TAC I/NET

Installation/Reference Guide

Application Specific Controller

MR-HP

for TAC I/NET Building Automation Systems

Schneider Electric

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On October 1st, 2009, TAC became the Buildings business of its parent company Schneider Electric. This document reflects the visual identity of Schneider Electric; however, there remains references to TAC as a corporate brand in the body copy. As each document is updated, the body copy will be changed to reflect appropriate corporate brand changes.

Contents

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 Schneider Electric for additional suggestions.

Overview

The MR-HP controller is a member of a family of Application Specific Controllers (ASCs). The intention of the design is to reduce "total install cost" through pre-engineered control algorithms and simplified installation requirements. This installation/reference guide will cover the four key elements of the ASC.

- Hardware Description — A description of the application of the MR-HP.
- Functional Design — A description of the control sequences, algorithms and point database.
- Installation — A step by step description of the installation of the MR-HP and its associated hardware.
- Unit Setup — A description of the parameters used in configuring and commissioning the MR-HP.

Hardware Description

The MR-HP controller provides sufficient applications flexibility to address multiple heat pump (HP)configurations. It is designed to operate in a stand-alone configuration or, with the support of a communications network, as an integral part of a comprehensive building automation system.

It offers the following features:

- Plug-on terminals for a thermostat, communications, power, and four external inputs.
- Plug-on terminals for six external outputs.
- A 12-position DIP switch for setting up initial application/equipment configurations.
- Indicator lamps for output status, communications, power, and self-test.

The following paragraphs provide a brief description of each of the hardware components of the MR-HP.

Controller

The MR-HP is packaged in a plastic enclosure with a snap-on cover. The enclosure is rated UL 94-V0. The controller measures 4.3” W × 8” H × 2.5” D (11.0 × 20.3 × 6.4 cm). The screw holes are 3.75” × 7.5” (9.5 × 19.1 cm) as shown in Figure 1. The enclosure meets Nema 1 requirements and is rated for use in plenum applications.

All I/O connections are accomplished through plug-on terminal blocks located on the left and right side of the controller housing. The terminal blocks for power, communications, a space temperature sensor, and four external input connections are located along the left side of the unit; those for output connections, together with the 12-position DIP switch, are located along the right side. Located between the output terminal block and the DIP switches is a bank of LED’s, which are used to indicate communications activity and output point status. An individual LED indicates power, and if the power up self-test fails, this LED flashes.

Power

Electrical power is accomplished through a two-position terminal block, labeled TB1, on the upper left side of the controller. The controller should be connected to a single 24 VAC Class-2 power source, which will power the controller electronics and its outputs (7 VA for the controller alone, up to 55 VA maximum for controller and outputs).

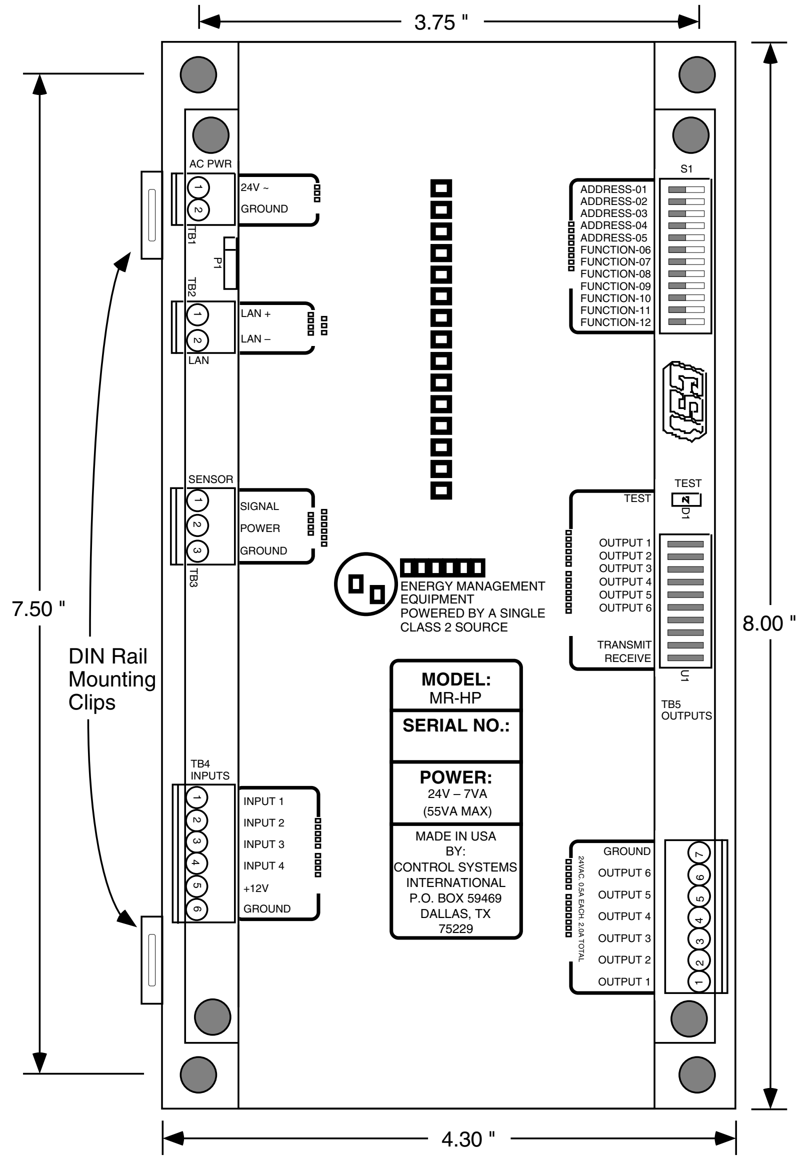

Figure 1. MR-HP (Cover Installed)

Communications

The MR-HP supports one communications port, labeled TB2, located on the left side of the controller. The electrical interface, which conforms to the RS485 standard, will operate over a single twisted-pair shielded of 22- or 24-AWG low-capacitance cable for distances up to 5,000 feet (1,500 meters).

The same communications cable will support a combination of 32 other Application Specific Controllers (ASCs), MicroRegulators (MRs) and Door Processing Units (DPUs), connected together in a “multi-dropped” arrangement, as illustrated in Figure 2. The cable should be run in a contiguous node-to-node arrangement without stubs or branches.

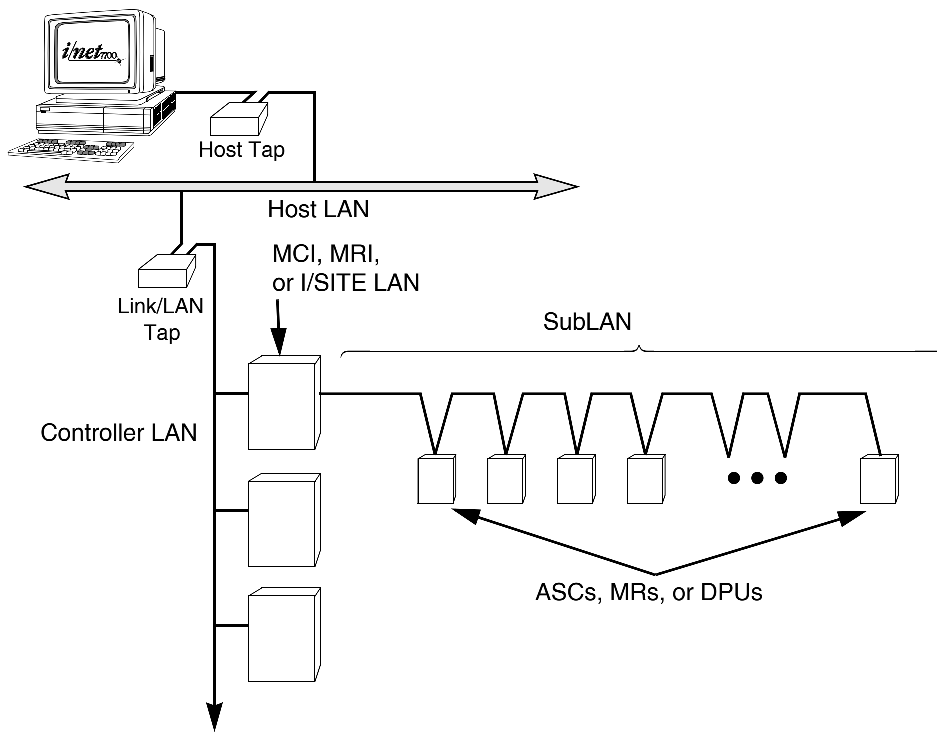

Figure 2. Typical ASC LAN Connection

Thermostat

The thermostat connection is provided through a three-position terminal block, labeled TB3, on the left side of the controller. There are three functional levels of thermostat that can be connected to the MR-HP, as follows:

- ✦ Intelligent thermostat (I/STAT) — described below.
- ✦ Thermostat with slide adjustment (S/STAT) — described below
- ✦ Thermistor temperature sensor (W/STAT) — described below
- ✦ Thermistor temperature sensor — described below

I/STAT

The I/STAT is packaged in a small plastic enclosure measuring 4.5” L × 2.75” W × 0.9” D (11.0 cm × 7.0 cm × 2.0 cm) as shown in Figure 3. Three 7-segment LEDs are located at the top, eight push-buttons and four discrete LEDs along the right side, and a space temperature sensor on the inside.

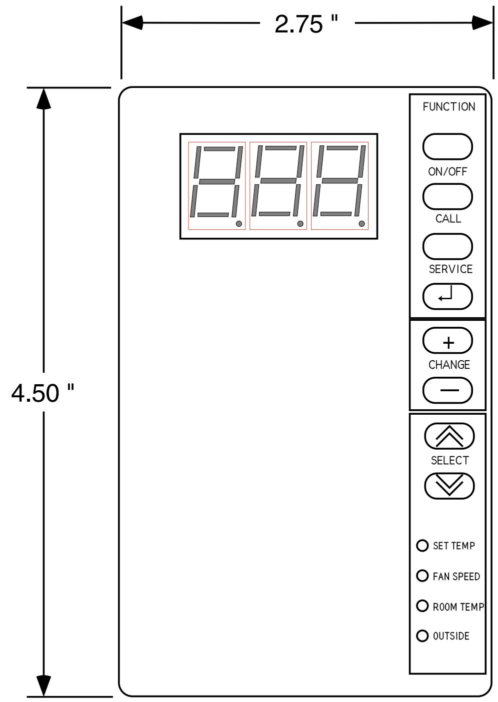

Figure 3. I/STAT

Note: *There is also a maintenance version of the I/STAT, called the M/STAT, that is functionally equivalent to the I/STAT but is equipped with a three foot interface cable so that it can be used as a portable maintenance tool. The S/STAT and W/STAT both contain maintenance ports for connection of an M/STAT.*

Three-Digit Display

The three-digit, seven-segment LED, display is used for both numeric and alphabetic data. Numeric data is normalized to accommodate each displayed value: values from 0.00 to 9.99 display with two fractional digits, values from 10.0 to 99.9 with one fractional digit, values of 100 or greater with no fractional digits, and values greater than 999 as --- (to indicate overflow).

The display of alphabetic data, normally parameter names, is quite primitive due to the limitations imposed by the seven-segment display. The seven LED segments consist of three horizontal segments (top, center, and bottom) and four vertical segments (upper left, upper right, lower left, and lower right). Generally, when it is necessary to display alphabetic data, the three positions will contain the first letters of the words that represent the data (for example, “Calibrate Space Sensor” would be represented by the three letters CSS). So the first challenge is to remember what the three letters stand for. But a second challenge is to interpret the characters that are displayed. They are often a combination of upper and lower case; and sometimes only vaguely resemble the character they are supposed to represent. (For example, there is no way to form a capital “N” in seven segments, so anytime an N is required, it is displayed as an upside-down, lower-case, “u,” which turns “Night SetUp” into either nSU or nSu - we chose nSU).

This is obviously not a very friendly interface, but the alternative was to represent the parameters by numbers. We thought you would prefer the names, even if interpreting them is a dual challenge.

Push-buttons

The eight push-buttons, arrayed along the right-hand side, are organized into three groups: Function, Change, and Select. The first group initiates all of the dialogue between you and the controller (refer to “I/STAT (M/STAT) Dialogue” on page 43). Although the details of each function will be described later, the following will give you an idea of what they do:

- On/Off — switches the controller from an unoccupied mode of operation to an occupied mode. Generally, the effect is to raise or lower the space temperature setpoint to what it would be under normal occupied (day time) conditions.
- Call — provides a tenant with the means for notifying maintenance personnel when there is a problem in the controlled space. This capability is setup by logically connecting the Call key to a discrete output point within the ASC. The operator must configure a free point for this purpose and populate the MR Parameters editor to enable this feature.
- Service — the Service key is designed for use by installation and maintenance personnel. The functions that it initiates are the subject of most of this Guide. While in the Service mode, the Service key can be used in the same manner as an escape key on a PC. For example: after making changes to a parameter data field, pressing the Service key will abort the changes made.

  After entering the correct password, the Service key will produce a menu of options, for selection (refer to “I/STAT (M/STAT) Dialogue” on page 43), as follows:

  - UP (Unit Parameters) — allows the system installer/technician to match the MR-HP control program to the HP equipment configuration. These parameters are typically entered once, during the installation phase of the project. The parameter details are provided in “Unit Parameters (UP)” on page 43.
  - oP (Operational Parameters) — allows the facilities manager to review and set ASC parameters, such as heating and cooling setpoints, that typically change from day to day based on the occupants of the space, the seasons, and so on. The parameter details are provided in “Operational Parameters (oP)” on page 46.
  - SSU (Switch Setup) — allows the installation contractor/Engineer to override the MR-HP DIP switches from an I/STAT or M/STAT. Although it doesn't happen often, this function is extremely useful when you must override the switch settings. (For example, it is not uncommon for a the facility to operate in one mode during construction, and another when the tenants arrive). The parameter details are provided in “Switch Setup Parameters (SSU)” on page 50.
  - Pnt (Point Display) — allows the maintenance engineer, and/or facilities manager, to display and control the values of points in the ASC. The dialogue details are provided in “I/STAT (M/STAT) Dialogue” on page 39.
- Enter — the Enter key [↵] serves the same purpose as the Enter key on a PC. It is used to select parameters for editing and, thereafter, for the entry of data.

The second group, the Change [+/–] keys, allow the operator to increase or decrease the value shown on the seven-segment display. These keys work in a number of different ways.

- Use these keys to increment and decrement the SET TEMP value by the amount defined in the MR Parameter editor at a TAC I/NET host PC.
- Use these keys to increment and decrement individual digits of a displayed parameter.

The top three LEDs, of the four that are located on the lower right portion of the I/STAT, indicate which digit is selected. If the top LED is illuminated, the right most digit is selected. If the second LED is illuminated the center digit is selected. If the third LED is illuminated, the left most digit is selected.

The third group, the Select keys, perform different actions, depending on the contents and state of the display, as follows:

- LED selection — if the I/STAT is not in the service mode, pressing the [↓], or [↑] key, will select the next lower, or higher, LED. The value corresponding to the illuminated LED legend will be displayed in the three-digit display.
- Parameter selection — if the display contains one of the parameters, from a menu of parameters, pressing the [↓] or [↑] key, will select the next, or previous, parameter.
- Digit selection — if the display contains a data value, pressing the [↓] or [↑] key, will select the next digit to the right, or to the left, for adjustment with the change keys.

