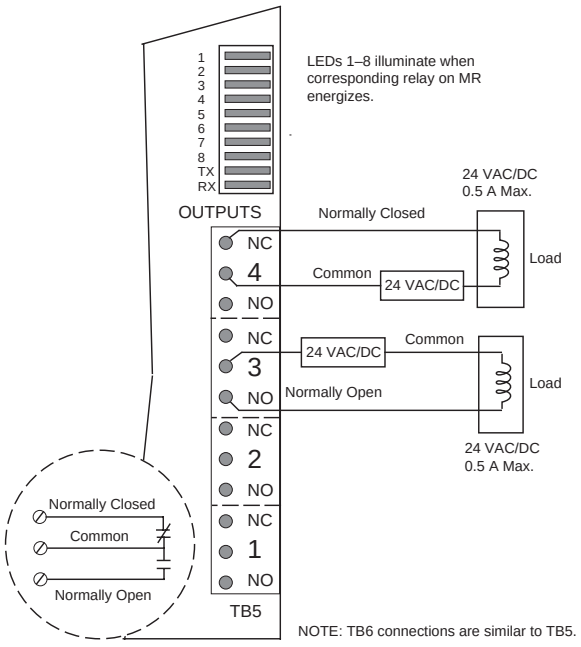

Figure 14. MR88R Relay Output Connections

Installing the MR632 Output Field Connections

The MR632 provides three 24 VAC triac outputs (TB5) and two 0–10 VDC analog outputs (TB6).

Triac Output Connection

Each triac output consists of a solid-state voltage sourcing output circuit capable of handling 0.5 A at 24 VAC, and provides discrete control of a field contactor or an analog proportional control of a transducer through pulse-width-modulation of the output contact.

1. Connect one lead from the device to the desired output (OUT-1 through OUT-3) terminal on TB5 (see Figure 15).
2. Repeat as required for additional connections.
3. Twist the other lead wires for all output devices together, and connect to a good earth ground.

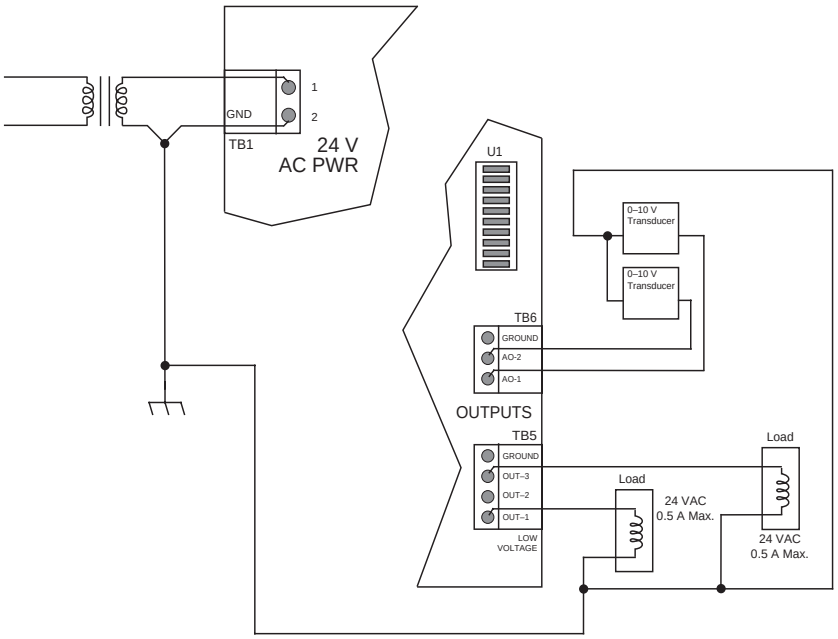

Figure 15. MR632 Triac/AO Output Connections

Analog Output Connection

The analog outputs provide a variable output for control of 0–10 V transducers. Connect the analog outputs to the MR632 as described below.

1. Connect one lead from the device to the desired output (AO-1 or AO-2) terminal at TB6 (see Figure 15).
2. Repeat as required for additional connections.
3. Twist the other lead wires for all output devices together, and connect to a good earth ground.

Setup and Operation

This chapter describes the various components of the I/STAT and MRs, and their setup and operation. These units mount indoors on a wall surface in an area that meets the specifications outlined (see "Specifications" on page 50). You should set the MR's address with DIP switch S1 before powering up the unit, or with the I/STAT prior to connection to the subLAN. Identify and record input and output terminals and addresses with their physical terminal block and pin numbers. Also identify the devices to which they connect. Write this information on a copy of the "Pinout Chart" on page 46. The MR setup requirements include connecting the inputs and outputs and setting the subLAN address.

Micro Regulator Features

The MRs are based on the same board design and share certain features. All of these boards have the same type of hardware inputs, dedicated sensor port, look-up tables, Automatic Time Schedules, and LAN communication port. The MRs also have universal inputs that are configured using plug-in resistor banks.

Hardware Inputs

The MRs have one I/STAT space sensor and various numbers of universal inputs. The space sensor point is connected either to an I/STAT sensor or 10K ohm thermistor (see Figure 6 on page 18 and Figure 7 on page 20).

The MR88 and MR88R provide 7 universal inputs each; the MR632 provides 5 universal inputs. These inputs are processed by a single 8-bit A/D convertor. The MR160 provides 15 universal inputs with processing done by two A/D convertors.

You can select the normal span or narrow span for each possible universal input address in the I/NET system MR parameters editor. When **Normal** is selected for the channel in the MR configuration editor, the input is processed using an A/D conversion range of 0–5 volts. When **Narrow** is selected the input is processed using an A/D conversion range of 2–4 volts.

0–10 V Inputs

The 0 –10 V range is accomplished by selecting **Normal** and inserting a divide-by-two resistance network in front of the analog Mux on the applicable channel. This is accomplished by plugging a 100K, 1%, $\frac{1}{8}$ watt resistor into the appropriate Cx position in the configuration resistor bank (see Table 4). The x corresponds to the input number (1–15). Setting the span selection to **Narrow** results in an input span of 4–8 volts.

