Overview

The MAR7000 is a controller and sensors in a single, attractive package that creates a flexible solution to stand-alone control challenges or BACnet network challenges. Temperature, humidity, and motion sensing are standard. Flexible input and output configurations and built-in programming ensure that a variety of application needs can be met:

- Heat pump unit, with up to two compressor stages, and with optional auxiliary heat, emergency heat, dehumidification, and/or fan status
- A/C, with up to two H/C stages, and with optional economizer, dehumidification, and/or fan status

Features

Interface and Function

- User-friendly English-language menus (no obscure numeric codes) on a 64 x 128 pixel, dot-matrix LCD display with 5 buttons for data selection and entry
- Built-in, factory-tested libraries of configurable application control sequences
- Integral energy management control with deadband heating and cooling setpoints and other advanced features
- Schedules can easily be set uniquely by entire week (Mon.–Sun.), weekdays (Mon.–Fri.), weekend (Sat.–Sun.), individual days, and/or holidays—or “learned” automatically via motion sensing
- Six On/Off and independent heating and cooling setpoint periods are available per day
- Three levels of password-protected access (user/operator/administrator) prevent disruption of operation and configuration
- Integral temperature, humidity, motion, and CO₂ sensor options
- A 72-hour power (capacitor) backup and a real-time clock for network time synchronization or full stand-alone operation

BACnet Standards

- Meets or exceeds BACnet AAC specifications in the ANSI/ASHRAE BACnet Standard 135-2008

Specifications and design subject to change without notice.
**Inputs and Outputs**

- Three or six analog inputs for use with external devices such as mixed air temperature, fan status, outside air, and remote CO₂.
- Analog inputs accept industry-standard 10K ohm thermistor sensors or dry contacts.
- Inputs can be configured via a switch for 10K ohm pull-up resistors (for unpowered contacts or devices) or 0–12 VDC.
- Input overvoltage protection (24 VAC, continuous).
- 12-bit analog-to-digital conversion on inputs.
- Seven NO, SPST (Form “A”) relays carry 1 A max. per relay or 1.5 A per bank of 3 relays (relays 1–3 and 4–6) @ 24 VAC/VDC.

**Connections**

- Screw terminal blocks, wire size 14–22 AWG, for inputs, outputs, power, and BACnet network.
- Integral peer-to-peer BACnet MS/TP LAN network communications on all devices (with configurable baud rate from 9600 to 76.8K baud).
- A four-pin EIA-485 data port on the underside of the case enables easy temporary computer connection to the BACnet network.
- “E” versions add an RJ-45 jack.

**Installation**

- Backplate mounts on a standard vertical 2 x 4-inch wall handy-box.
- Two-piece design allows field rough-in and termination of field wiring to the backplate without needing the MAR7000 at the site—permitting MAR7000s to be bulk-configured off-site and plugged into the wired backplates at a later time if desired.
- Attractive white plastic case.

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**Specifications**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supply Voltage</strong></td>
<td>24 VAC (+20%/-15%), Class 2</td>
</tr>
<tr>
<td><strong>Supply Power</strong></td>
<td>13 VA (not including relays)</td>
</tr>
<tr>
<td><strong>Connections</strong></td>
<td>Wire clamp type terminal blocks; 14–22 AWG, copper Four-pin EIA-485</td>
</tr>
<tr>
<td><strong>Outputs</strong></td>
<td>NO, SPST, Form “A” relays carry 1 A max. per relay or a total of 1.5 A per bank of 3 relays (relays 1–3 and 4–6) @ 24 VAC/VDC</td>
</tr>
<tr>
<td><strong>External Inputs</strong></td>
<td>Analog 0–12 VDC (active/passive contacts, 10K thermistors)</td>
</tr>
<tr>
<td><strong>Display</strong></td>
<td>64 x 128 pixel dot matrix LCD</td>
</tr>
<tr>
<td><strong>Case Material</strong></td>
<td>White flame-retardant plastic</td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td>5.406 x 4.9 x 1.135 inches (138 x 125 x 29 mm)</td>
</tr>
<tr>
<td><strong>Approvals</strong></td>
<td>UL 916 Energy Management Equipment; FCC Class B, Part 15, Subpart B and complies with Canadian ICES-003 Class B (CO₂ models only: FCC Class A, Part 15, Subpart B and complies with Canadian ICES-003 Class A)</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>0.496 lbs. (225 g) or 0.694 lbs. (314 g) for CO₂ models</td>
</tr>
<tr>
<td><strong>Humidity Sensor</strong></td>
<td>CMOS</td>
</tr>
<tr>
<td><strong>Sensor Type</strong></td>
<td>CMOS</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>0 to 100% RH</td>
</tr>
<tr>
<td><strong>Accuracy @ 25°C</strong></td>
<td>±2% RH (10 to 90% RH)</td>
</tr>
<tr>
<td><strong>Response Time</strong></td>
<td>Less than or equal to 4 seconds</td>
</tr>
<tr>
<td><strong>Temperature Sensor</strong></td>
<td>CMOS</td>
</tr>
<tr>
<td><strong>Sensor Type</strong></td>
<td>CMOS</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>±0.9° F offset (±0.5° C) from 40 to 104° F (4.4 to 40° C)</td>
</tr>
<tr>
<td><strong>Operating Range</strong></td>
<td>36 to 120° F (2.2 to 48.8° C)</td>
</tr>
<tr>
<td><strong>Motion Sensor</strong></td>
<td>Passive infrared with 10 meter (33 feet) range (see diagrams on the next page)</td>
</tr>
<tr>
<td><strong>CO₂ Sensor</strong></td>
<td>See chart on the next page</td>
</tr>
<tr>
<td><strong>Environmental Limits</strong></td>
<td>Humidity</td>
</tr>
<tr>
<td><strong>Humidity</strong></td>
<td>0 to 95% RH (non-condensing)</td>
</tr>
</tbody>
</table>
**CO₂ Sensor Specifications**