LEDs

The four LEDs on the lower right portion of the I/STAT have different meanings, depending on where you are in the dialogue, as follows:

- Normal mode — if the service key has not been pressed, the LEDs indicate which value, from the four values indicated on the legends next to each LED, is being displayed.
- Service mode — if the service key has been pressed, the LEDs are only used for digit selection and decimal point alignment, as described above.
- Prove Performance — if the MR-HP is in the Prove Performance mode, the LEDs will indicate the current status of output points as described in “Prove Performance” on page 55.

S/STAT

The S/STAT is packaged in a small plastic enclosure measuring 4.5” L × 2.75” W × 0.9” D (11.0 × 7.0 × 2.0 cm) suitable for wall mounting on a standard 2” × 4” handi box. The S/STAT can also be mounted on a European wall box or flat surface. The S/STAT is shown in Figure 4.

Timed-override Push-button

The Timed-override push-button is used to activate the timed override function of the MR-HP, in the same manner as the On/Off button on the I/STAT.

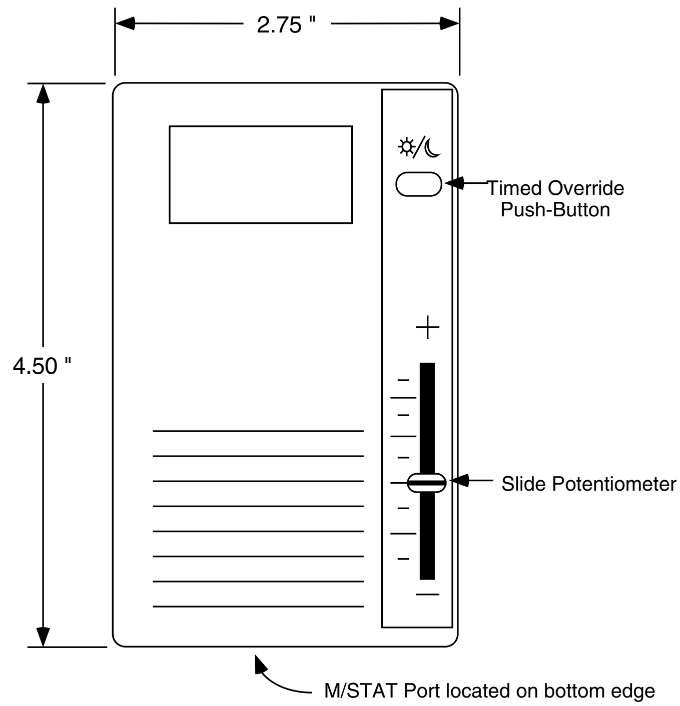

Figure 4. S/STAT

Slide Potentiometer

The Slide Potentiometer is used to adjust the temperature setpoint for the controlled space. The adjustment, which can be positive or negative, is limited by the “STAT Adjustment Range (SAr)” parameter (refer to “STAT Adjustment Range” on page 48 for details).

Maintenance Port

The S/STAT contains a maintenance port, on the bottom surface, for the connection of an M/STAT. While connected, the M/STAT can be used to program the MR-HP in the same manner as an I/STAT.

W/STAT

The W/STAT is packaged in a small plastic enclosure measuring 4.5" L × 2.75" W × 0.9" D (11.0 cm × 7.0 cm × 2.0 cm) suitable for wall mounting on a standard 2" × 4" handi box. The W/STAT can also be mounted on a European wall box or flat surface. The W/STAT, shown in Figure 5, is similar to the S/STAT, although the W/STAT does not have a timed override push-button or a slide potentiometer. The W/STAT consists of a thermistor input and a maintenance port.

Maintenance Port

The W/STAT contains a maintenance port on its bottom surface, allowing the connection of an M/STAT. Connecting an M/STAT allows you to function as though you were connected to the MR-HP with an I/STAT.

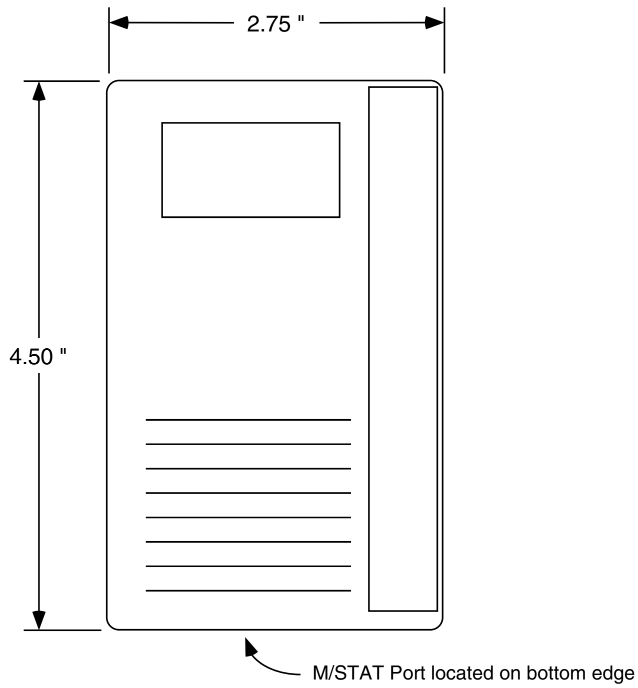

Figure 5. W/STAT

Thermistor

A thermistor can be connected to the I/STAT port of the MR-HP. However the operator will be unable to perform any programming from the STAT.

External Inputs

The MR-HP provides four External inputs, labeled TB4, located along the left side. The inputs may be connected to such devices as a duct temperature sensor or contact, common equipment shutdown contacts (smoke, fire, etc.), occupancy sensor or contact, and so on.

The configuration of the board is the same for discrete and analog inputs. The input termination pin provides +5VDC for dry contacts, thermistors, or other resistive devices. The current is low enough that the +5VDC can be overridden by a self-power analog transmitter.

- Discrete — This point type will reflect the condition of a single dry contact, with state descriptions that match the contact status. A closed contact will drive the corresponding point's state to, "1" an open contact will drive it to "0."
- Analog — The conversion coefficient of this point type will convert the analog value on the input to engineering units for display. For example, a conversion coefficient of m = 1, B = 0 will yield engineering units of 0 for a short from the input to ground, and 255 for an open circuit the input pin and to ground.

The MR-HP contains pre-defined state descriptions and conversion coefficients for the pre-defined inputs. Once connected to the MCI, you can modify or define new station parameters as desired for points that are not required for the application (free points).

External Outputs

The MR-HP provides six external hardware outputs, labeled TB5, located along the right side. The outputs are driven by optically-isolated triacs, which provides 24 VAC power to the controlled device. Each output can be one of the following:

- Discrete — a single triac is connected to a discrete actuator, or an interposing relay. The triac can be energized or de-energized to control the actuator or relay. This output “sense” is determined by the “Control Command” pair that is assigned to the Discrete Output (DO) point. (Refer to the chapter dealing with controller configuration in the *TAC I/NET Operator Guide* for details.)
- Pulse Width Modulation (1-Out-PWM) — a single triac output is connected to the PWM input. The MR-HP software controls the PWM actuator by energizing the triac for a period of time that is proportional to the desired analog value. CSI offers PWM devices for a variety of applications.
- Bidirectional motor (2-Out-PWM) — two triac outputs are connected to the increase and decrease inputs to the motor. The software controls the bidirectional actuator by energizing the appropriate triac (either increase or decrease) for a period of time that is proportional to the desired change in that direction, in the same manner as the 1-Out-PWM.
- Time Proportioning actuator (1-Out-Cycle) — a single triac is connected to the Time Proportioning actuator input. (This type of actuator control will be referred to as Duty Cycle control through the remainder of this document.) The software cycles the Duty Cycle actuator, based on the time period of the actuator, typically in the order of minutes. The triac is energized for the On portion of the cycle, and de-energized for the Off portion. For example: with a ten minute period, an analog value equal to 20% of the analog span would cause the triac to be energized for two minutes and de-energized for eight (a 20% duty cycle).

DIP Switches

A group of 12 DIP switches are located along the right side of the controller. The first five switches determine the MR-HP address on the MCI SubLAN. The remaining seven switches are used to establish the application and equipment configuration.

The ON position of each switch is in the direction of the numbers labeling each individual switch. The OFF position is in the direction of the “Open” label on the DIP switch base.

Indicator Lamps

The MR-HP provides a bank of LEDs to indicate LAN transmit and receive, and output point status. A single LED provides for self test/power indication. These LEDs are located along the right side of the MR-HP (see Figure 1).

The self-test LED is illuminated, and remains that way, when the MR-HP successfully passes a self-test upon power up. If the power-up self-test fails, all outputs are de-energized and the self-test LED flashes at one-half second intervals.

The LED bank contains ten independent LEDs. The first 6 indicate the status of the outputs 1 through 6. LEDs 7 and 8 are not supported on this platform. The last two LEDs indicate transmit and receive activity on the MR subLAN. The TX LED is illuminated whenever the MR-HP is transmitting data, and the RX whenever it is receiving data. Note that the MR-HP does not respond each time it receives data, which is the reason that there is much more activity on the RX LED than on the TX. The RX LED will only be active when the MR-HP is installed on a subLAN with an MCI poling the MRs. The TX LED will only be active if the MR-HP is configured to communicate using the MR-HP configuration.

Functional Description

Design Objectives

The MR-HP software was designed to satisfy the following functional objectives:

- ✦ Reduce the total installed cost of the MR-HP to a competitive level.
- ✦ Provide a point database and communications protocol that is compatible with the MicroRegulator (MR) product family, so that MR-HP controllers can be integrated into existing TAC I/NET configurations.
- ✦ Operate in a stand-alone or integrated mode, with provisions for switching from stand-alone to integrated, or vice versa, without a new EPROM or applications database.
- ✦ Provide an update path for new configurations, or corrections to the applications database, that does not require a new EPROM.

The first objective was reached by examining various facets of the costs associated with purchasing, installing, and commissioning an MR-HP controller. These cost issues then became one of the key design parameters.

The second objective was reached by basing the MR-HP design on the existing MR design, hence the model designation. An MR-HP can be connected to the same communications network as MRs, and/or DPUs, and is even treated as an MR by an upstream MCI.

The third objective was reached by consolidating all of the common heat pump unit configurations into a single applications database. That database is loaded into the MR-HP at the factory. Then, when it reaches the site, the MR-HP can be installed and commissioned without the support of any other TAC I/NET device, except an I/STAT or M/STAT. For many applications, the MR-HP will do a credible job of control with nothing more than proper DIP switch settings.

The fourth objective was reached by equipping the MR-HP with sufficient Non-Volatile Random Access Memory (NOVRAM) to contain the entire applications database, together with a host-based update program for downloading a new applications database. Thus an update can be sent out from the factory, on diskette, and downloaded to the desired MR-HPs from any connected TAC I/NET host PC, without visiting the ceiling or rooftops.

Heat Pump Components

The MR-HP supports the following hardware components:

- ✦ Fan — The fan is always present and runs continuously when occupied or can be run when a stage of heating or cooling is required.

- Damper — The MR-HP will support a 2-position or modulating damper for minimum outside air requirements, or a 2-position or modulating damper as a stage of economizer cooling. The modulating economizer operation also supports an operator defined minimum outside air position.
- Compressors — The MR-HP will support up to two stages of compressors for cooling and heating.
- Reversing Valve — The MR-HP will support a heat pump which requires the reversing valve to energize for cooling or for heating.
- Supplemental Heat — The MR-HP will support up to two stages of 2-position supplemental heat.

Fan Control

The fan is the most basic component of an air handler. The fan has two basic modes of operation as defined by the Fan type DIP switch setting (SW10).

On

Setting the switch to On will cause the fan to run continuously when the Occupancy point is On, and cycle on and off, as required to meet night setup and night setback requirements, when the Occupancy point is Off.

Auto

Setting the switch to Auto will cause the fan to run when there is a call for a stage of cooling or heating, or economizer cooling, during both occupied and unoccupied hours.

Damper Control

Damper configuration is defined by the Damper Type (dt) parameter, and offers the following options:

None

No damper is present in the configuration.

Heat Pump Operation

The MR-HP will support one or two stages of compressors for heating and cooling. The compressor is used to compress a low pressure refrigerant vapor to a high pressure/high temperature vapor. The vapor then passes through the condensing coil which is used to reject the heat. In a typical cooling configuration, the condensing coil is located outdoors to reject the heat into the atmosphere or by passing condensing water over the coil to reject the heat into the water. Passing the refrigerant vapor through the coil will convert the high pressure/high temperature vapor into a high pressure liquid. The liquid is then passed through a metering device at the evaporator coil which will convert the refrigerant to a low pressure/low temperature liquid. The evaporator coil is located in the air stream of the supply fan indoors. The heat in the air is rejected into the coil and is transferred to the refrigerant. The heat pump will be used for heating by redirecting the flow of the refrigerant when it leaves the compressor. This is accomplished with a reversing valve. The solenoid operated valve will direct the high temperature/high pressure vapor to the evaporator coil instead of the condensing coil. This will cause the heat to be reject into the air stream, thus supplying heat to the space.

The efficiency of the heat pump while heating will decrease as the temperature of the outdoor air or water at the condensing coil decreases. The MR-HP has an emergency heating point which can be used to lockout the compressors and to start supplemental heat in their place. The MR-HP will support up to two stages of supplemental heat. When the emergency heat point is off, supplemental heat is treated as additional stages of heating. When the emergency heat point is on, the supplemental heat is staged in place of the compressors.

Reversing Valve

The reversing valve is used to re-direct the refrigerant with the purpose of changing the mode of operation of the heat pump. The reversing valve operation can be configured to energize the output for heating or for cooling (DIP switch 12).

The reversing valve will control to the cooling state when the temperature rises above the mid-point between the active heating setpoint plus $\frac{1}{2}$ of the heating band and the active cooling setpoint minus $\frac{1}{2}$ of the cooling band.

$$\text{Cooling State} = \frac{\left(\text{active cooling} - \frac{\text{cooling band}}{2} + \text{active heating} + \frac{\text{heating band}}{2}\right)}{2}$$

The reversing valve will control to the heating position when the temperature drops $\frac{1}{2}$ of 1 degree F ($\frac{1}{4}$ of 1 degree C) below the same midpoint value. This will give the reversing valve a differential on the low side of the mid-point to prevent the valve from oscillating.

$$\text{Heating State} = \frac{\left(\text{active cooling} - \frac{\text{cooling band}}{2} + \text{active heating} + \frac{\text{heating band}}{2}\right)}{2} - 0.5$$

Minimum Outside Air

The outside air damper in this application is used to allow a pre-defined amount of outside air into a space to satisfy indoor air quality requirements. The damper will open when the fan is controlled On and the space is occupied. This configuration will support two-position control only. The damper will remain closed when the MR-HP is satisfying night setup and night setback requirements.