0–20 mA Inputs

The universal inputs can be configured for 0–20 mA operation by selecting **Normal** and inserting a current-sensing resistor (249 ohm, 0.1%, $\frac{1}{8}$ watt) into the appropriate Ax position (see Table 6), with x corresponding to the input number (1–15). Setting the span selection to **Narrow** results in an input span of 8–16 mA.

Discrete or Pulse Inputs

For discrete/pulse contact input operation, select **Normal** and insert a contact excitation resistor (1K ohm, 1%, 1/8 watt) into the appropriate Bx position (see Table 6), with x corresponding to the input number (1–15). The field contact will be wired between the input and ground and will pull the 5-volt level to ground when the contact is closed. A voltage below 1.25 V (25% scale) is considered a closed contact; a voltage above 3.75 V (75% scale) is considered an open contact.

Universal Inputs

The universal inputs are configured for thermistor (temperature sensing) operation by selecting the normal or narrow span and inserting a thermistor excitation resistor (10K ohm, 0.1%, 1/8 watt) into the appropriate Bx position (see Table 6), with x corresponding to the input number (1–15). The thermistor input circuit consists of a 10K ohm, NTC thermistor connected between the signal input and ground. The thermistor signal input is biased/excited on the MR controller using a precision 5-volt reference. The MR meters the resulting voltage divider network and translates the voltage to temperature.

Table 6. Point Type Resistor Configuration

Point Type	Resistor Type	Resistor Bank	Factory Resistor Configuration
0–5 V (Normal span) or 2–4 V (Narrow span)	None	None	None
0–10 V (Normal span) or 4–8 V (Narrow span)	100K Ohm 1%, 1/8 W	C1–C15 only	None
0–20 mA (Normal span) or 8–16 mA (Narrow span)	249 Ohm 0.1%, 1/8 W	A1–A15 only	None
10K Thermistor	10K Ohm 0.1%, 1/8 W	B1–B15 only	B1–B15
Discrete Contact or Pulse Contact	1K Ohm 1%, 1/8 W	B1–B15 only	None

To achieve better resolution (0.27° F per count or better) over the indoor temperature span of interest (32–90° F, 0–32° C) the A/D conversion span can be reduced from the normal 0–5 V range. A reduced (narrow) range of 2–4 V can be selected. This is set in the I/NET system MR parameters editor.

When using thermistors for outside temperature measurements or standard 1–5 V or 4–20 mA devices, the user sets the span to **Normal**. When set for **Normal**, the thermistor span covers a range of –40 to 176° F (–40 to 80° C).

The narrow span can also be used to achieve better resolution on the 0–5 V and 0–20 mA sensors by reducing the conversion span to 2–4 V and 8–16 mA. This improves resolution with many sensors, especially those with 4–20 mA outputs.

The MRs provide a glitch filter on the AI inputs that takes the median of the last three averaged samples. The points defined as DI or PI are considered to have changed state after seeing two consecutive samples in the new state (above 75% or below 25%).

The MRs also provide a mean value filter to reduce/eliminate random electrical noise, especially AC (60 Hz) power line noise.

I/STAT Sensor Port

The I/STAT sensor port is designed to support the connection of an intelligent thermostat (I/STAT) or connection of an inexpensive 10K ohm thermistor for space temperature sensing.

Note: *Recommended 10K ohm resistors are CSI part numbers 605525-0003, -0004, -0005, -0006, -0007, -0008, -0009, -0010, and -0011.*

The following resistance conversion table is provided for the CSI recommended 10K ohm resistors.

Table 7. CSI 10K Ohm Resistance Vs. Temperature Conversion

Temperature °C	Ratio	MT ±%	NTC
–55	96.77	4.5	7.4
–50	67.23	3.9	7.2
–40	33.72	3.3	6.7
–30	17.72	2.6	6.2
–20	9.713	2.1	5.8
–10	5.534	1.5	5.5
0	**3.266**	**1.1**	**5.1**
10	1.990	0.6	4.8
20	1.249	0.1	4.5
25	**1.00**	**0.0**	**4.4**
30	0.8056	0.2	4.3
37	0.6015	0.6	4.1
40	0.5326	0.7	4.0
50	0.3602	1.1	3.8
60	0.2489	1.3	3.6
70	**0.1753**	**1.8**	**3.4**
80	0.1258	2.1	3.2
90	0.09174	2.3	2.1
100	0.06798	2.6	2.9
110	0.05110	2.7	2.8
120	0.03894	3.2	2.7
125	0.03416	3.3	2.6
130	0.03005	3.4	2.5
140	0.02347	3.7	2.4
150	0.01853		

Look-Up Tables

The MR provides a collection of four look-up tables to accurately translate the non-linear characteristics of thermistors.

Note: *There are several variations of curves, dissipation characteristics and accuracies available for 10K ohm thermistors, not all 10K thermistors are alike. Contact CSI to identify the required thermistor specifications.*

Table 8. Look-Up Table 1 and 2 Ranges

	Low	High
Table 1 Normal	–104° F	1134° F
Table 1 Narrow	24.5° F	91.6° F
Table 2 Normal	–104° F	1134° F
Table 2 Narrow	25.3° F	94.1° F
Usable range depends upon the capabilities of the selected sensor.		

The look-up tables translate the thermistor-controlled voltage directly to temperature in degrees centigrade with a 100° positive bias to permit readings below zero. The look-up table entries are defined by the equation 100(°C+100).

The output from the look-up table will apply the user defined M and B conversion coefficients to create the engineering unit value. The typical M and B coefficients are as follows for counts m = 1 and b = 0.

For engineering units of °C: M = 0.0100 B = –100

For engineering units of °F: M = 0.0180 B = –148

When connecting an I/STAT to the sensor port (TB3), you specify the database point to use Look-up Table 1 (normal or narrow). The factory defined look-up tables take into consideration the normal versus narrow span selection, and no change to the conversion coefficients is required. Table 1 also accounts for an elevated self-heating error that is a function of the I/STAT. A separate pair (normal and narrow) of look-up tables, defined as Table 2, is provided in the MR firmware to support accommodation of 10K ohm thermistors connected to any available analog input (including the I/STAT sensor port).