Economizer

The economizer application is design to supply outside air to the fan as a first stage of cooling when the MR-HP has received an enthalpy “okay” signal locally or remotely. (In simple terms, the enthalpy is a measure of the total heat of a sample of a material, in this case outside air. The engineering unit used in the United States is BTU per pound, the SI unit is kiloJoules per kilogram (KJ/kg). Typically, as the enthalpy increases the discomfort of the occupants in a space will increase.) A local enthalpy controller will typically compare the enthalpy of the outside air to the enthalpy of the return air at the HP. If the outside air enthalpy is lower, the MR-HP will allow outside air into the HP. If the return air enthalpy is lower, the outside air damper will close. A remote enthalpy control signal (from the MCI) will typically be the result of an empirical determination. For example, an operator makes a decision to use outside air any time it’s enthalpy is below 22 BTU/LBS. (The distributed controllers on a CSI controller LAN are capable of calculating the enthalpy of air based on temperature and relative humidity.)

Two-position Control

When the enthalpy point is enabled, the damper point will energize as the space temperature rises above the cooling setpoint and will de-energize as the space temperature decreases. The damper output type will be 2-position or modulating control. The output of the MR-HP can be wired to an actuator with a "spring return" to force the damper closed when power is removed from the actuator. When wired in series with a low limit temperature switch (freezestat), hardwired freeze protection can be achieved. The damper output can also be wired to an interposing, double-throw relay to control a tri-state actuator, one which requires power to open and power to close. two-position control can also be used to enable a pre-existing economizer package on the HP. These economizer packages often include controls for modulating the outside air and return air dampers. Be aware that the economizer package will be enabled and disabled as the space temperature rises and falls. Another way of controlling the economizer package is to configure the damper type as an OA, in which case the economizer would be enabled when the fan is On and the space is occupied.

Modulating

The modulating control will first of all control to the minimum outside air required and secondly will be treated as the first stage of cooling. The minimum outside air requirement will be satisfied regardless of the condition of the enthalpy. The minimum outside air requirement will only be satisfied when the fan is On and the space is occupied. The Shutdown/Purge/Lockout point, when ranged from 0 to 99, will change the minimum damper position from 0% to 99%. (Refer to"Local Shutdown/Purge/Lockout" on page 45 for its other features and how it can affect the control of the damper.) Please note that the damper position is not proportional to the amount of air passing through the damper. A chart of the airflow characteristics of most dampers, shows that the percentage of maximum airflow increases much faster than damper position. For example, if the damper position is controlled to 10%, the actual air flow may be 25% of the maximum air flow of that damper. When controlled to 50%, the actual air flow may be near the maximum of that damper.

Like the other stages of cooling, the process variable for the economizer is the space temperature. When the enthalpy point has enabled the economizer operation, the damper will open as the space temperature rises and close as the space temperature decreases. The damper uses a PID control to maintain the process variable at setpoint. The default configuration uses "Proportional only" control. If the economizer is the only stage of cooling, then the economizer will work across the full range of the cooling band (Cb). As the temperature rises the damper output will increase proportionally. When the temperature is equal to the active cooling setpoint minus one-half of the cooling band, the damper will control to 0% (assuming S/P/L is equal to 0). When the temperature is equal to the active cooling setpoint, the damper will control to 50%. Likewise, when the temperature is greater than the active cooling setpoint plus one-half of the cooling band, the damper will control to 100%.

If the S/P/L point is controlled to a value of 20%, then damper will control to 20% when the temperature is below the active cooling setpoint minus one-half of the cooling band. When the temperature is equal to the active cooling setpoint, the PID algorithm will output 50%. This 50% is applied to the remaining 80% of the operating band which will result in the damper controlling to 60% ((100-20)•0.50 + 20 = 60%).

“Proportional only” control has an inherent offset error. In other words, P only control can get the process variable very close, but not necessarily equal to the setpoint. In most cases P only control will work very well in controlling space temperature. The introduction of “Integral” into the algorithm will correct the offset error. The “Integral” element of the algorithm can be added by setting the Cooling Error Correction (CEC) parameter to a value other than zero. (Refer to the parameter section of this manual for a more complete description of CEC.) There a four setting which can be applied to CEC. They are none, mild, medium and strong. If error correction is required to eliminate offset, then apply the mild setting first. The stronger the error correction, the more likely the damper will overshoot in it’s control of the space temperature. This will result in the space temperature oscillating around the setpoint rather than holding very near or at setpoint. The “Derivative” portion of the PID algorithm is not applied because space temperature responds very slowly to change.

The MR-HP supports over three hundred different combinations of the above mentioned hardware. It is beyond the scope of this document to cover all of the combinations. The following paragraphs will describe in detail how the MR-HP will function for each of the hardware components and how they interrelate.

Heat Pump Configurations

The MR-HP requires the operator to define the basic mechanical configuration of the heat pump by setting DIP switches and setting the Unit Parameters (see “Unit Parameters (UP)” on page 43). The following table is a compilation of 14 basic configurations reviewed in this document.

Table 1. MR-HP Configurations

Heat Pump Configuration	Number of Compressors	DIP SW 6	Number of Stages of Supplemental Heat	DIP SW 8–9	Damper Type dt
1	1	0	0	0	None
2	1	0	0	0	Minimum OA
3	1	0	0	0	Economizer
4	2	1	0	0	None
5	2	1	0	0	Minimum OA
6	2	1	0	0	Economizer
7	1	0	1	1	None
8	1	0	1	1	Minimum OA
9	1	0	1	1	Economizer
10	2	1	1	1	None
11	2	1	1	1	Minimum OA
12	2	1	1	1	Economizer
13	1	0	2	2	None
14	2	1	2	2	None

Heat Pump Configuration 1 - One Compressor

This configuration will support one compressor for heating and cooling. The fan will be controlled as defined by the fan type DIP switch 10. The reversing valve must be configured using DIP switch 12, either energize to heat or energize to cool.

As the temperature rises above the active cooling setpoint plus $\frac{1}{2}$ of the cooling band, the compressor will energize for cooling. The compressor will remain on as the temperature drops through the cooling band and will finally control off when the temperature drops below the active cooling setpoint minus $\frac{1}{2}$ of the cooling band. The reversing valve will cross over to the heating position as defined above in the reversing valve section. The compressor will energize for heating when the temperature drops below the active heating setpoint minus $\frac{1}{2}$ of the heating band. The compressor will remain on until the temperature rises above the active heating setpoint plus $\frac{1}{2}$ of the heating band. The fan will start and stop based upon a call for heating or cooling unless defined as a fan type of On. In which case, the fan will run continuously when the space is occupied. (See Figure 6 for configuration 1.)

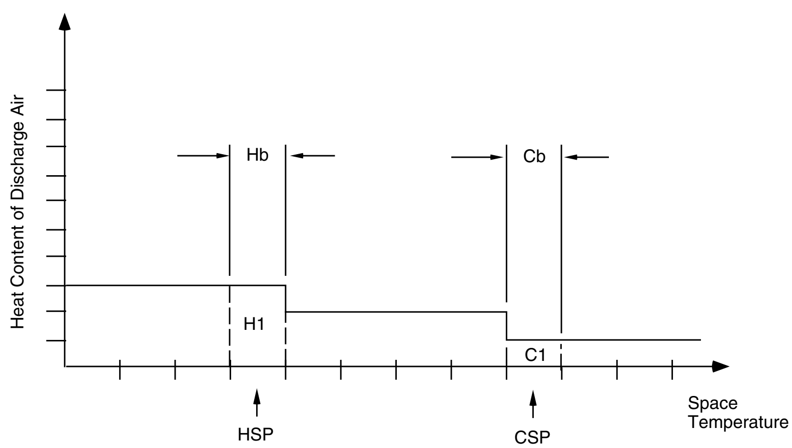

Figure 6. Heat Pump Configuration 1 and 2

Configuration 2 - One Compressor and Minimum Outside Air Damper

This configuration will support one compressor for heating and cooling. The fan will be controlled as defined by the fan type DIP switch 10. The reversing valve must be configured using DIP switch 12, either energize to heat or energize to cool. The damper is defined for minimum outside air using the damper type parameter (dt). The damper can be defined as modulating or two-position using the damper output type parameter (do). It will control full open when the fan is controlled on for normal operation during occupancy. The staging of the compressor, reversing valve and fan are identical to configuration 1.

Configuration 3 - One Compressor and an Economizer Damper

This configuration will support 1 compressor for heating and cooling. The fan will be controlled as defined by the fan type DIP switch 10. The reversing valve must be configured using DIP switch 12, either energize to heat or energize to cool. The damper is defined for economizer operation using the damper type parameter (dt). The damper can be defined as modulating or two-position using the damper output type parameter (do). (See Figure 7 for configuration 3.)

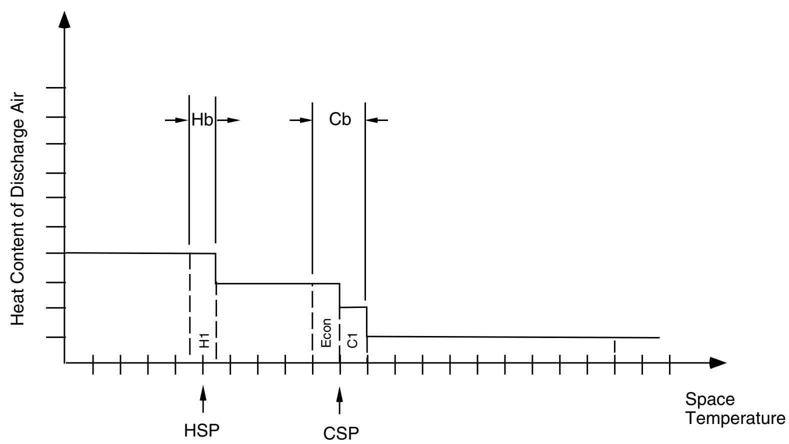

Figure 7. Heat Pump Configuration 3

The economizer and the compressor share the operating range of the cooling band. The economizer will always be treated as the first stage of cooling. The economizer will work over the lower fifty percent of the cooling band the compressor over the upper fifty percent. The economizer is only operational when the occupancy point is on.

For two-position damper control, the damper is fully opened when the enthalpy point is in the on state and the space temperature rises above the active cooling setpoint. The compressor will control on when the temperature rises above the active cooling setpoint plus $\frac{1}{2}$ of the cooling band and will remain on until the temperature drops below the active cooling setpoint.

The economizer damper defined as modulating will start to open when the temperature rises above the active cooling setpoint minus one-half of the cooling band. The damper position will increase proportionally until reaching 100% open when the temperature is equal to the active cooling setpoint. At this point, the % Load point will be at 50%.

Cooling Error Correction (CEC) can be applied to the economizer damper control. Refer to "Cooling Error Correction" on page 49 for a thorough description of CEC. The "control point" for the damper control is 0% open. In the event that the temperature goes outside the sensor limits of the point or that the setpoint is outside of it's limits, the damper will control to 0% open. The control point is also the target of PID control when CEC is applied. This means that anytime the temperature is above the active cooling setpoint minus one-half of the cooling band, the damper position will increase until the temperature reaches that value.

As the space temperature decrease, the reversing valve will change over for heating. The compressor will start when the temperature drops below the active heating setpoint minus one-half of the heating band and remain on until the temperature rises above the active heating setpoint plus one-half of the heating band.

Configuration 4 — Two Compressors

This configuration will support two compressors for heating and cooling. The fan will be controlled as defined by the fan type DIP switch 10. The reversing valve must be configured using DIP switch 12, either energize to heat or energize to cool.

The first compressor will control over the lower half of the cooling band and the second over the upper half. As the temperature rises above the active cooling setpoint, the first compressor will energize for cooling. The second compressor will start after the first and after the temperature rises above the active cooling setpoint plus one-half of the cooling band. The second stage will control off when the temperature drops below the active cooling setpoint. The first compressor will remain on as the temperature drops through the lower half of the cooling band and will finally control off when the temperature drops below the active cooling setpoint minus $\frac{1}{2}$ of the cooling band.

The reversing valve will cross over to the heating position as defined above in the reversing valve section. The first compressor will energize for heating when the temperature drops below the active heating setpoint. The second compressor will energize when the temperature drops below the active heating setpoint minus one-half of the heating band. It will de-energize when the temperature rises above the active heating setpoint. The first compressor will remain on until the temperature rises above the active heating setpoint plus one-half of the heating band. The fan will start and stop based upon a call for heating or cooling unless defined as a fan type of On. In which case, the fan will run continuously when the space is occupied. (See Figure 8 for configuration 4.)

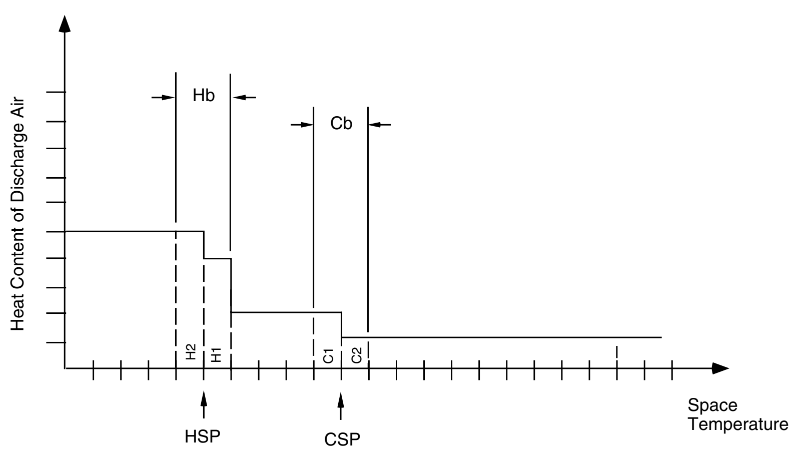

Figure 8. Heat Pump Configuration 4 and 5

Configuration 5 - Two Compressors and Minimum Outside Air Damper

This configuration will support two compressors for heating and cooling. The fan will be controlled as defined by the fan type DIP switch 10. The reversing valve must be configured using DIP switch 12, either energize to heat or energize to cool. The damper is defined for minimum outside air using the damper type parameter (dt). The damper can be defined as modulating or two-position using the damper output type parameter (do). It will control full open when the fan is controlled on for normal operation during occupancy. The staging of the compressor, reversing valve and fan are identical to configuration 4.

Configuration 6 - Two Compressors and Economizer Damper

This configuration will support two compressors for heating and cooling. The fan will be controlled as defined by the fan type DIP switch 10. The reversing valve must be configured using DIP switch 12, either energize to heat or energize to cool. The damper is defined for economizer control using the damper type parameter (dt). The damper can be defined as modulating or two-position using the damper output type parameter (do).

The addition of the economizer to the cooling means that the cooling band (Cb) is divided into to thirds. As the temperature rises above the active cooling setpoint minus one-half of the cooling band, the damper will open if the enthalpy point is on. The first and second compressors will stage as illustrated regardless of the economizer operation.

The reversing valve will cross over to the heating position as defined above in the reversing valve section. The first compressor will energize for heating when the temperature drops below the active heating setpoint. The second compressor will energize when the temperature drops below the active heating setpoint minus one-half of the heating band. It will de-energize when the temperature rises above the active heating setpoint. The first compressor will remain on until the temperature rises above the active heating setpoint plus one-half of the heating band. The fan will start and stop based upon a call for heating or cooling unless defined as a fan type of On. In which case, the fan will run continuously when the space is occupied. (See Figure 9 for configuration 6.)

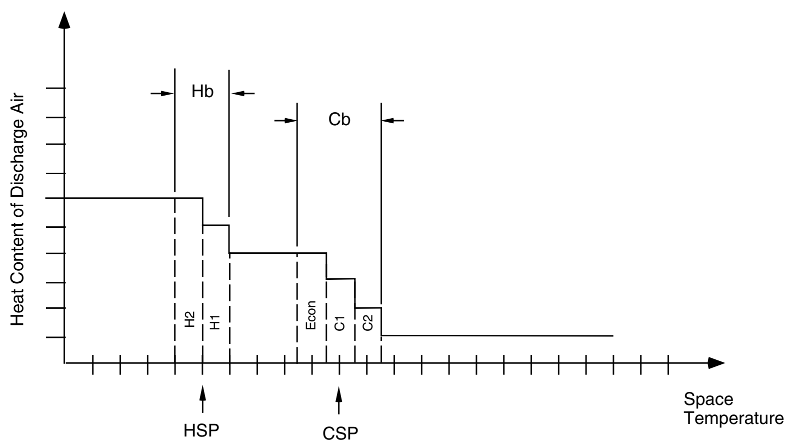

Figure 9. Heat Pump Configuration 6

Configuration 7 - One Compressor and One Stage of Supplemental Heat.

This configuration will support one compressor for heating and cooling. The fan will be controlled as defined by the fan type DIP switch 10. The reversing valve must be configured using DIP switch 12, either energize to heat or energize to cool.

As the temperature rises above the active cooling setpoint plus $\frac{1}{2}$ of the cooling band, the compressor will energize for cooling. The compressor will remain on as the temperature drops through the cooling band and will finally control off when the temperature drops below the active cooling setpoint minus $\frac{1}{2}$ of the cooling band.

The reversing valve will cross over to the heating position as defined above in the reversing valve section. The compressor will energize for heating when the temperature drops below the active heating setpoint. The supplemental heat will energize when the temperature drops below the active heating setpoint minus one-half of the heating band. It will de-energize when the temperature rises above the active heating setpoint. The compressor will remain on until the temperature rises above the active heating setpoint plus one-half of the heating band. If DIP switch 7 is set for "emergency heat" and the point address 06 DO is on, then the compressor is locked out on a call for heat and the supplemental heat is staged in its place. The fan will start and stop based upon a call for heating or cooling unless defined as a fan type of On. In which case, the fan will run continuously when the space is occupied. (See Figure 10 for configuration 7.)

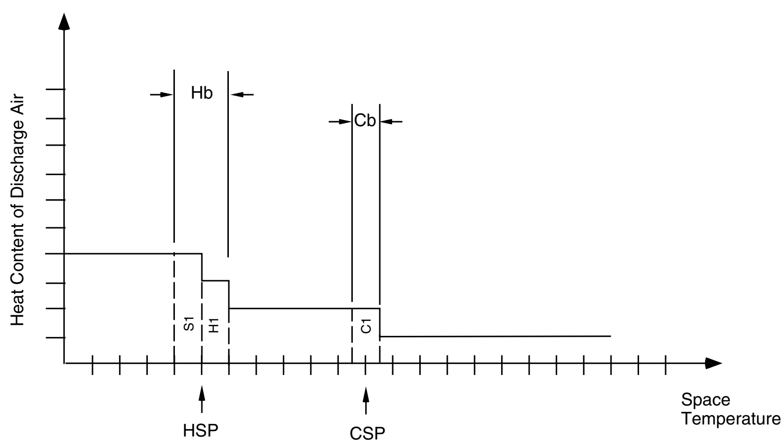

Figure 10. Heat Pump Configuration 7 and 8

Configuration 8 - One Compressor, One Stage of Supplemental Heat and Minimum Outside Air Damper

This configuration will support one compressor for heating and cooling. The fan will be controlled as defined by the fan type DIP switch 10. The reversing valve must be configured using DIP switch 12, either energize to heat or energize to cool. The damper is defined for minimum outside air using the damper type parameter (dt). The damper can be defined as modulating or two-position using the damper output type parameter (do). It will control full open when the fan is controlled on for normal operation during occupancy.

As the temperature rises above the active cooling setpoint plus $\frac{1}{2}$ of the cooling band, the compressor will energize for cooling. The compressor will remain on as the temperature drops through the cooling band and will finally control off when the temperature drops below the active cooling setpoint minus $\frac{1}{2}$ of the cooling band.

The reversing valve will cross over to the heating position as defined above in the reversing valve section. The compressor will energize for heating when the temperature drops below the active heating setpoint. The supplemental heat will energize when the temperature drops below the active heating setpoint minus one-half of the heating band. It will de-energize when the temperature rises above the active heating setpoint. The compressor will remain on until the temperature rises above the active heating setpoint plus one-half of the heating band. If DIP switch 7 is set for "emergency heat" and the point address 06 DO is on, then the compressor is locked out on a call for heating and the supplemental heat is staged in its place. The fan will start and stop based upon a call for heating or cooling unless defined as a fan type of On. In which case, the fan will run continuously when the space is occupied. (See Figure 10 for configuration 8.)

Configuration 9 - One Compressor, One Stage of Supplemental Heat and an Economizer Damper

This configuration will support one compressor for heating and cooling. The fan will be controlled as defined by the fan type DIP switch 10. The reversing valve must be configured using DIP switch 12, either energize to heat or energize to cool. The damper is defined for economizer operation using the damper type parameter (dt). The damper can be defined as modulating or two-position using the damper output type parameter (do). (See Figure 11 for configuration 9.)

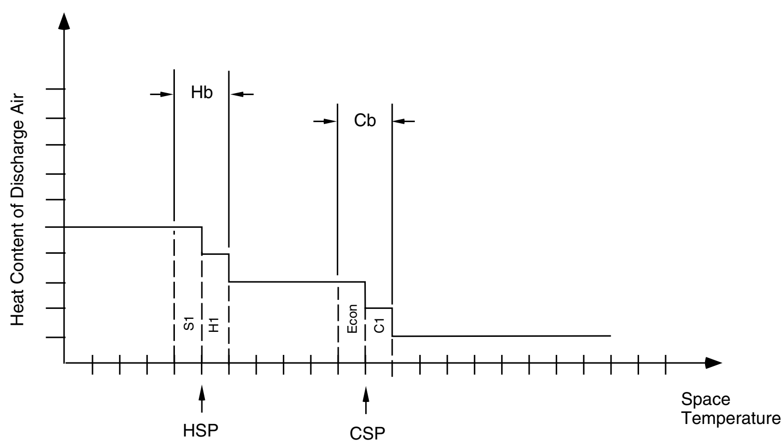

Figure 11. Heat Pump Configuration 9

The economizer and the compressor share the operating range of the cooling band. The economizer will always be treated as the first stage of cooling. The economizer will work over the lower fifty percent of the cooling band the compressor over the upper fifty percent. The economizer is only operational when the occupancy point is on.

For two-position damper control, the damper is fully opened when the enthalpy point is in the on state and the space temperature rises above the active cooling setpoint. The compressor will control on when the temperature rises above the active cooling setpoint plus $\frac{1}{2}$ of the cooling band and will remain on until the temperature drops below the active cooling setpoint.

The economizer damper defined as modulating will start to open when the temperature rises above the active cooling setpoint minus one-half of the cooling band. The damper position will increase proportionally until reaching 100% open when the temperature is equal to the active cooling setpoint. At this point, the % Load point will be at 50%.

Cooling Error Correction (CEC) can be applied to the economizer damper control. Refer to "Cooling Error Correction" on page 49 for a thorough description of CEC. The "control point" for the damper control is 0% open. In the event that the temperature goes outside the sensor limits of the point or that the setpoint is outside of it's limits, then the damper will control to 0% open. The control point is also the target of PID control when CEC is applied. This means that anytime the temperature is above the active cooling setpoint minus one-half of the cooling band, the damper position will increase until the temperature reaches that value.

The reversing valve will cross over to the heating position as defined above in the reversing valve section. The compressor will energize for heating when the temperature drops below the active heating setpoint. The supplemental heat will energize when the temperature drops below the active heating setpoint minus one-half of the heating band. It will de-energize when the temperature rises above the active heating setpoint. The compressor will remain on until the temperature rises above the active heating setpoint plus one-half of the heating band. If DIP switch 7 is set for “emergency heat” and the point address 06 DO is on, then the compressor is locked out on a call for heating and the supplemental heat is staged in its place. The fan will start and stop based upon a call for heating or cooling unless defined as a fan type of On. In which case, the fan will run continuously when the space is occupied.

Configuration 10 - Two Compressors and One Stage of Supplemental Heat

This configuration will support two compressors for heating and cooling and one stage of supplemental heat. The fan will be controlled as defined by the fan type DIP switch 10. The reversing valve must be configured using DIP switch 12, either energize to heat or energize to cool.

The first compressor will control over the lower half of the cooling band and the second over the upper half. As the temperature rises above the active cooling setpoint, the first compressor will energize for cooling. The second compressor will start after the first and after the temperature rises above the active cooling setpoint plus one-half of the cooling band. The second stage will control off when the temperature drops below the active cooling setpoint. The first compressor will remain on as the temperature drops through the lower half of the cooling band and will finally control off when the temperature drops below the active cooling setpoint minus $\frac{1}{2}$ of the cooling band.

The reversing valve will cross over to the heating position as defined above in the reversing valve section. The heating band is divided into thirds. The first compressor will operate in the first third of the heating band as the temperature decreases. The second compressor will operate in the second third of the heating band as the temperature decreases. The supplemental heat will be treated as the third stage of heating and will energize when the temperature drops below the active heating setpoint minus one-half of the heating band. The stages of heat will stage off in the order they energized as the temperature rises through the heating band. If DIP switch 7 is set for “emergency heat” and the point address 06 DO is on, then the compressors are locked out on a call for heating and the supplemental heat is staged in their place. The fan will start and stop based upon a call for heating or cooling unless defined as a fan type of On. In which case, the fan will run continuously when the space is occupied. (See Figure 12 for configuration 10.)

Configuration 11 - Two Compressors, One Stage of Supplemental Heat and Minimum Outside Air Damper

This configuration will support two compressors for heating and cooling. The fan will be controlled as defined by the fan type DIP switch 10. The reversing valve must be configured using DIP switch 12, either energize to heat or energize to cool. The damper

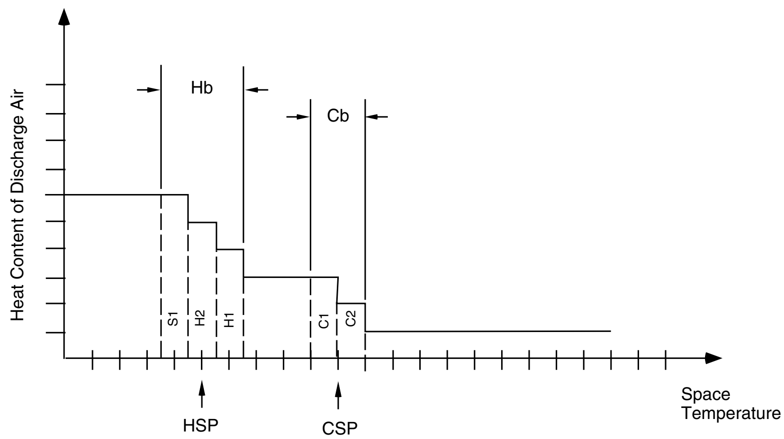

Figure 12. Heat Pump Configuration 10 and 11

is defined for minimum outside air using the damper type parameter (dt). The damper can be defined as modulating or two-position using the damper output type parameter (do). It will control full open when the fan is controlled on for normal operation during occupancy.

The first compressor will control over the lower half of the cooling band and the second over the upper half. As the temperature rises above the active cooling setpoint, the first compressor will energize for cooling. The second compressor will start after the first and after the temperature rises above the active cooling setpoint plus one-half of the cooling band. The second stage will control off when the temperature drops below the active cooling setpoint. The first compressor will remain on as the temperature drops through the lower half of the cooling band and will finally control off when the temperature drops below the active cooling setpoint minus $\frac{1}{2}$ of the cooling band.

The reversing valve will cross over to the heating position as defined above in the reversing valve section. The heating band is divided into thirds. The first compressor will operate in the first third of the heating band as the temperature decreases. The second compressor will operate in the second third of the heating band as the temperature decreases. The supplemental heat will be treated as the third stage of heating and will energize when the temperature drops below the active heating setpoint minus one-half of the heating band. The stages of heat will stage off in the order they energized as the temperature rises through the heating band. If DIP switch 7 is set for “emergency heat” and the point address 06 DO is on, then the compressors are locked out on a call for heating and the supplemental heat is staged in their place. The fan will start and stop based upon a call for heating or cooling unless defined as a fan type of On. In which case, the fan will run continuously when the space is occupied. (See Figure 12 for configuration 11.)

Configuration 12 - Two Compressors, One Stage of Supplemental Heat and Economizer Damper

This configuration will support two compressors for heating and cooling. The fan will be controlled as defined by the fan type DIP switch 10. The reversing valve must be configured using DIP switch 12, either energize to heat or energize to cool. The damper is defined for economizer control using the damper type parameter (dt). The damper can be defined as modulating or two-position using the damper output type parameter (do).

The addition of the economizer to the cooling means that the cooling band (Cb) is divided into to thirds. As the temperature rises above the active cooling setpoint minus one-half of the cooling band, the damper will open if the enthalpy point is on. The first and second compressors will stage as illustrated regardless of the economizer operation.

The reversing valve will cross over to the heating position as defined above in the reversing valve section. The heating band is divided into thirds. The first compressor will operate in the first third of the heating band as the temperature decreases. The second compressor will operate in the second third of the heating band as the temperature decreases. The supplemental heat will be treated as the third stage of heating and will energize when the temperature drops below the active heating setpoint minus one-half of the heating band. The stages of heat will stage off in the order they energized as the temperature rises through the heating band. If DIP switch 7 is set for “emergency heat” and the point address 06 DO is on, then the compressors are locked out on a call for heating and the supplemental heat is staged in their place. The fan will start and stop based upon a call for heating or cooling unless defined as a fan type of On. In which case, the fan will run continuously when the space is occupied. (See Figure 13 for configuration 12.)

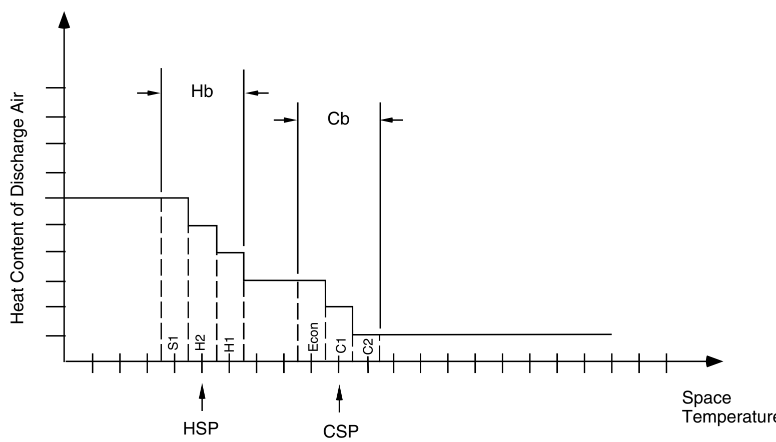

Figure 13. Heat Pump Configuration 12

Configuration 13 - One Compressor and Two stages of Supplemental Heat.