Automatic Time Schedule

The MRI/MCI maintains a clock for its connected MRs. The MRI/MCI sends a Time/Day of Week synchronization broadcast every minute to its family of MRs. If communication between the MRs and the MRI/MCI is severed, the MRs revert to their local resident ATS schedule. The local resident schedule provides one start and stop command for each day of the week. When communication with the MRI/MCI is reestablished, the MRs return to the clock ATS commands controlled by the MRI/MCI.

Note: *If MR power is lost and subsequently restored following an MRI/MCI-to-MR communications failure, the master device control point (controlled by the MR stand-alone ATS schedule) will default to its deenergized state. No further time-based commands will be issued to the point until MRI/MCI-to-MR communications are reestablished.*

SubLAN Port

The RS485 subLAN port (TB2) is accessed through a three-position terminal block located along the left edge of the MR (see Figure 16). When connected through this port, the MR controllers can communicate with the MRI, MCI, or I/SITE.

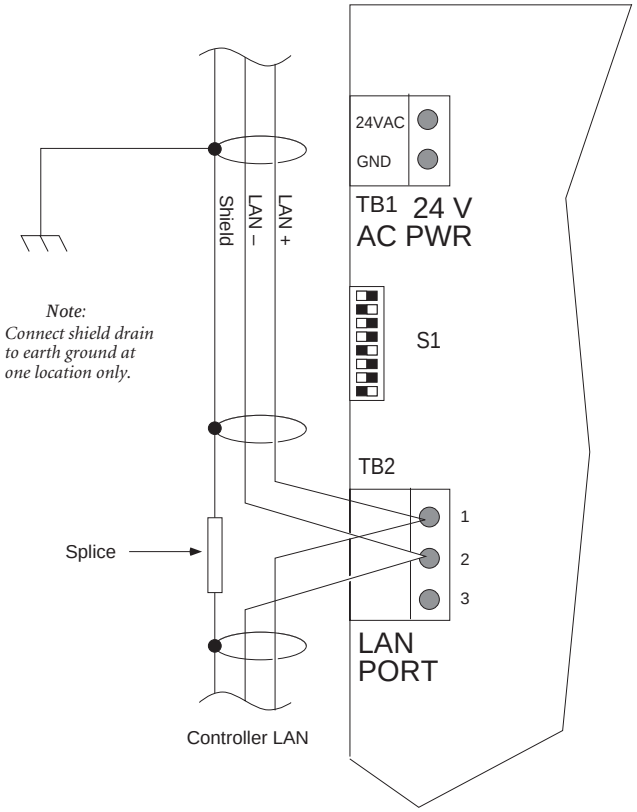

Figure 16. MR Board RS485 LAN Port

Field connections for the RS485 LAN port are shown in Table 9.

Table 9. RS485 Port Termination

Terminal	Function
1	LAN +
2	LAN –
3	No connection

SubLAN Addressing

Set the subLAN address (point address of the MR) through DIP switches located in switch bank S1, between TB1 and TB2. The MR address range is 0 through 31, and corresponds to the PP (point) portion of the LLSSPPBB LAN address.

The switch values are given in Table 10. The value of the switches are added together when they are in the ON position. All switches **OFF** equal an address of zero. All switches **ON** equal an address of 31. For example, an address of 13 would have switches 1, 3, and 4 **ON** (1 + 4 + 8 = 13).

Note: *Each MR on the same subLAN must have a unique LAN address for proper operation.*

Table 10. MR Addressing Switch Values

Switch Number	1	2	3	4	5
Switch Values	1	2	4	8	16

You may also set the LAN address through the I/STAT keypad. Refer to "MR Address" on page 40 for the procedure.

SubLAN Speed

Set the subLAN communications speed for the MRs on DIP switches 6 and 7. Set the subLAN speed to 9,600 baud using Table 11.

Table 11. SubLAN Communications Speed Setting

Baud Rate	Switch 6	Switch 7	Switch 8
9,600 baud	On	On	Off

Note: *Switch 8* ***must*** *be set Off, unless you choose to set the address and baud rate from an I/STAT.*

You may also set the subLAN communications speed for the MR using the I/STAT keypad. Refer to "Parameters" on page 39 for the procedure.

Caution: *When using the I/STAT to set the subLAN parameters, turn DIP switch 8 to the On position. If switch 8 is placed in the Off position, any address or baud rate entered with the I/STAT will be overwritten with the DIP switch settings at the next power cycle.*

Micro Regulator Setup

The micro regulator setup requirements include connecting the inputs and outputs, setting the subLAN data rate, and setting the subLAN address.

MR88 Control Outputs

The MR88 provides eight low-voltage triac outputs for 24 VAC at a maximum of 0.5 A. These outputs occupy the address range of 00 through 07. The MR88 also provides a bank of ten LEDs (U1) to indicate specific output status. The Test LED (D1) is a self-test/power indicator. If the MR88 self-test passes, the LED will come on and remain illuminated. If the self-test fails, the LED will flash according to the specific self-test failure listed in Table 12. The functions of the MR88 LEDs are listed in Table 12.

Table 12. MR88 LED Functions

LED	Label	Function
1	1	Triac output at address 00 is energized
2	2	Triac output at address 01 is energized
3	3	Triac output at address 02 is energized
4	4	Triac output at address 03 is energized
5	5	Triac output at address 04 is energized
6	6	Triac output at address 05 is energized
7	7	Triac output at address 06 is energized
8	8	Triac output at address 07 is energized
9	TX	Transmitting to subLAN
10	RX	Receiving from subLAN
D1	TEST	On indicates power applied to MR. Constant flashes — Database problem in NOVRAM due to corruption. Possible software problem. Occurs initially when installed from the factory. Reinforce MR address and baud rate through DIP switch settings or I/STAT. 1 flash with a 2-second pause — RAM failure, processor faulty. 2 flashes with a 2-second pause — EPROM bad (checksum failure). 3 flashes with a 2-second pause — NOVRAM bad. Unable to clear NOVRAM. Steady “on” — self-test passed, power applied to board.

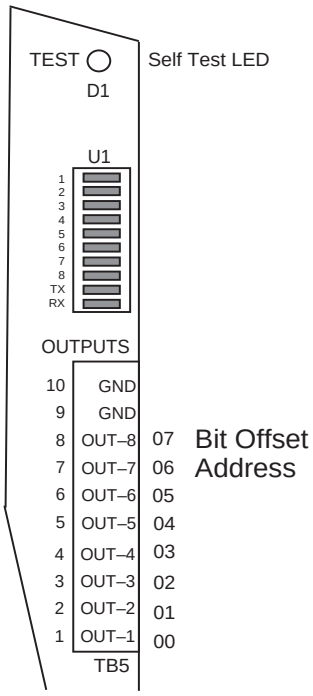

Figure 17. MR88 LED and Output Location

MR88R Control Outputs

The MR88R provides eight form-C relay outputs with three screw terminations (TB5 and TB6), rated at 24 VAC/DC at a maximum of 0.5 A. Each contact may be wired to the output device as Normally Open (NO) or Normally Closed (NC).

The center terminal of each group (terminal number) is the common terminal. These outputs occupy bit offsets 00 through 07.

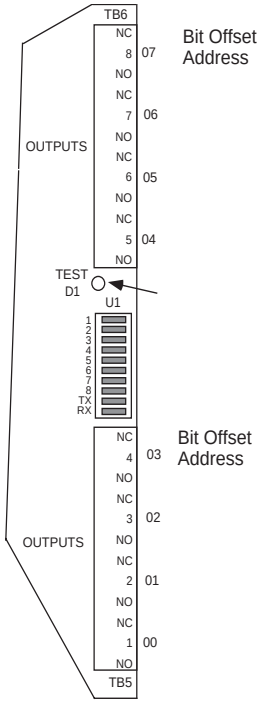

Figure 18. MR88R LEDs and Outputs

The MR88R provides a bank of ten LEDs (see Figure 18) that show the status of subLAN communications and the state of each output. A test LED (D1) is provided to indicate when power is applied to the MR and to serve as a self-test indicator.

The functions of the MR88R LEDs are listed in Table 13.

Table 13. MR88R LED Functions

LED	Label	Function
1	1	Relay output at address 00 is energized
2	2	Relay output at address 01 is energized
3	3	Relay output at address 02 is energized
4	4	Relay output at address 03 is energized
5	5	Relay output at address 04 is energized
6	6	Relay output at address 05 is energized
7	7	Relay output at address 06 is energized
8	8	Relay output at address 07 is energized

Table 13. MR88R LED Functions (Continued)

LED	Label	Function
9	TX	Transmitting to subLAN
10	RX	Receiving from subLAN
D1	TEST	On (steady light) indicates self test passed, power applied to MR board. Constant flashes — Database problem in NOVRAM due to corruption. Possible software problem. Occurs initially when installed from the factory. Reinforce MR address and baud rate through DIP switch settings or I/STAT. 1 flash with a 2-second pause — RAM failure, processor faulty. 2 flashes with a 2-second pause — EPROM bad (checksum failure). 3 flashes with a 2-second pause — NOVRAM bad. Unable to clear NOVRAM.

MR632 Control Outputs

The MR632 provides three low-voltage triac outputs for 24 VAC at a maximum of 0.5 A (addresses 00, 01, and 02) and two 0–10 V analog outputs (addresses 03 and 04). The MR632 also provides a bank of ten LEDs (U1) to indicate specific output status, power/self-test status and communication states (see Figure 19). The functions of the MR632 LEDs are listed in Table 14.

Table 14. MR632 LED Functions

LED	Label	Function
1	1	Triac output at address 00 is energized
2	2	Triac output at address 01 is energized
3	3	Triac output at address 02 is energized
4	A4	AO-1 $^1/_4$ scale (MSB-1) (point 3)
5	A2	AO-1 $^1/_2$ scale (MSB)
6	B4	AO-2 $^1/_4$ scale (MSB-1) (point 4)
7	B2	AO-2 $^1/_2$ scale (MSB)
8	TST	On indicates power applied to the MR. Constant flashes — Database problem in NOVRAM due to corruption. Possible software problem. Occurs initially when installed from the factory. Reinforce MR address and baud rate through DIP switch settings or I/STAT. 1 flash with a 2-second pause — RAM failure, processor faulty. 2 flashes with a 2-second pause — EPROM bad (checksum failure). 3 flashes with a 2-second pause — NOVRAM bad. Unable to clear NOVRAM. Steady “on” — self-test passed, power applied to board.
9	TX	Transmitting to subLAN
10	RX	Receiving from subLAN
A2 and A4 are binary representation of the 0–10 V analog output of AO1, and B2 and B4 for AO2. For example, A2 and A4 off indicate that AO-1 has less than 2.5 V output. A4 on, A2 off indicates 2.5–5.0 V output. A4 off, A2 on indicates 5.0–7.5 V output. A2 and A4 on indicates 7.5–10 V output.		

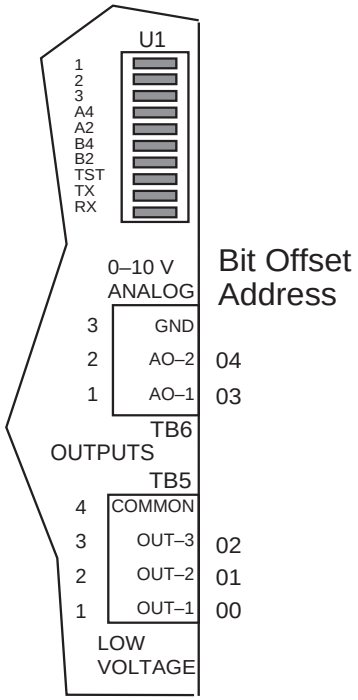

Figure 19. MR632 LEDs and Outputs

I/STAT Setup

For all micro regulator types except for the MR160, the I/STAT setup is done through the I/NET system MR parameters editor. The MR parameters editor allows you to control a Master Device point by pressing the On/Off button, or define and control a call feature by pressing the Call button on the I/STAT. You may also perform password-protected service functions such as address and baud rate changes, conversion coefficient changes (FM and FB) for all input points, display input values, display/control output values or display any module output in the connected MR.

When used with the MR160, only Service mode functions are provided. Note that these functions are not password-protected as they are with the other MR types.

LED Display

The three-digit, 7-segment LED display follows certain limitations due to its design. Numeric data is normalized to accommodate the displayed value. Any value above 99.9 is displayed without fractional digits. Values between 10 and 99.9 (inclusive) display with one fractional digit, and values below 10 display with two fractional digits.