This configuration will support one compressor for heating and cooling and two stages of supplemental heat. The fan will be controlled as defined by the fan type DIP switch 10. The reversing valve must be configured using DIP switch 12, either energize to heat or energize to cool.

As the temperature rises above the active cooling setpoint plus $\frac{1}{2}$ of the cooling band, the compressor will energize for cooling. The compressor will remain on as the temperature drops through the cooling band and will finally control off when the temperature drops below the active cooling setpoint minus $\frac{1}{2}$ of the cooling band.

The reversing valve will cross over to the heating position as defined above in the reversing valve section. The heating band is divided into thirds. The compressor will operate in the first third of the heating band as the temperature decreases. The first stage of supplemental heat will operate in the second third of the heating band as the temperature decreases. The second stage of supplemental heat will be treated as the third stage of heating and will energize when the temperature drops below the active heating setpoint minus one-half of the heating band. The stages of heat will stage off in the order they energized as the temperature rises through the heating band. If DIP switch 7 is set for "emergency heat" and the point address 06 DO is on, then the compressor is locked out on a call for heating and the supplemental heat is staged in its place. The first stage of supplemental heat will operate in the position of the compressor. The second stage of supplemental heat will work in the heating band were the first stage had been working. The fan will start and stop based upon a call for heating or cooling unless defined as a fan type of On. In which case, the fan will run continuously when the space is occupied. (See Figure 14 for this configuration.)

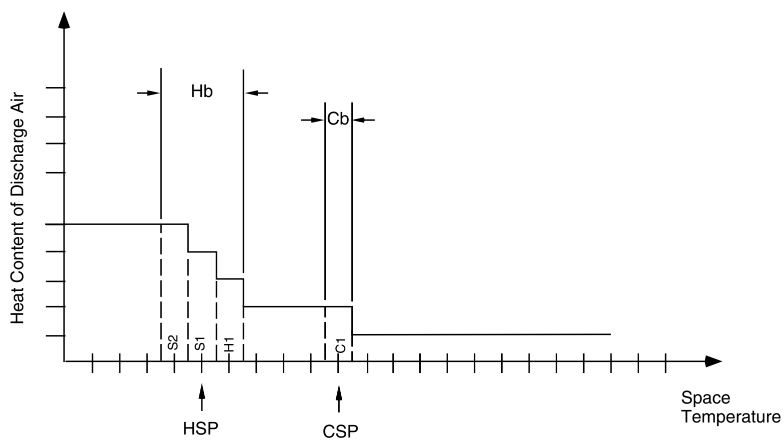

Figure 14. Heat Pump Configuration 13

Configuration 14 - Two Compressors and Two Stages of Supplemental Heat

This configuration will support two compressors for heating and cooling. The fan will be controlled as defined by the fan type DIP switch 10. The reversing valve must be configured using DIP switch 12, either energize to heat or energize to cool.

The first compressor will control over the lower half of the cooling band and the second over the upper half. As the temperature rises above the active cooling setpoint, the first compressor will energize for cooling. The second compressor will start after the first and after the temperature rises above the active cooling setpoint plus one-half of the cooling band. The second stage will control off when the temperature drops below the active cooling setpoint. The first compressor will remain on as the temperature drops through the lower half of the cooling band and will finally control off when the temperature drops below the active cooling setpoint minus $\frac{1}{2}$ of the cooling band.

The reversing valve will cross over to the heating position as defined above in the reversing valve section. This configuration divides the heating band into fourths. As the temperature decreases through the heating band, the compressors stage on and then the supplemental heat stages on. If DIP switch 7 is set for "emergency heat" and the point address 06 DO is on, then the compressors are locked out on a call for heating and the stages of supplemental heat are staged in their place. The first stage of supplemental heat will operate in the position of the first compressor. The second stage of supplemental heat will operate in the position of the second compressor. The fan will start and stop based upon a call for heating or cooling unless defined as a fan type of On. In which case, the fan will run continuously when the space is occupied. (See Figure 15 for configuration 14.)

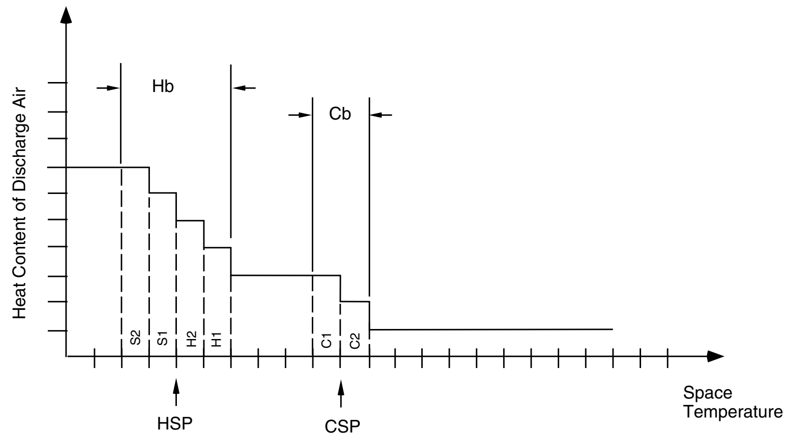

Figure 15. Heat Pump Configuration 14

Point Database

The MR-HP has the capacity for 10 input and 10 output points. In some configurations all of the points are used to satisfy the HP function. In other configurations one or more of the points are available for other applications (up to four contacts or sensors can be connected to free input points, and up to two output points can be connected to discrete actuators or contactors).

When a free point is to be used in another application, the point's parameters, and even it's type, can be modified using the TAC I/NET Resident I/O editor, in the normal manner of TAC I/NET points. However, the Resident I/O editor does not protect against modifications of non-free points. Any modifications, except for point names (which have no impact on the operation of the point), could cause the MR-HP controller to work improperly.

In the following descriptions, a generic point name in parentheses follows the descriptive name for each point. These generic names are limited to eight characters so that they can be combined with the eight-character MR-HP name, which forms a unique point name for display on graphic pages, point and message summaries. For example, if the MR-HP name represents a location, the combined name would consist of the location, followed by a name that indicates the point's function within the MR-HP - the result should be familiar to those who understand the application.

The following table lists the points in the MR-HP application.

Table 2. MR-HP Input/Output Points

BB	Type	Input Description	Type	Output Description	BB
00	EXT AI	Loc SPL (local Shutdown/Purge/Lockout) or spare	EXT DO	Y2 (C2) — 2nd Stage Compressor, DMPR (–) or Spare	00
01	EXT DI	Loc OCC (local Occupancy) or spare	EXT DO	Y1 (C1) — 1st Stage Compressor	01
02	EXT DI	Loc Ent (local Enthalpy status) or spare	EXT DO	G (Fan) — Fan Control	02
03	EXT AI	SStaAdj (S/STAT adjustment) or spare	EXT DO	O (Rev) — Reversing Valve	03
04	INT AI	MCI SPL (Shutdown/Purge/Lockout from MCI)	EXT DO	S1 — Supplemental Heat Stage 1 or Spare	04
05	INT AI	IStaBSP (I/STAT base setpoint)	INT AO	S2/DMP — Supplemental Heat Stage 2 or Damper Position (DMPR +)	05
06	INT AI	Heat Pump % Load	INT DO	Emr/Dmd — Emergency Heat or Demand Control	06
07	EXT AI	Space T	INT DO	MCI Occ (Occupancy from MCI)	07
08	INT DI	MCI Ent (enthalpy status from MCI)	INT AO	STATAdj (SetpoINT adjust from I/STAT or S/STAT)	08
09	INT AI	MCI OAT (outside air temperature from MCI)	INT AO	MCI SP (System SetpoINT from MCI)	09

Input Points

The MR-HP supports five external input points, four points to connect to local resistor/thermistor/discrete sensors, and a fifth for the thermostat's thermistor (and I/STAT's communications). The other input points are internal only.

00 AI (EXT) - Shutdown/Purge/Lockout (Loc SPL)

This point is the input for local shutdown/purge/lockout notification when the Shutdown/Purge/Lockout (SPL) parameter is set to 1. The local contact is connected to TB4-1, Input 1.

A short circuit (closed contact) is interpreted as normal. An open circuit (open contact) is interpreted as shutdown, which turns the fan off and closes the dampers. A mid-range value (closed contact through a 10K resistor) is interpreted as purge, which opens the damper and turns the fan on (see Figure 16 on page 28).

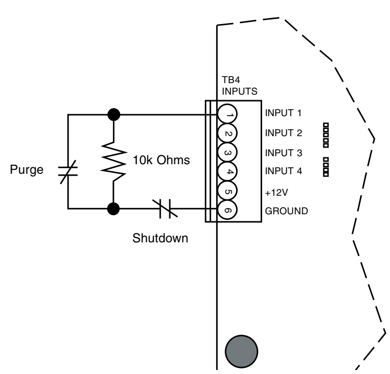

Figure 16. Local Shutdown/Purge/Lockout Terminations

If the SPL parameter is set to 0, this becomes a free point.

01 DI (EXT) - Local Occupancy (Loc Occ)

This point is the input for local Occupancy notification. The input is connected to TB4-2, Input 2. For local occupancy notification, an open circuit (open contact) indicates that the space is unoccupied; a short circuit (closed contact) that it is occupied.

The local occupancy point is enabled by setting oCC=1. This point will then work in conjunction with the On/Off button on the I/STAT and S/STAT to control 07 DO.

02 DI (EXT) - Enthalpy (Loc Ent)

The input to this external discrete input is a local enthalpy contact which compares the return air enthalpy to the outside air enthalpy. If the outside air enthalpy is lower than the return air enthalpy, the contact closes. The closed contact will enable the economizer operation as described above.

This point serves as the enthalpy input when the Ent parameter has a value of 1. When Ent is zero, this becomes a free point and the enthalpy logic comes from the MCI (08 DI).

03 AI (EXT) - S/STAT Adjustment (SStaAdj)

This point is the input for the S/STAT "slider" potentiometer adjustment in configurations that include an S/STAT (DIP switch position 11 On), the input is connected to TB4-4, Input 4. The value of this point will range from 0 to 100. It is applied directly to the range of the STAT Adjust Range (SAr) parameter. For example, if SAr is a value of 8, the S/STAT value of 0 will apply -4 to the heating and cooling setpoints. An SStaAdj value of 100 will apply +4 to the heating and cooling setpoints. This value is seen in the STAT Adjustment point 08 AO.

This point also serves as the override feature when using the S/STAT. The On/Off button on the S/STAT, when pressed, will cause the S/STAT signal to temporarily short, this in turn triggers the MR-HP to control the Occupancy Off or On depending on it's current condition and the Override Duration (od) parameter.

If DIP switch position 11 is Off, this becomes a free point.

04 AI (INT) - Shutdown/Purge/Lockout (MCI SPL)

This point is used for Shutdown/Purge/Lockout notification from the connected MCI, in the same manner that 00 AI is used as a local contact. The value must be developed in the MCI from a calculation equation that is attached to address 04 AI. The values are interpreted as shown in Table 3. If the SPL parameter is set to 1 (local), then this becomes a free internal point.

Table 3. Shutdown/Purge/Lockout Values

S/P/L Value	Mode	Heating	Cooling	Damper	Fan
0–99	Normal	Normal	Normal	Modulating	Normal
100–199	Lockout Heat	Lockout	Normal	Modulating	Normal
200–299	Lockout Cool	Normal	Lockout	Lockout Econ - Min OA honored	Normal
300–399	Lockout Heat and Cool	Lockout	Lockout	Lockout Econ - Min OA honored	Normal
400–599	Purge	Lockout	Lockout	Full Open	On
Over 600	Shutdown	Lockout	Lockout	Full Closed	Off

Note: *1. "Normal" for the Fan means that the fan is being controlled in a normal manner, Cycling when DIP switch 10 is configured for Auto, and On when DIP switch 10 is On.*

2. "Normal" for heating and cooling means that the various stages are cycling to maintain space temperature.

3. "Modulating" a damper means that the damper is being controlled according to the current application configuration, based on Occupancy status and space temperature. However, because of Indoor Air Quality (IAQ) considerations, the MR-HP design allows the minimum outside air value to be adjusted dynamically from the connected MCI. This is accomplished by interpreting the two least significant digits of "S/P/L Value" as the minimum damper position. As the two least significant digits increase from 0 through 99, the minimum damper position will increase from 0 to 99% open. (The minimum outside air value will only be honored when the fan is On and the space is occupied regardless of the Lockout condition of cooling.)

4. "Lockout" denotes control of the heating or cooling stage off.

05 AI (INT) - Base Setpoint (IStaBSP)

The base setpoint is the "Base Address" defined in the MR I/STAT parameters editor from the MCI and required for the sole purpose of displaying the correct "SET TEMP" on the I/STAT. The SET TEMP value is Base Setpoint plus the STAT Adjustment (08 AO). The Base Setpoint is developed from the System Setpoint (09 AO) if the Setpoint Offset (SPo) parameter is set to a non-zero value, or from the Cooling Setpoint (CSP) and Heating Setpoint (HSP) parameters if SPo is set to 0. The STAT adjustment value (08 AO) is supplied by an occupant of the space through either an I/STAT directly or an S/STAT indirectly.

06 AI (INT) - HP Loading (% Load)

This point supplies the connected MCI, or further upstream PCUs, with information concerning the loading of the individual HP. Its value is determined as follows:

- Cooling: 0 to +100 for 0 to 100% cooling load as the temperature rises across Cb.
- Heating: 0 to -100 for 0 to 100% heating load as the temperature falls across Hb.

Refer to "Unit Setup" on page 43 for descriptions of the cooling band (Cb) and the heating band (Hb).

07 AI (EXT) - Space Temperature (Space T)

This point contains the current (sensed) value of the space temperature, which is the primary input to the controller. Errors in the reading can be corrected by calibrating the sensor (refer to"Calibrate Space Sensor" on page 50).

08 DI (INT) MCI Enthalpy (MCI Ent)

This point is the MCI equivalent of the local enthalpy point discussed at address 02 DI. The MCI point can be "tied" to a point resident in the MCI via a calculation extension in the MCI to control enthalpy.

If the Ent parameter is set to 1 (local) then this becomes a free point.

09 AI (INT) Outside Air Temperature (MCI OAT)

Outside air temperature is not used for HP control, but is included in the MR-HP database so that it can be accessed from the I/STAT. The value must be supplied by the MCI, typically from a calculation equation that is attached to 09 AI. It must be assigned from the host PC, and would normally be developed from sensed data in a sister MR, or a PCU on the same, or even another, controller LAN.

Output Points

The MR-HP controller supports six external discrete outputs. Each output requires an external (EXT) point in the Resident I/O database unless the corresponding output is either the increase (INC) or decrease (DEC) control for a bidirectional actuator (e.g. the actuator in Damper Output (do) type 2). In those cases the output control bypasses the point database and goes directly to the hardware, which means that an internal (INT) point can be assigned to the corresponding addresses.

Caution: *Neither the I/STAT parameter interpreter, nor the equivalent host PC parameter interpreter, protects against the assignment of incompatible parameters (i.e., assigning two desired, different outputs to the same output terminal). If such an assignment is made, the results are generally unpredictable.*

00 DO (EXT) Stage Two Compressor (Y2 (C2)) or spare

The control source for this output (TB4-1) will be determined by the setting of DIP switch 6.