When an operator error occurs during input, the contents of the display flash at 0.5-second intervals. The display reverts to non-flashing display when any key is pressed.

Information displayed by the LEDs depends upon the current mode of the I/STAT. Under the normal operations mode, the LEDs are interpreted as defined by operator input through the MR parameters editor. Under Call and Service modes, the LEDs display the currently-selected function information

I/STAT Functions

Other than the basic display and control features accessed through the Select buttons/LEDs on the I/STAT, there are three functions provided from the I/STAT keypad: On/Off, Call and Service.

On/Off

Note: *This function is not available with the MR160.*

This function controls the Master Device Control Point of the MR from the I/STAT. The point controlled is assigned through the MR parameters editor. The On/Off LED shows the current status of this function. When the On/Off key is pressed while the point is off, the point is controlled on, and an interval timer (assigned from the MR parameters editor) begins to count down. When the timer expires, the point and the LED are controlled off. If the interval timer is set to zero, the point and LED will be controlled on when the key is pressed and will remain on until the key is pressed again, or until the ATS off time occurs.

When the On/Off key is pressed while the point is on, the point and LED are controlled off. The command to turn the point off is actually delayed two seconds to allow a resumption of the interval timer without short-cycling the controlled equipment.

If an ATS extension has scheduled the point on, the first time the On/Off key is pressed the point and LED will be controlled off. The second time the key is pressed, it will turn the point and LED on.

Note: *If the interval timer expires before the ATS scheduled off time, the point will follow the ATS off time. If the interval timer expires after the scheduled ATS off time, the point will follow the interval timer off time.*

Call

Note: *This function is not available with the MR160.*

The Call function allows you to control a discrete point output, which must be assigned in the MR parameters editor. Pressing the Call button causes this point to toggle states. For advanced applications, attach an event definition (EV) extension to this point to enable event actions and event sequences.

Service

The Service function mode allows you to adjust parameters (MR address and subLAN speed). You may also calibrate the hardware coefficient parameters (factory-calibrated coefficients). Offset calibration (P1) allows you to adjust the analog input point's offset value (FB). Gain and offset calibration (P2) allows you to adjust both the offset value (FB) and gain value (FM) for any of the analog input points. The Point function allows you to display any input point or display/control any output point. The Module function works the same as the Point function, except that you can only display the output of the MR module.

Note: *The MR160 provides limited Service mode functions only. These functions are not password-protected as they are with the other MR types.*

Password

Note: *This function is not available with the MR160.*

After pressing Service, you must enter a numeric password that is set through the MR parameters editor in the I/NET system software. The default password is 000. The password is entered and displayed on the LED from left to right, one digit at a time. The I/STAT identifies the digit position you are entering by illuminating the accompanying decimal point. The LED displays 000 and you must press the Select arrow keys to display the desired number. Use the following steps to enter the password.

1. Press the Change (+ or –) keys until the desired number appears.
2. When the number displays, press the Enter [↵] key.
3. Repeat this procedure for each number.

The MR controller validates the password and enables the Select LED functions on the I/STAT. At this point, select the target function by pressing the Select up/down arrows. One of the four LEDs located on the lower right corner of the I/STAT illuminates as you press the up/down arrows. When the desired function LED illuminates press the Enter key. Change the displayed state or value, or the point parameter number, and again press the Enter key. The specific procedures for each adjustable parameter are listed in Table 15.

Table 15. I/STAT Target Service Function Selection

LED Position	LED	Function Type
1	Set Temp	Parameters
2	Fan Speed	Calibration
3	Room Temp	Point
4	Outside	Module

Note: *The I/STAT password may be created or modified using the I/NET system software.*

Parameters

The Parameters function allows modification of the MR controller address and the MRI/MCI/MR subLAN communications speed.

Table 16. Parameters Selection

Parameter Number	Parameter	Selection Number	Selection
P1	MR Controller Address	None	PP portion of LLSSPPBB address
P2	SubLAN Speed	1.2	1200 baud
		2.4	2400 baud
		4.8	4800 baud
		9.6	9600 baud *
* 9600 baud is currently the **only** supported baud rate			

Note: *The I/STAT can be used to override the MR address and baud rate at any time. However, if dip switch S1-8 is placed in the* **OFF** *position, any address or baud rate entered with the I/STAT will be overwritten with the DIP switch settings at the next power cycle.*

Caution: *Exercise caution when inspecting or changing the MR address/baud rate from the I/STAT. If the I/STAT Enter button is pressed while the new (or current) MR address/baud rate is displayed, the MR address/baud rate will be changed (or re-enforced)* ***and all previously-entered MR database information will be erased****. This is true even if the current address/baud rate is not changed. To inspect the current MR address or baud rate without erasing any existing MR information, use the I/STAT Service button when exiting the I/STAT Service mode.*

1. Press the Service key.
2. Enter the numeric password by using the Change + or – keys and then Enter key. The prompt SEL appears.
3. Select the function type by pressing the Select up or down arrow keys until the Set Temp LED is lighted.
4. Press the Enter key. P1 displays in the LED (see Table 16).
5. Use the Select keys to switch between P1 (address) and P2 (baud rate).

MR Address – Use the following steps to set the MR's subLAN address.

1. To select or change the MR address, select P1 and press the Enter key. The current MR address appears in the LED display.
2. Change the address by pressing the Change + or – keys until the desired selection appears in the LED display.
3. Press the Enter key to accept the displayed address.
4. The I/STAT returns control of the keypad and displays the initial P1 selection.

Note: *The MR160 is a 2-station device, requiring two addresses.*

MR Baud Rate – Use the following steps to set the MR's baud rate (data transfer speed).

1. To display or set the MR baud rate, select P2 and press the Enter key. The current baud rate appears in the LED display

Note: *The current release of the MRs supports* ***only*** *9600 baud.*

2. Change the baud rate by pressing the Change + or – keys until the desired baud rate appears in the LED display.
3. Press the Enter key to accept the displayed baud rate.
4. The I/STAT returns control of the keypad and displays the initial P2 selection.