Table 4. Compressor Settings with DIP Switch 6

SW 6	SSU parameter 6	Number of Compressors	Point 00DO
Off	0	1	Spare
On	1	2	Y2 (C2)

When switch 6 is off (or SSU parameter 6 is 0) this will be a free point and can be used accordingly. When switch 6 is on (or SSU parameter 6 is 1) this output will be used to control the second stage compressor for heating and cooling.

If the MR-HP is configured for an economizer or minimum outside air damper (dt = 0 or dt = 1), and the damper output type is 2-output-PWM (do = 2), the output 1 (TB4-1) is the decrease pulse for the damper control. In which case, a second stage of compressor cannot be used.

01 DO (EXT) Stage One Compressor (Y1 (C1))

This hardware address (TB4-2, Output 2) is dedicated to the control algorithms for the first stage compressor.

02 DO (EXT) Fan (G)

This hardware address (TB4-3, Output 3) is dedicated to the control algorithms for the fan.

03 DO (EXT) O – Reversing Valve (O (Rev))

This hardware address (TB4-4, Output 4) is dedicated to the control algorithms of the reversing valve.

04 DO (EXT) Stage One of Supplemental Heat (S1) or spare

This hardware address (TB4-5, Output 5) is dedicated to the control algorithms of the first stage of supplemental heat or can be used as a free point. DIP switches 8 and 9 determine the number of stages of supplemental heat. When DIP switches 8 and 9 are off (or the SSU parameter 8–9 is a value of 0) this address becomes a free point and can be used accordingly.

05 AO (INT) Stage Two of Supplemental Heat or Damper Position (S2/Dmp)

This hardware address (TB4-6, Output 6) is dedicated to the control algorithms of the second stage of supplemental heat or to the control algorithms of the damper. This point can not be used as a free point. This internal analog output point will range in value from 0 to 100. For two-position control the point will be a value of 0 when off and a value of 100 when on. Because two different strategies can control the same address, the operator must check the following conditions carefully to prevent a conflict from occurring.

This address will be controlled by the supplemental heat when the value of DIP switches 8 and 9 (SSU parameter 8-9) is two or more. If this is desired, then the operator must change the damper type parameter (dt) to a value of 2 (no damper).

Using this address to control a damper, requires the operator to define the damper type parameter (dt) to a value of 0 or 1 (economizer or minimum outside air). If this is desirable, then the operator must change the value of DIP switches 8 and 9 (SSU parameter 8-9) to less than 2, which means that switch 9 must be off.

Note: *This point can **not** be used as a free point.*

Table 5. Supplemental Heat Address with DIP Switch 8 and 9

SW 8	SW 9	SSU Parameter 8-9	Parameter dt	Point 04 DO	Point 05 AO
0	0	0	-	Spare	Free For Damper Use
1	0	1	-	S1	Free For Damper Use
0	1	2	-	S1	S2
1	1	3	-	S1	S2
-	-	-	0	No Effect	Damper
-	-	-	1	No Effect	Damper
-	-	-	2	No Effect	Free For S2 Use

06 DO (INT) Emergency Heat or MCI Demand Control (Emr/Dmd)

This address is used for the emergency heat point when DIP switch 7 (SSU parameter 7) is off (or 0). Emergency heat is used to lockout the compressors from being used for heating and enables the supplemental heat to operate in it's place.

This address is used for the MCI Demand Control point when DIP switch 7 (SSU parameter 7) is on (or1). When the demand point is on and the space is occupied, the heat pump will control to the demand setup and setback setpoints.

Note: *This point can **not** be used as a free point.*

Table 6. Emergency Heat or MCI Demand Control Address with DIP Switch 7

SW 7	SSU parameter 7	Point 00DO
Off	0	Emergency Heat
On	1	MCI Demand Control

07 DO (INT) Occupancy from MCI (MCI Occ)

This point is the internal occupancy point (parameter oCC=0), and is driven by the Automatic Time Scheduler (ATS) in the MCI (see 01AI if occupancy is driven by an external timer). If the oCC parameter is set to 1 (local), then this point is driven by 01 AI Loc OCC.

08 AO (INT) STAT Adjustment (STATAdj)

This point is associated with operator STAT adjustment of the S/STAT or I/STAT setpoint. The output range is determined by the STAT Adjustment range (SAr). If SAr = 4, this point will range from -2 to +2, allowing the local occupant to raise and lower their heating and cooling setpoints across a four degree span. See 03 AI for a description of how the S/STAT is applied to this point.

09 DO (INT) System Setpoint (MCI SP)

This internal point is reserved for the system setpoint SP from the MCI. The system setpoint is only active when the Setpoint Offset parameter (SPo) is non-zero.The cooling setpoint is then SP+SPo and the heating setpoint is SP-SPo (replacing CSP and HSP parameters which are used when SPo is left at its default zero).

Database Distribution

In previous TAC I/NET systems, the database was always entered at a TAC I/NET host and then downloaded to subordinate controllers and micro-controllers. As a result, all of the devices in the TAC I/NET system, from top to bottom, had access to the database. That is not the case with the advent of the MR-HP. In this case the database is loaded into the MR-HP at the factory. When an MR-HP, with its pre-loaded database, is integrated into a TAC I/NET system, its database must be distributed to the other TAC I/NET devices, in particular, to the parent MCI, MRI, or I/SITE LAN.

This is accomplished through an Update_MCI function available at the TAC I/NET host. This function is available from within the “ASC Parameters” editor, which is accessible from the “Edit” option on the Command line after connection to the MCI. After the “ASC Parameters” editor is selected, the Update_MCI function is offered as a Command-line option. Select that entry to upload the database from the MR-HP to MCI.

Parameters can be displayed or modified by the TAC I/NET host along with copying the new values/states to other MR-HPs. Also, MR-HP names are automatically used as the first eight characters of each of the twenty points associated with an ASC.

An Update_ASC feature is also available from this command line. When executed, the operator has the ability to download a new database to the MR-HP. The database will be in the form of a binary file.

See Also: The section on “ASC Editors” in the *TAC I/NET Operator Guide*.

Installation

This section provides the installation instructions for mounting the MR-HP and installing the input and output connections, connecting the MR-HP to a subLAN, termination of the thermostat, and finally the dialogue required for configuring the MR-HP.

Controller Installation

Check the mounting location for the MR-HP. The available area must measure at least 4.3”W × 8”L × 2.4”H (11 × 21 × 6 cm) and should be a moisture free container away from any large electrical devices. The screw holes are 3.75” × 7.5” (9.5 × 19.1 cm) as shown in Figure 1 on page 3, and will require a phillips pan head screw or slotted pan head screw.

You will not need to remove the plastic cover to install the MR-HP, or any of the connections. To replace the 4A FB fuse, remove the plastic cover, remove the old fuse and install a new fuse (see Figure 17).

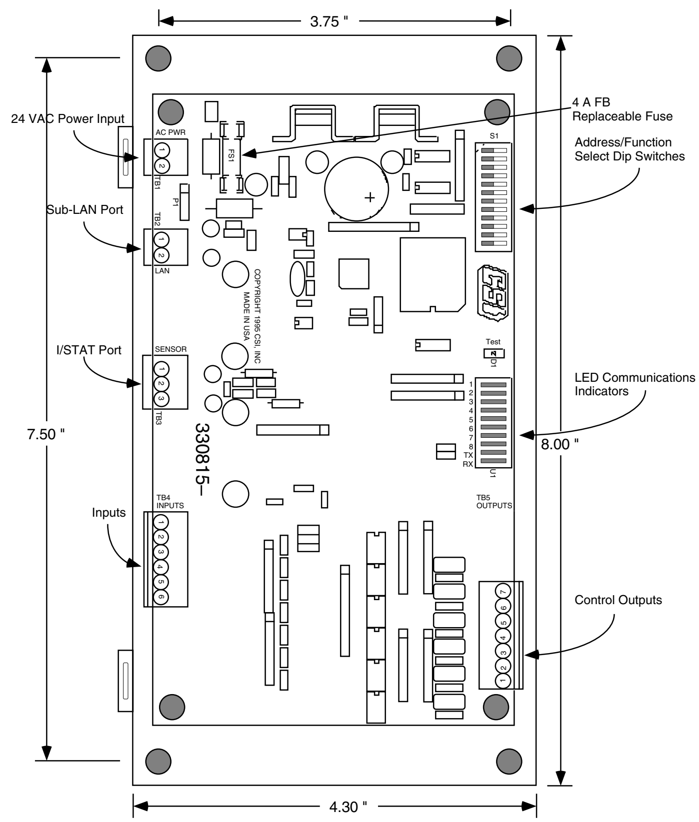

Figure 17. MR-HP Controller

Connecting the Inputs

Warning: *Ensure that no power is connected to the MR-HP during electrical installation. Failure to disconnect power from all interconnected equipment when performing electrical installation may result in damage to the components and/or electrical shock or burns*

1. Connect the external input devices (contact or thermistor) leads to an input terminal, TB4-1 through TB4-4 (Input 1 to Input 4, see Figure 18).
2. Connect the other input device lead (common return lead) to the signal ground terminal, TB4-6 (Ground).

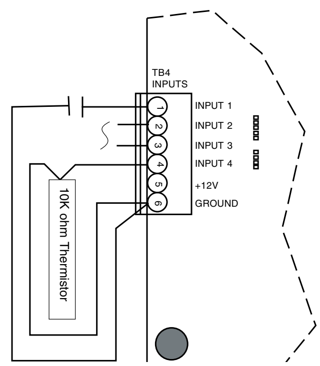

Figure 18. Input Device Connections

I/STAT, W/STAT and S/STAT Connections

1. Connect the I/STAT, W/STAT or S/STAT white, red, and black conductors to TB3-1 through TB3-3 (Signal, Power, and Ground) as shown in Figure 19.
2. When connecting an S/STAT connect the blue and yellow conductors to TB4-4 (Input 4). Refer to Table 8 on page 39 for DIP switch settings.

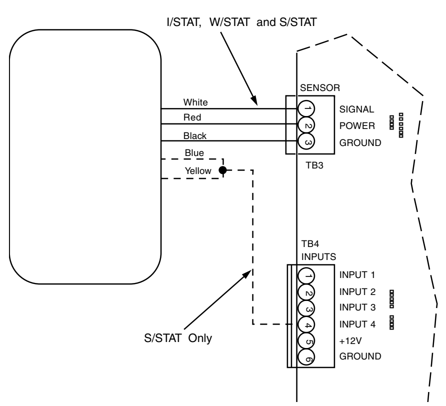

Figure 19. I/STAT Connection

Connecting the SubLAN

1. Connect the + lead of the twisted pair subLAN cable to terminal TB2-1 (LAN+, see Figure 20).
2. Connect the – lead of the twisted pair subLAN cable to terminal TB2-2 (LAN –).

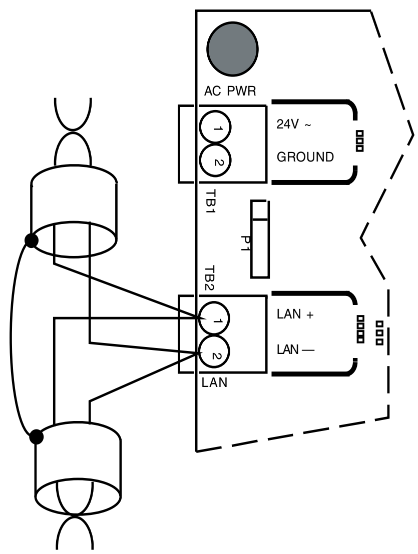

Figure 20. LAN Connection

3. Shield drain wire continuity must be maintained as the subLAN cable passes through each MR-HP. 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.
4. Connect the shield drain wire directly to Electrical Service Earth Ground at only one end of the cable (e.g., at the MCI, MRI, or at one MR-HP).

Note: *Use 22- to 24-AWG, low-capacitance, twisted pair, shielded cable (refer to "Specifications" on page 59). Multi-pair cable can be used to support multiple TAC I/NET controller subLANs but should not be used for other signaling or power purposes.*

Connecting the Output Devices

1. Connect one lead of the control relays to TB5-1 through TB5-6 (Output 1 through Output 6) as shown in Figure 21.
2. Connect the other lead of the control relays to earth ground as shown.

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

- ✦ *Electrical Service Earth Ground wire must be securely connected to the equipment chassis.*
- ✦ *The 24 VAC transformer secondary lead must be securely connected to the Electrical Service Earth Ground wire.*

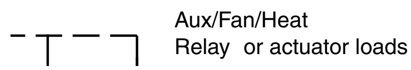

Figure 21. Output Device Connections

Note: *The Electrical Service Earth Ground wire must be connected to the ground terminal on the controller power input terminal block, TB1-2 (Ground).*

Connecting the Power Supply

1. Connect the 24 VAC input lead from a separate, isolated 24 VAC transformer to TB1-1 (24 VAC), see Figure 22.
2. Connect TB1-2 (Ground) to earth ground using 14-AWG wire (2.1 mm2). TB1-2 connects to the same earth ground connection as the neutral lead from the transformer.

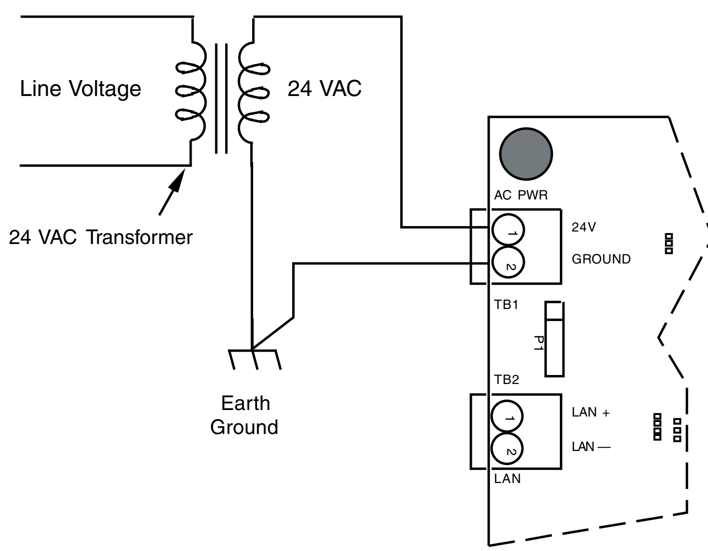

Figure 22. Power Connection

Note: *Connecting TB1-2 (Ground) to a chassis bonding post separated by seams, welds, or fasteners in the metal chassis could produce continuity ground faults.*

Warning: *Applying 24 VAC power to any connector other than TB1 will cause component damage on the MR-HP circuit board.*

Grounding Requirements

To ensure proper operation of the controller, it is imperative that the unit be correctly grounded. Therefore, use the following grounding requirements during unit installation.

Controller Earth Ground

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

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

SubLAN Ground

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

- Ensure that the subLAN cable shield drain wire is not connected to the controller subLAN terminal block.
- Connect the shield drain wire directly to Electrical Service Earth Ground at **only** one end of the cable (e.g., at the MCI, MRI, I/SITE LAN, or at one MR-HP).

Switch Settings

The DIP switch settings define the subLAN address and basic configuration of the unit. Define the subLAN address using switches 1 – 5 to set an address ranging from 0 to 31. The value is the accumulated value of switches 1 – 5 when set to the ON position (refer to Table 7). The ON position of the switch is away from the "Open" label on the switch base. The basic configuration can be initially set using the DIP switch settings in Table 8.