Calibration

This function allows you to change the factory calibrated M and B coefficients (FM and FB). There are two calibration procedures: adjust offset (FB), and adjust gain (FM) and offset (FB).

Table 17. Calibration Selection

Calibration Number	Calibration Function
P1	Adjust Offset
P2	Adjust Gain and Offset

Caution: *Use of the recalibration functions is not recommended for those persons that have **not** received factory training on the process and associated instructions.*

Offset Calibration Procedure – The offset calibration procedure (P1) allows you to adjust the offset value for each of the available input points. To perform this function with the I/STAT, use the following steps.

1. Press the Service key.
2. Enter the numeric password by using the Change +/– keys and then Enter key. The prompt SEL appears.
3. Select the function type by pressing the Select up/down arrow keys until the Fan Speed LED lights.
4. Press the Enter key.
5. Select offset calibration by pressing the Enter key when P1 displays (see Table 17). The LEDs will display P0 for bit address 00.
6. Select the value of the offset bit (BB portion of the LLSSPPBB address) that you wish to calibrate (0–7) by pressing the Select (up or down) keys until the desired bit offset appears in the LED.
7. Press the Enter key to accept the selection. The LEDs display the calibrated Adjusted A/D counts for the selected input point.
8. Press the Change keys (+/–) until the desired reading appears in the LED. Each time you press a change key the value will change by one (i.e., pressing the + key three times increases the current FB parameter by three).
9. Press the Enter key to accept the displayed value.
10. FB is calculated automatically. The I/STAT returns control of the keypad displaying the original BB number selected.
11. Repeat Steps 6 9 until all FB coefficients are entered for the desired points.
12. Press the Service key to escape from the function.

Gain and Offset Calibration Procedure – The gain and offset calibration procedure (P2) allows you to adjust the gain and offset values for each of the available input points. This procedure requires that the offset values be adjusted at two separate points on the sensor's curve, at least 10% apart with 50% preferred. This allows the system to automatically perform the necessary calculations.

Caution: *Use this procedure **only** when you have the ability to control the process variable, or you are calibrating the MR to a specified transducer voltage output that can be simulated with a variable power supply.*

Note: *The difference between the two adjustment points must be at least 10% of the span. The I/STAT will indicate an error condition (flashing LED) if this criteria is not met.*

1. Press the Service key.
2. Enter the numeric password by using the Change +/– keys and then Enter key. The prompt SEL appears.
3. Select the function type by pressing the Select up/down arrow keys until the Fan Speed LED lights.
4. Press the Enter key.
5. Select gain and offset calibration by pressing the Select key until P2 displays (see Table 17).
6. Press the Enter key to accept the function. The LEDs will display P0.
7. Select the value of the offset bit (BB portion of the LLSSPPBB address) that you wish to calibrate (0–7) by pressing the Select (up or down) keys until the desired point's bit offset appears in the LED.
8. Press the Enter key to accept the selected offset point. The selected point's Adjusted A/D count value displays in the LED.
9. Press the Change +/– keys until the respective sensor input is driven to the low end of the applicable span.
10. Press the Enter key to accept the displayed value.
11. Drive the selected process variable to the high end of the applicable span. This must be at least 10% above the low end, with a 50% increase preferred.
12. Press the Change +/– keys until the correct value is displayed in the LED.
13. Press the Enter key to accept the displayed value.
14. FM and FB are calculated automatically. The I/STAT returns control of the keypad displaying the original bit offset selection.
15. Repeat Steps 7 13 until all FM and FB coefficients are set for the desired points.
16. Press the Service key to escape from the function.

Point

At times you may want to display the current status of a point or control an output point. Using the I/STAT keyboard, follow the steps shown below.

1. Press the Service key.
2. Enter the numeric password by using the Change (+ or –) keys, then press the Enter key.
3. Press the up/down Select arrows until the Room Temp LED lights, then press the Enter key. The LEDs will display the output points designated PC0 through PC09, and the input points as P0 through P9.

Note: *You may want to download the controller with all possible input (AI) and output (DO) points before installation in order to provide engineering unit display of the AI. Check-out of DO points may be easier without an application program downloaded. When you plan to use the I/STAT to control outputs for equipment/wiring checkout, ensure that you do* ***not*** *direct any DDC modules to the outputs, as these are not subject to I/STAT control.*

4. Select the point to be displayed or controlled using the Select up/down arrow keys.

Note: *The first point is displayed when the function is invoked. The LED display precedes the bit offset number (BB) with a C for control output points. Control output points will be displayed before an input point with the same bit offset.*

The I/STAT displays the current state/value of the point. The display is updated at a one-second scan rate.

5. Change the state/value by pressing the Change + or – keys.

Note: *Input points are for display only.*

6. Accept the changed state/value by pressing the Enter key. The I/STAT returns control to you and displays the original point selected.
7. Repeat Steps 4 6 as desired.

Module

Note: *This function is not available with the MR160.*

The Module function allows you to display the outputs of all 16 modules in an MR. In each case, except for Float modules, the current output is displayed. Float always displays zero (0). Use the following procedure to display modules.

1. Press the Service key.
2. Enter the numeric password by using the Change (+ or –) keys, then press the Enter key.
3. Press the up/down Select arrows until the Outside LED lights, then press the Enter key.
4. Select the module (P1–P16) to be displayed using the Select up/down arrow keys.

Note: *Only the modules defined in the database are displayed when the function is invoked.*

The I/STAT displays the current state/value of the modules output. The module output display is refreshed at a one-second scan rate.

5. Pressing the Enter key returns control to you and displays the original module selected.
6. Repeat Steps 4 5 as desired.

Point Address and Switch Summary

All base board addresses begin with 00 (BB, bit offset). Addresses labeled below as internal will be used only as internal points (they do not have an external hardware point associated with them). Points labeled below as external can be defined as external (hardware) points or internal (software) points.

Inputs

There are a total of 10 input point addresses available on each of the MR88, MR88R, and MR632 controllers. The MR160 controller has a total of 20 input point addresses (10 for each address).

Table 18. Input Point Address

Location	Point Type	Number of Points	Point Address
MR88	External AI / DI / PI / Thermistor	**7**	**00–06**
	Thermistor / I/STAT	**1**	**07**
	Internal / Indirect only	**2**	**08–09**
MR88R	External AI / DI / PI / Thermistor	**7**	**00–06**
	Thermistor / I/STAT	**1**	**07**
	Internal / Indirect only	**2**	**08–09**
MR160 (base subLAN address)	External AI / DI / PI / Thermistor	**8**	**00–07**
	Internal only	**2**	**08–09**
MR160 (second subLAN address)	External AI / DI / PI / Thermistor	**7**	**00–06**
	Thermistor / I/STAT (limited functions)	**1**	**07**
	Internal / Indirect only	**2**	**08–09**
MR632	External AI / DI / PI / Thermistor	**5**	**00–04**
	Thermistor / I/STAT	**1**	**07**
	Internal / Indirect only	**4**	**05–06, 08–09**
Input points may be defined as AI, DI, or PI. Only one type can be defined for a specific point.			
Note: The MR160 occupies two consecutive subLAN addresses. For example, an MR160 with the subLAN set for address 9 will use addresses 9 and 10. No other controller could have address 9 or 10.			

Outputs

There are 10 output point addresses available through the MR88, MR88R, and MR632. The MR160 has no output points.

Table 19. Output Point Addresses

	Location	Point Type	Number of Points	Address
MR88	Base Hardware	External DO/PWM	8	00–07
		Internal only	2	08, 09
MR88R	Base Hardware	External DO/PWM Form-C relay	8	00–07
		Internal	2	08, 09
MR632	Base Hardware	External DO/PWM AO	3 2	00–02 03, 04
		Internal Only	5	05–09
External output points may be defined as DO or PWM but not as both.				

DIP Switch Settings

DIP Switch S1 controls the subLAN address of the controller. It also controls the setting of the subLAN communication speed.

Table 20. MR Addressing Switch Values

Switch Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Switch Function	**LAN Address**					**Baud Rate**		**I/STAT Override**
Switch Values	1	2	4	8	16	9600 baud		On = I/STAT Override
Switch Setting						On	On	
SW8 Off = No I/STAT override (switches 1–7 active). SW8 On = I/STAT override of DIP switch in use (switches 1–7 inactive).								

Note: *DIP S1 switch SW8* ***must*** *be set to the On position for the I/STAT to control the address and baud rate of the MR. SW8 tells the MR to ignore switches 1–7 on DIP S1. Failing to have SW8 set to the On position will cause the switch settings to be activated at the next power cycle.*

Pinout Chart

MR88

Location: _____
Station Address: _____
Point Address: _____

Input	Terminal Block	Point Type/ Address	Point Description
	TB4-1	AI/DI/PI 00	
	TB4-2	AI/DI/PI 01	
	TB4-3	AI/DI/PI 02	
	TB4-4	AI/DI/PI 03	
	TB4-5	AI/DI/PI 04	
	TB4-6	AI/DI/PI 05	
	TB4-7	AI/DI/PI 06	
	TB4-8	Not used	
	TB4-9	+24 Volt	
	TB4-10	Ground	

0utput	Terminal Block	Point Type/ Address	Point Description
	TB5-1 (24VAC)	DO/PWM 00	
	TB5-2 (24VAC)	DO/PWM 01	
	TB5-3 (24VAC)	DO/PWM 02	
	TB5-4 (24VAC)	DO/PWM 03	
	TB5-5 (24VAC)	DO/PWM 04	
	TB5-6 (24VAC)	DO/PWM 05	
	TB5-7 (24VAC)	DO/PWM 06	
	TB5-8 (24VAC)	DO/PWM 07	
	TB5-9	Ground	
	TB5-10	Ground	

MR88R

Location: _____
Station Address: _____
Point Address: _____

Input	Terminal Block	Point Type/ Address	Point Description
	TB4-1	AI/DI/PI 00	
	TB4-2	AI/DI/PI 01	
	TB4-3	AI/DI/PI 02	
	TB4-4	AI/DI/PI 03	
	TB4-5	AI/DI/PI 04	
	TB4-6	AI/DI/PI 05	
	TB4-7	AI/DI/PI 06	
	TB4-8	Not used	
	TB4-9	+ 24 Volt	
	TB4-10	Ground	

0utput	Terminal Block	Point Type/ Address	Point Description
	TB5-1	NO 1	
	TB5-2	COM OUT 1	
	TB5-3	NC 1	
	TB5-4	NO 2	
	TB5-5	COM OUT 2	
	TB5-6	NC 2	
	TB5-7	NO 3	
	TB5-8	COM OUT 3	
	TB5-9	NC 3	
	TB5-10	NO 4	
	TB5-11	COM OUT 4	
	TB5-12	NC 4	
	TB6-1	NO 5	
	TB6-2	COM OUT 5	
	TB6-3	NC 5	
	TB6-4	NO 6	
	TB6-5	COM OUT 6	
	TB6-6	NC 6	
	TB6-7	NO 7	
	TB6-8	COM OUT 7	
	TB6-9	NC 7	
	TB6-10	NO 8	
	TB6-11	COM OUT 8	
	TB6-12	NC 8	

MR160

Location: _____
Station Address: _____
Point Address: _____

Inputs	Terminal Block	Point Type/Address (First MR Address)	Point Description
	TB5-1	AI/DI/PI 00	_____
	TB5-2	AI/DI/PI 01	_____
	TB5-3	AI/DI/PI 02	_____
	TB5-4	AI/DI/PI 03	_____
	TB5-5	AI/DI/PI 04	_____
	TB5-6	AI/DI/PI 05	_____
	TB5-7	AI/DI/PI 06	_____
	TB5-8	AI/DI/PI 07	_____
	TB5-9	+24 Volt	
	TB5-10	Ground	
		(Second MR Address)	
	TB6-1	AI/DI/PI 00	_____
	TB6-2	AI/DI/PI 01	_____
	TB6-3	AI/DI/PI 02	_____
	TB6-4	AI/DI/PI 03	_____
	TB6-5	AI/DI/PI 04	_____
	TB6-6	AI/DI/PI 05	_____
	TB6-7	AI/DI/PI 06	_____
	TB6-8	Not used	
	TB6-9	+ 24 Volt	
	TB6-10	Ground	