Table 7. MR-HP Address

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

Note: *DIP switch settings take affect only after you cycle power on the controller.*

Table 8. DIP Switch Configuration Settings

Compressor Stages		Point 06DO Definition		Supplemental Heating Stages			Fan Type		S/STAT		Reversing Valve	
SW6		**SW7**			**SW8**	**SW9**	**SW10**		**SW11**		**SW12**	
1 Stage	Off	Emergency Heat	Off	None	Off	Off	On	On	Yes	On	Energize to Heat	Off
2 Stage	On	Demand Control	On	1 Heat Stage	On	Off	Auto	Off	No	Off	Energize to Cool	On
				2 Heat Stages	Off	On						
				2 Heat Stages	On	On						

I/STAT (M/STAT) Dialogue

This section describes the basic dialogue required to properly configure the MR-HP using the I/STAT. The parameters and switch settings can be modified and copied to other MR-HPs from the Host PC editor through the MCI. The I/STAT description found in the Hardware Description section gives an overview of the function of the individual keys.

Password

The first step is entering the MR-HP password. The password itself is edited from the Host PC in the MR parameters editor. (Refer to the *TAC I/NET Operator's Guide* for details.)

1. Press the service key. The display will show 0.00. The default password is 183.
2. Press the [+] key to increase or the [–] key to decrement the left most digit.
3. Press the [↵] key to enter the value and move onto the next digit. Press the Service key to escape this mode and return to normal operation.
4. Repeat steps two and three until all three digits are complete. The last [↵] key press should cause the I/STAT to display oP for Operator Parameters. If it does not and the password flashes, then the password you entered does not match the password in the MR-HP.

Selecting Parameter Groups

After the password is entered, the mnemonic for the first parameter group, Operation Parameters (oP), appears in the display.

1. Press the [⌄] key once to display the mnemonic for Unit Parameters (UP).
2. Press the [⌄] key again to display the mnemonic for Switch SetUp Parameters (SSU).
3. Press the [⌄] key again to display the mnemonic for Point (Pnt) status group.
4. Pressing the [⌄] key again will return to the oP group.

Modifying an Analog Value

1. With the UP displayed on the I/STAT, press the [↵] key once.

2. The I/STAT will display Cd (the parameter for Compressor Delay). Press the [↵] key.
3. The I/STAT will display the current value of the Cd parameter. For this example we will use the default value of 60.0. The following is provided to assist in understand the editing function of the display.
4. Press the [⇑/⇓] keys to move between these LED's.
   - ✧ SET TEMP - This LED will be lit if the [+] and [–] keys are to edit the right most digit.
   - ✧ FAN SPEED - This LED will be lit if the [+] and [–] keys are to edit the center digit.
   - ✧ ROOM TEMP - This LED will be lit if the [+] and [–] keys are to edit the right most digit.
5. To change the value from 60.0 to 79.0, press the [⇓] key once (the FAN SPEED LED should be on). Press the [–] key once. The resulting display will be 69.0.
6. Press the [⇓] key once (The ROOM TEMP LED should be on). Press the [+] key once. The resulting display will be 79.0.
7. Press the [↵] key to enter the value into the MR-HP. Press the Service key to escape without entering the value into the MR-HP. In either case the I/STAT will take you back to Cd.

Modifying a Discrete Value

The I/STAT is currently displaying the Cd parameter in the UP group from the previous example.

1. Press the [⇓] key until the I/STAT displays the Damper Type (dt) parameter. Press the [↵] key. The I/STAT will display the current value of dt, which for this example is the default value of 1.
2. Press the [+] key to select the next discrete option (2 in this case) or [–] to select the previous option (0 in this case). Pressing [+] or [–] repeatedly will cycle through all of the options.
3. When the display shows the value you want to select, press the [↵] key to enter the value in the MR-HP. Press the Service key to escape without entering the value into the MR-HP. In either case the I/STAT will take you back to dt.

Checking an Input Point Value

The I/STAT is currently displaying the dt parameter in the UP groups from the previous example.

1. Press the Service key, which will redisplay UP.
2. Press the [⇓] key through oP and SSU until Pnt is displayed. Press the [↵] key.
3. The I/STAT will display PC0 for the output point at address 0. Pressing the [⇑] or [⇓] keys scrolls the display through the mnemonics for all 10 input and output points. Stop when the display shows the mnemonic P 7. This is the input point for space temperature.

4. Press enter. The I/STAT will display the current value of the space temperature. The value of input points cannot be changed from the I/STAT.

Controlling an Output Point Value

1. Press the Service key once to escape from P 7.
2. Press the [^] key until the displays shows PC1.
3. Press the [↵] key. The I/STAT will display the current status of output 01 which is the point associated with the first compressor.
4. Press the [+] key to increase the value.
5. Press the [–] key to decrease the value.
6. Press the [↵] key to enter the value into the MR-HP. The MR-HP does not support the “Manual” command from the STA, which means that if an output point is being controlled by the MR-HP software, the software will override the manual control the next time it runs.

Calibration

Calibrate Space Sensor

To calibrate the space temperature sensor using the reading from a presumably more accurate thermal measurement standard, select oP from the parameter group and then use the following steps.

1. Select CSS using the [⇑/⇓] keys, then press the [↵] key.
2. The current space temperature display. Enter the new temperature by pressing the [+/–] keys until the display shows the desired reading, then press the [↵] key.
3. The I/STAT will produce a new offset (b) value in the appropriate Factory Conversion Coefficients, and the LCD will redisplay CSS.
4. Press the Service key to exit.

Unit Setup

Parameter Editing

The Unit Parameters (UP), Operational Parameters (oP), and Switch Setup Parameters (SSU), allow you to customize the MR-HP control configurations previously defined in the setup of the MR-HP.

If you choose to accept the factory defaults for setpoints, bands, etc., you do not need to change any of the MR-HP Unit and Operational Parameters. If you do elect to modify the parameters you may use either the I/STAT or M/STAT, or the ASC Parameters editor in the TAC I/NET host.

Unit Parameters (UP)

The Unit Parameters (UP) will address the physical configuration of the individual MR-HP.

The following table contains the parameters found in UP, their range and default settings. (To display or change the Unit Parameter settings in Table 9, select UP from the Service mode. Refer to the "I/STAT (M/STAT) Dialogue" on page 43 for I/STAT navigation.)

Table 9. Unit Parameter Settings

Unit Parameter Name	Default Value	Parameter Description	Range
Cd	30	Compressor Delay –Interstage	0–999 Seconds
Hd	10	Supplemental Heat Delay - Interstage	0–999 Seconds
Fd	60	Fan delay – Run On Time	0–999 Seconds
dt	1	Damper Type	0 = Econ 1 = Minimum OA Damper 2 = No Damper
do	0	Damper Output Type	0 = 2-position, 1 output 1 = PWM, 1 output 2 = PWM, 2 outputs 3 = Duty Cycle, 1 output
dS	185	Damper Stroke	0–999 Seconds
SPL	0	Local Shutdown/Purge/ Lockout (input 1)	0 = No (MCI) 1 = Yes (Local)
oCC	0	Local Occupancy (input 2)	0 = No (MCI) 1 = Yes (Local)
Ent	0	Local Enthalpy (input 3)	0 = No (MCI) 1 = Yes (Local)

Compressor Delay

The Compressor Delay (Cd) parameter sets the minimum delay in seconds before the first stage of compressor can start. Cd also serves as the interstage delay for a second compressor.

This is comparable to a delay-before-make relay. As the space temperature decreases or increases, a stage of compressor is required. The second stage time delay will not begin until the first stage has completed it's time delay. The control strategy will prevent the output from energizing for the duration of Cd.

Supplemental Heating Delay

The Supplemental Heating Delay (Hd) parameter sets the minimum delay in seconds before the first stage of supplemental heating can start. Hd also serves as the interstage delay for a second stage.

This is comparable to a delay-before-make relay. As the space temperature decreases, a stage of supplemental heat is required. The second stage time delay will not begin until the first stage has completed its time delay. The control strategy will prevent the output from energizing for the duration of Hd.

Fan Delay – Run On Time

The Fan Delay (Fd) parameter is the time in seconds that the fan continues to run after the first stage of heating or cooling has been turned off.

The Fd parameter is comparable to a delay-before-break relay. The longer the duration, the longer the fan will run after it is no longer required. This parameter will allow the fan to remove latent heat from the heating coil after being controlled off. The delay will also help prevent short cycling.

Damper Type

The Damper Type (dt) parameter defines the type of control implemented on the outside air damper. There are three states for this parameter.

Econ

The Econ definition will control the outside air damper based upon the enthalpy input point. If enthalpy is On, then the damper output will energize if defined as 2-position (parameter do) or the damper output will modulate to maintain the space temperature at the active cooling setpoint. Indoor air quality requires a minimum damper position. This minimum value comes from the S/P/L point and is honored regardless of the enthalpy switch. (Refer to the "Functional Description" on page 13 for more details on these configurations.)

OA

The OA definition treats the damper as minimum outside air damper to meet indoor air quality requirements. The damper point will energize any time the fan is On and the occupancy point is On.

None

Define dt as None when no damper is present. The damper type must be defined as None if two stages of Supplemental Heating is required.

Damper Output Type

The Damper Output (do) parameter allows you to define the type of control to be applied to the damper actuator.

0 = 2-Pos — relay/triac (TB5-6, Output 6)

1 = 1-Out-PWM — PWM transducer (TB5-6, Output 6)

2 = 2-Out-PWM — bidirectional actuator (TB5-6, Output 6 = Increment, TB5-1, Output 1 = Decrement)

3 = 1-Duty Cycle— Time Proportioning actuator (TB5-6, Output 6)

The dt, do and dS parameters work together to define the heating output control. The dt parameter will define the control strategy. The do parameter will define the type of output control. The dS parameter will define the output response duration.

Note: *The second stage of supplemental heat uses output 6 (TB5-6 if the value of DIP switches 8 and 9 are greater than 1. Therefore, in order to properly stage the supplemental heat, set the do parameter to zero for 2-position control.*

Damper Stroke

The Damper Stroke Time (dS) parameter is the number of seconds that the HP damper takes to move from fully closed to fully open.

The value of dS will depend upon the Damper Output (do) type.

- For 2-position control, leave the dS at its default setting (any value greater than zero).
- For 1-output PWM, dS will be the pulse duration required to cause the PWM device to go to the desired output. For example, in order for the PWM transducer to output a 10 VDC signal, a 5.2 second pulse is required. This requires that dS be 5.2 seconds. In all cases of PWM control, the output will pulse for 0.1 second for a zero control signal.
- For 2-output PWM control, dS will be the throttling time of the actuator. The throttling time is defined as the time required for the actuator to change position from fully open to fully closed.
- For the 1-output duty cycle (time proportioning), dS will be the throttling time of the actuator.

Local Shutdown/Purge/Lockout

The Local Shutdown/Purge/Lockout (SPL) parameter identifies the source for unit shutdown/purge/lockout notification. When the SPL parameter is set to 0, remote notification comes from the MCI, MRI, or I/SITE LAN at address 04 AI. When the SPL parameter is set to 1, local notification comes from a contact closure that is wired directly to the MR-HP controller at address 00 AI. (Refer to Functional Descriptions, Point Database, for a complete description of the effect of Shutdown/Purge/Lockout on the control strategy. Refer to “Point Database” on page 27 for a complete description of the effect of Shutdown/Purge/Lockout on the control strategy.

Local Occupancy

The Local Occupancy (oCC) parameter will determine the source of the "Occupancy" point in the MR-HP. When oCC is 0, Occupancy comes from the MRI Automatic Time Schedule. When oCC is 1, the Occupancy comes from a local switch contact. Refer to "Point Database" on page 27 for a complete description of Occupancy.

Local Enthalpy

The Local Enthalpy (Ent) parameter will determine the source of the "Enthalpy" point in the MR-HP. When Ent is 0, the Enthalpy point is internal point address 08 DI and it's logic comes from the MRI. When Ent is 1, the Enthalpy decision comes from the hardware input point 02 DI as a local switch contact. (Refer to Functional Descriptions, Point Database, for a description of Enthalpy's effect on the program. Refer to "Damper Control" on page 14 for a description of enthalpy and it's use.

Operational Parameters (oP)

The Operational Parameters (oP) are used to define how the MR-HP will control in it's given environment. The parameters associated with oP effect the temperature setpoints and how they are displayed on the I/STAT.

The following table contains the parameters found in oP, their range and default settings. (To display or change the Operational Parameter settings in Table 10, select oP from the Service mode. Refer to "I/STAT (M/STAT) Dialogue" on page 43 for I/STAT navigation.)

Table 10. Operational Parameter Settings

Operational Parameter Name	Default Value	Parameter Description	Range
Od	60	Override Duration	0 – 255 Minutes
SPo	0.00 (0.00)	Setpoint Offset (when non-zero, ignore CSP, HSP)	0.00 – 9.99° F (0.00 – 9.99° C)
SAr	5.00 (4.00)	Stat Adjustment Range	0.00 – 9.99° F (0.00 – 9.99° C)
nSU	85.0 (30.0)	Night Setup	49.0 – 99.9° F (10.0 – 35.9° C)
dSU	80.0 (27.0)	Demand Setup	49.0 – 99.9° F (10.0 – 35.9° C)
CSP	75.0 (24.0)	Cooling Setpoint	49.0 – 99.9° F (10.0 – 35.9° C)
HSP	70.0 (21.0)	Heating Setpoint	34.0 – 85.0° F (4.0 – 30.0° C)
dSb	67.5 (19.5)	Demand SetBack	34.0 – 85.0° F (4.0 – 30.0° C)
nSb	65.0 (18.)	Night SetBack	34.0 – 85.0° F (4.0 – 30.0° C)
Cb	3 (2.0)	Cooling Band	1 – 9.50° F (0.50 – 8.00° C)

Table 10. Operational Parameter Settings (Continued)

Operational Parameter Name	Default Value	Parameter Description	Range
Hb	2.5 (2.0)	Heating Band	1 – 9.50° F (0.50 – 8.00° C)
CEC	0	Cooling Error Correction	0 = None 1 = Mild (600 seconds) 2 = Medium (300 seconds) 3 = Strong(60 seconds)
SPd	0	Setpoint Display	0 = Actual 1 = Average
CSS	–	Calibrate Space Sensor	–
PP	–	Prove Performance	–

Override Duration

The Override Duration (Od) parameter controls the number of minutes that the operating mode of the MR-HP controller will be overridden when the On/Off button on the I/STAT or S/STAT is pressed. The state of the occupancy point (point 01 DI or 07 DO) determines the operating mode.

If the occupancy point has been controlled On by ATS or the local occupancy point (01 DI), then pressing the On/Off button does not affect occupancy. If the occupancy point is Off, pressing the On/Off button will control Occupancy On for the duration of od. Pressing the On/Off button while in override operation will cancel the override and return the control of the HP to unoccupied setpoints.

If you set the Od parameter value to 0, the On/Off button is disabled and it will not affect the operation of the MR-HP. If you set the Od parameter value to 255, the key is treated as a physical On/Off button. It must be pressed to put the system into override and pressed again to take it out of override.