MR632

Location: _____
Station Address: _____
Point Address: _____

Input	Terminal Block	Point Type/ Address	Point Description
	TB4-1	AI/DI/PI 00	
	TB4-2	AI/DI/PI 01	
	TB4-3	AI/DI/PI 02	
	TB4-4	AI/DI/PI 03	
	TB4-5	AI/DI/PI 04	
	TB4-6	Not used	
	TB4-7	+24 VDC	
	TB4-8	Ground	

0utput	Terminal Block	Point Type/ Address	Point Description
	TB5-1 (24 VAC)	DO/PWM 00	
	TB5-2 (24 VAC)	DO/PWM 01	
	TB5-3 (24 VAC)	DO/PWM 02	
	TB5-4 (ground)		
	TB6-1	0–10 V/AO 03	
	TB6-2	0–10 V/AO 04	
	TB6-3 (ground)		

Specifications

Dimensions

I/STAT . . . . . 2.75" W × 4.5" H × 0.9" D
. . . . . (6.99 × 11.43 × 2.29 cm)

MR Controllers:
PCB . . . . . 4.0" W × 7.0" H (10.16 × 17.78 cm)
Baseplate . . . . . 5.5" W × 8.5" H (13.97 × 21.59 cm)

Operating Environment

Temperature . . . . . 32–122° F (0–50° C)

Humidity . . . . . 10% to 90%, noncondensing

Input power . . . . . 24 VAC @ 7 VA + output triac load

Micro Regulator 88, 88R, 160, and 632 Inputs

Universal analog inputs:

Quantity
MR88. 7
MR88R 7
MR160 15
MR632 5

Range . . . . . 0–5 V selectable to 2–4 V
. . . . . .0–10 V selectable to 4–8 V
. . . . . 0–20 mA selectable to 8–16 mA
. . . . . 10K ohm thermistor (NTC)

Resolution 0.4%

Accuracy . . . . . .1.0% (0–5 V)
. . . . . 2.0% (0–10 V, 0–20 mA, thermistor)

Discrete contact inputs:

Contact excitation . . . . . 5 V @ 5 mA
Pulse input rate . . . . . 4 Hz maximum
Input duration . . . . . 100 msec minimum

MR88 Outputs

Quantity 8

Type . . . . . .low-voltage triac, voltage sourcing
. . . . . 24 VAC @ 0.5 A each (2 A maximum)

Operating Modes . . . . .Latched or PWM Proportional

External 24 V supply output (on input terminal TB4)
. . . . . .Unregulated 22–36 V
. . . . . 100 mA maximum load

MR88R Outputs

Quantity 8

Type . . . . . .low-voltage form-C relay
. . . . . 24 VAC/DC @ 0.5 A maximum

External 24 V supply output (on input terminal TB4)
. . . . . .Unregulated 22–36 V
. . . . . 100 mA maximum load

MR160 Outputs

External 24 V supply output (on input terminal TB4)
. . . . . .Unregulated 22–36 V
. . . . . 100 mA maximum load

MR632 Outputs

Low-voltage triac (voltage sourcing):
Quantity 3
Type . . . . . 24 VAC @ 0.5 A each

Analog::
Quantity 2
Operating Modes. . . . . Analog and Latched
Type . . . . . 0–10 V @ 10 mA

External 24 V supply output (on input terminal TB4)
. . . . . .Unregulated 22–36 V
. . . . . 100 mA maximum load

SubLAN Port

Protocol . . . . . Asynchronous, polling, RS485

Baud rate. . . . . 9,600 baud

Cables

subLAN: 22 AWG (0.324 mm^2) shielded, twisted pair (Belden 9184) 5,000' (1,500 m) maximum
or
24 AWG (0.206 mm^2) shielded, twisted pair (Belden 9841) 4,000' (1,200 m) maximum per segment

I/STAT: 18–24 AWG (0.206–0.897 mm^2) three conductor cable, 100' (30 m) maximum from the MR
or
22 AWG (0.324 mm^2 or Belden 9184) shielded, twisted pair cable (recommended for electrically noisy environments), 100' (30 m) maximum from the MR

Universal Enclosure

Model ENCL1813

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Warranty

Repair or Replacement

If this unit fails to operate because of a defect in materials or workmanship within two (2) years of the date you purchased it, it will either be repaired or replaced by Control Systems International, Inc. (CSI) at no charge to you. Before contacting CSI, it is recommended that you first contact the dealer from whom you purchased this equipment to determine whether they will have it repaired or replaced. If the dealer will not, please contact CSI to arrange to have this equipment repaired or replaced.

CSI EXPRESSLY RESERVES THE RIGHT TO REPAIR OR REPLACE THIS EQUIPMENT WITH NEW OR REFURBISHED PARTS OR EQUIPMENT.

Exclusions and Limitations

Your warranty does not cover:

- Damage by negligence, misuse, or accident
- Compatibility with the equipment of any other manufacturer
- Modifications to the equipment to make it compatible with the equipment of any other manufacturer
- Damage to the equipment resulting from improper installation or operation.

Legal Rights and Limits

All applicable implied warranties, including the implied warranty of merchantability and of fitness for a particular purpose given to you by law are hereby limited in durability to the duration of this warranty. Under no circumstances will CSI be liable for any incidental or consequential damages.

Some states in the U.S.A. do not allow limitations on how long implied warranties last, or exclusions or limitations of incidental or consequential damages, so exclusions or limitations mentioned may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Purchaser's Responsibility

In order to obtain service under this warranty, you must deliver the equipment to the place of purchase or to CSI and provide proof of the original purchase date along with the returned equipment. Failure to provide adequate proof of the original purchase date could result in denial of warranty service.

Out of Warranty Service

Direct requests for information on out-of-warranty service to Product Service Manager at the address below.

P.O. Box 59469, Dallas, Tx 75229
Phone: (972) 323-1111
FAX Phone: (972) 242-0026

CSI Europe
Unit B3, Armstrong Mall
Southwood, Farnborough
Hampshire GU14 ONR, United Kingdom
Phone: 44 1252 370900
FAX Phone: 44 1252 372470

CSI Pacific
36 Hasler Rd.
Osborne Park, Western Australia 6017
Phone: 61-9-244 2799
FAX Phone: 61-9-244 4335

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