Setpoint Offset

The Setpoint Offset (SPo) establishes the value for the occupied setpoints as follows:

- ✦ Cooling Setpoint = System Setpoint (09 AO) + SPo
- ✦ Heating Setpoint = System Setpoint (09 AO) - SPo

Note: *The SPo does not affect the Demand or night-time setpoints (dSU, dSb, nSU, and nSb).*

For an MR-HP operating in a stand-alone configuration (not connected to an MCI, MRI, or I/SITE LAN), you should set the SPo to 0. In this case the Cooling Setpoint (CSP) and Heating Setpoint (HSP) parameters become the source for the occupied setpoints.

STAT Adjustment Range

The STAT Adjustment Range (SAr) parameter determines the range of temperature control, in degrees Fahrenheit, that an operator has using an I/STAT or an S/STAT. The range is equally divided across the active setpoint, which limits the adjustment in either direction to one-half of the total range.

The Stat Adjustment Range is applied to the limits of the Stat Adjust point (08 AO) in the negative and positive direction. The range is also applied to the increment limits in the I/STAT parameters found in the MRI editor - MR Parameters. (The default increment range in of the Stat adjustment is 0.5 degrees. An SAr of 8 will allow the occupant to raise and lower the setpoint by +4 to –4 degrees.

Note: *The Stat adjustment function is disabled when the space temperature is being controlled to the Demand or night-time setpoints (dSU, dSb, nSU, and nSb).*

Night Setup

The Night Setup (nSU) parameter supplies the cooling setpoint during the time the area is unoccupied. The high limit of this parameter is 99.9° F (35.9° C). Any value over 99.0° F (35.0° C) will cause the cooling control sequences to "go to control failsafe" when the space becomes unoccupied. The intention is to give the operator the ability to disable the night setup feature.

Demand Setup

The Demand Setup (dSU) parameter supplies the occupied cooling setpoint when the demand point is On. The high limit of this parameter is 99.9° F (35.9° C). Any value over 99.0° F (35.0° C) will cause the cooling control sequences to "go to control failsafe" when the demand point is controlled On. The intention is to give the operator the ability to completely disable the cooling sequences when the unit goes into the demand mode of operation.

Note: *If DIP switch 7 is set for Emergency Heat then the demand setup and setback have no effect in the control strategies.*

Cooling Setpoint

The Cooling Setpoint (CSP) parameter supplies the occupied cooling setpoint when the demand point is Off and the occupancy point is On. The high limit of this parameter is 99.9° F (35.9° C). Any value over 99.0° F (35.0° C) will cause the cooling control sequences to "go to control failsafe."

Heating Setpoint

The Heating Setpoint (HSP) parameter supplies the occupied heating setpoint when the demand point is Off and the occupancy point is On. The low limit of this parameter is 34.0° F (4.0° C). Any value below 35.0° F (5.0° C) will cause the heating control sequences to "go to control failsafe."

Demand SetBack

The Demand SetBack (dSb) parameter supplies the occupied heating setpoint when the demand point is On and occupancy is On. The low limit of this parameter is 34.0° F (4.0° C). Any value below 35.0° F (5.0° C) will cause the heating control sequences to "go to control failsafe" when the demand point is controlled On. The intention is to give the operator the ability to completely disable the heating sequences when the unit goes into the demand mode of operation.

Night SetBack

The Night SetBack (nSb) parameter supplies the unoccupied heating setpoint. The low limit of this parameter is 34.0° F (4.0° C). Any value below 35.0° F (5.0° C) will cause the heating control sequences to "go to control failsafe" when the occupancy point is controlled On. The intention is to give the operator the ability to completely disable the heating sequences when the unit goes unoccupied.

Cooling Band

The Cooling Band (Cb) parameter defines the span of space temperature, in degrees Fahrenheit, that surrounds the active cooling setpoint (one-half of the span above the setpoint, and one-half below the setpoint). The% load point (06 AI) is a positive value between 0 and 100, and will reflect where the temperature is in relation to the setpoint and cooling band. As the temperature increases through the cooling band, the stages of cooling will be implemented.

Heating Band

The Heating Band (Hb) parameter defines the span of space temperature, in degrees Fahrenheit, that surrounds the active heating setpoint (one-half of the span above the setpoint, and one-half below the setpoint). The% load point (06 AI) is a negative value between 0 and –100, and will reflect where the temperature is in relation to the setpoint and heating band. As the temperature decreases through the heating band, the stages of heating will be implemented.

Cooling Error Correction

The Cooling Error Correction (CEC) parameter lets you eliminate the "Offset" error that naturally occurs in Proportional-only control in a standard 2 or 3-mode controller. You can eliminate the Offset error in the TAC I/NET DDC application by adding an appropriate integral (I) factor where the unit is in "Seconds." This produces the classical "Resets per unit of time" type of correction. Refer to the *TAC I/NET Reference Guide* for details.

You may produce an equivalent action in the MR-HP using the CEC parameter, except that the units are expressed in terms of "strength," as follows:

- 0 = Proportional-only control (no offset error correction)
- 1 = Mild correction (nominally 10 minutes to completely remove the error)
- 2 = Medium correction (nominally 5 minutes to completely remove the error)
- 3 = Strong correction (nominally 1 minute to completely remove the error)

Note: *Stronger actions produce tighter control, but can cause the space temperature to oscillate. It is recommend that if CEC is to be implemented, it should start with Mild and progress to Strong as necessitated by the application.*

Setpoint Display

The Setpoint Display (SPd) parameter controls the value that is displayed on the I/STAT when you select SET TEMP. A value of 0 displays the current active cooling or active heating setpoint. The I/STAT will display the setpoint which is closest to the temperature in the space. A value of 1 displays the average of the active heating and active cooling setpoints. The value displayed from SET TEMP is also the value of the "active setpoint" used at the TAC I/NET host.

The active cooling and heating setpoints are determined by several conditions. First, if the status of the occupancy is Off, then the setpoints will be based upon the night setup and night setback setpoints. If the occupancy is On and the demand control point is On, then the setpoints will be based upon the demand setup and setback setpoints. If the occupancy is On and the demand control point is Off, then the setpoints will be based upon either the CSP and HSP parameters or the system setpoint with the setpoint offset (SPo).

Calibrate Space Sensor

When you select the operational parameter Calibrate Space Sensor (CSS), the current value of the space temperature point (07 AI) displays. From this display you may calibrate the space temperature sensor using the reading from a presumably more accurate thermal measurement standard. The calibration procedure adjusts the factory offset value associated with the space temperature point (BB07).

Prove Performance

The Prove Performance (PP) parameter will allow the operator validate the control of the outputs by varying the space temperature. When PP is selected, the I/STAT will display the current space temperature. The operator presses the + key causes space temperature to increment at 0.2° F (0.1° C). Pressing the - key causes the space temperature to decrement by 0.2° F (0.1° C).

The four LEDs on the lower portion of the I/STAT will indicate the current status of the outputs. For example, is the Fan is On then the LED for SET TEMP will be energized. The definition of the LEDs is dependent on the space temperature being above or below the average of the current heating and cooling setpoints. The following table explains the assignment of the outputs.

Table 11. LED Definitions

LED	Space Temperature > Average Setpoint	Space Temperature < Average Setpoint
SET TEMP	Fan Control	Fan Control
FAN SPEED	Damper Position	Reversing Valve Control
ROOM TEMP	Compressor Stage 1	Supplemental Heat Stage1
OUTSIDE	Compressor Stage 2	Supplemental Heat Stage2

Switch Setup Parameters (SSU)

The Switch Setup Parameters allow you to modify or change the settings associated with switches the DIP switches 1–12 located on the MR-HP. The settings can be altered through the I/STAT, ASC Parameters editor from a TAC I/NET host, or with the DIP switches on the MR-HP. In any case, the latest modification to the configuration takes precedence. If the last change was to the DIP switches, then all DIP switch settings are applied. (A power cycle must occur for a change in the DIP switches to occur.) If the latest change was made through the SSU parameters, then those settings are applied. Refer to the installation section of this manual for more information on setting the DIP switches at the MR-HP.

1–5

This defines the address of the MR-HP on the subLAN of the MRI. Each address on the subLAN must be unique.

6

This parameter refers to DIP switch 6. The parameter determines the number of compressor which will be controlled. A setting of 0 (switch 6 is off) will control one compressor on address 01DO. A setting of 1 (switch 6 is on) will control two compressors (outputs 01DO and 00DO).

7

This parameter refers to DIP switch 7. The parameter is intended to determine the type of control for point address 06 DO. A setting of 0 (switch 7 is off) will cause point 06 DO be used for Emergency Heat application. (When this point is controlled On, the compressors will be prevented from be used for heating applications and will cause the supplemental heat to be used as the first and second stage of heat. When this point is control Off, then the compressors can be used for heating.) A setting of 1 (switch 7 is on) will cause point 06 DO to be used for demand control. (When this point is controlled On during occupancy, the unit will defer to the demand setup and setback setpoints.)

8–9

This parameter refers to DIP switches 8 and 9. The switches are used in combination to define the number of stages of supplementary heat. Both switches Off equates to no supplementary heat. This will free output 5, 04DO, for use for other applications. Setting 8-9 to a value of 1 (switch 8 On and 9 Off) will define one stage of supplementary heat. The one stage will use output 5, 04DO, for control. Setting 8-9 to a value of 2 (switch 8 Off and 9 On, or both 8 and 9 On) will configure the controller for two stages of supplementary heat. Stage one will use output 5, 04DO. Stage two will use output 6, 05AO. This output is also used as the damper position point. Hence, the controller should not be configured for two stages of supplemental heat and a damper. When two stages are used, the value of 05AO will be 0 for Off and 100 for On.

10

The fan type parameter defines whether the fan controls on and off with the stages of heating or cooling (0 = Auto) or whether it runs continuously (1 = On) during occupied hours and stages as required when unoccupied.

11

This parameter determines the presence of a S/STAT on input 4. This parameter should be 0 for I/STAT, W/STAT or straight thermistor and a 1 when an S/STAT is present.

If present, the S/STAT value is brought into the MR-HP ranging from 0 to 100 at address 03 AI. The MR-HP internal software will apply this value to the Stat Adjustment point (08 AO) via the Stat Adjustment Range parameter (SAr).

12

This parameter refers to DIP switch 12. The switch will define the control action of the reversing valve. A setting of 0 (or off) will cause the reversing valve to be energized on a call for heating. A setting of 1 (or On) will cause the reversing valve to be energized on a call for cooling.

Clearing Memory in the MR-HP

The MR-HP resides on a communication subLAN that is susceptible to communication errors from external sources. These communication errors could result in corruption of the MR-HP's NOVRAM. When this occurs, the MR-HP will stop communicating, or will cause continuous Lost/Restore messages. For this reason, the MR-HP is provided with a means of clearing its NOVRAM.

1. Remove power from the MR-HP.
2. Set DIP switches 6 through 12 to the On position and restore power.
3. Remove power again.
4. Set DIP switches 6 through 12 to the Off position and restore power.
5. Remove power again and reset the switches to their normal configuration.

Normal communication should be restored to the MR-HP. If not, then the problem lies elsewhere. Once communication is restored, perform the Update_ASC from the TAC I/NET host to restore the NOVRAM image to the MR-HP.

Pinout Chart

MR-HP

Location: ______________________

Station Address: ______________________

Station Address: ______________________

Point Address: ______________________

Input	Terminal Block	Point Type/ Address	Point Description
Input 1	TB4	AI/DI 00	Local SPL or free
Input 2	TB4	AI/DI 01	Local Occupancy or free
Input 3	TB4	AI/DI 02	Local Enthalpy or free
Input 4	TB4	AI/DI 03	S/STAT

0utput	Terminal Block	Point Type/ Address	Point Description
Output 1	TB5 (24VAC)	DO 00	Y2 (C2) — Compressor Stage 2, or Damper (–), or free point
Output 2	TB5 (24VAC)	DO 01	Y1 (C1) — Compressor Stage 1
Output 3	TB5 (24VAC)	DO 02	G (Fan) — Fan
Output 4	TB5 (24VAC)	DO 03	O (Rev) — Reversing Valve
Output 5	TB5 (24VAC)	DO 04	S1 — Supplemental Heat Stage 1 or free point
Output 6	TB5 (24VAC)	AO/PWM 05	S2/DMP — Supplemental Heat Stage 2 or Damper Position (DMPR +)

Specifications

Dimensions

MR-HP:
Housing . . . . 7.75"W × 6.25"L × 2.5"H
. . . . (19.7 × 15.9 × 6.3 cm)
PCB . . . . 4.8" W × 3.425" L (10.2 × 17.8 cm)

I/STAT and S/STAT . . . . 2.75"W × 4.5"L × 0.9"D
. . . . (7.0 × 11.4 × 2.3 cm)

Operating Environment

Temperature . . . . 32–122°F (0–50°C)

Humidity . . . . 10% to 90%, non-condensing

Input power:
with I/STAT
. . . . . . 24 VAC @7 VA + output load, 4 A fused
without I/STAT
. . . . . . 24 VAC @6 VA + output load, 4 A fused

Cables

SubLAN:

- 22 AWG (0.324 mm^2) shielded, twisted pair (Belden 9184 equivalent) 5,000 feet (1,500 m) maximum

  or

- 24 AWG (0.206 mm^2) shielded, twisted pair (Belden 9841 equivalent) 4,000 feet (1,200 m) maximum per segment. 30 pF/ft. or less between conductors, 55 pF/ft. or less conductor to shield, 85 to 150 ohm impedance.

I/STAT and S/STAT:

- 18–24 AWG three conductor cable or shielded, twisted pair (Belden 9184 equivalent) 100 feet (30 m) maximum from the controller.

Note: *The S/STAT will require four conductors*

MR-HP Inputs

Quantity 4

AI inputs:
Type . . . 10K Ω Thermistor NTC Dale 1M1002-C3)
Range . . . . 25°F to 113°F (-4°C to 45°C)
Resolution . . . . 0.4% Span
Accuracy . . . . 1.0% Typical (2% max)

DI inputs:
contact excitation . . . . 5 V @ 0.5 mA
input duration . . . . 0.2 second minimum

MR-HP Outputs

Quantity . . . . 6 on terminal block

Type . . . . 5 low voltage triac, voltage sourcing
. . . . 24 VAC @ 0.5 A maximum

Operating Mode . . . . . . 2-position, 3-state Floating,
. . . . Time Proportional Modulation

SubLAN Port

Protocol . . . . Asynchronous, polling

Connection type RS485

Baud rate . . . . 9,600 baud

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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 Schneider Electric at no charge to you. Before contacting Schneider Electric, 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 Schneider Electric to arrange to have this equipment repaired or replaced.

SCHNEIDER ELECTRIC 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 Schneider Electric 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 Schneider Electric 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.

Schneider Electric

Schneider Electric
Buildings – Europe
Jägershillgatan 18
213 75 Malmö
Sweden
Phone: +46 40 38 68 50
Fax: +46 40 21 82 87

Schneider Electric
Buildings – Americas
1650 W. Crosby Rd.
Dallas, TX 75006 USA
Phone: +1 (972) 323 1111
Fax: +1 (972) 242 0026

Schneider Electric
Buildings – Asia-Pacific
Level 3/2A Lord Street
Botany NSW 2019
Australia
Phone: +61 (0) 2 8336 6100
Fax: +61 (0) 2 8336 6190

www.schneider-electric.com/buildings

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