<table>
<thead>
<tr>
<th>Applications</th>
<th>For zones with <strong>occupied/unoccupied</strong> times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>Non Dispersive Infrared (NDIR), with ABC Logic</td>
</tr>
<tr>
<td>Calibration</td>
<td>Self-calibrates over several weeks*</td>
</tr>
<tr>
<td>Typical Life of Sensor</td>
<td>15 years</td>
</tr>
<tr>
<td>Measurement Range</td>
<td>400 to 2000 ppm</td>
</tr>
<tr>
<td>Accuracy (at nominal operating temperature)</td>
<td>±35 ppm @ 500 ppm, ±60 ppm @ 800 ppm, ±75 ppm @ 1000 ppm, ±90 ppm @ 1200 ppm</td>
</tr>
<tr>
<td>Altitude Correction</td>
<td>Configurable from 0 to 32,000 feet</td>
</tr>
<tr>
<td>Pressure Dependence</td>
<td>0.135 of reading per mm Hg</td>
</tr>
<tr>
<td>Temperature Dependence</td>
<td>0.2% FS (full scale) per °C</td>
</tr>
<tr>
<td>Stability</td>
<td>&lt; 2% of FS over life of sensor</td>
</tr>
<tr>
<td>Response Time</td>
<td>&lt; 2 minutes for 90% step change typical</td>
</tr>
<tr>
<td>Warm Up Time</td>
<td>&lt; 2 minutes (operational) and 10 minutes (maximum accuracy)</td>
</tr>
</tbody>
</table>

This model uses Automatic Background Calibration Logic, or ABC Logic, a patented self-calibration technique designed to be used in applications where concentrations will drop to outside ambient conditions (approximately 400 ppm) at least three times in a 14 day period, typically during unoccupied periods. With ABC Logic enabled, the sensor will typically reach its operational accuracy after 25 hours of continuous operation if it was exposed to ambient reference levels of air at 400 ±10 ppm CO₂. The sensor will maintain accuracy specifications with ABC Logic enabled, given that it is at least four times in 21 days exposed to the reference value and this reference value is the lowest concentration to which the sensor is exposed. ABC Logic requires continuous operation of the sensor for periods of at least 24 hours.
Connections and Wiring

**CAUTION**
- This thermostat is for 24 VAC applications only. Do not use on voltages over 30 VAC.
- All installation and wiring must conform to local and national electrical and building codes.
- Use this thermostat only as described in this manual.

Wiring Considerations
- Because of the many connections (power, network, inputs, outputs, and their respective grounds or switched commons), be sure wiring is well planned before installation of conduit!
- Make sure that conduit for all wiring has adequate diameter for all necessary wiring. Using 1-inch conduit and junction boxes is recommended! Use external junction boxes above the ceiling or in another convenient location as needed to make connections that run to the MAR7000's junction box.
- To prevent excessive voltage drop, use a conductor size that is adequate for the wiring length! Allow plenty of “cushion” to allow for transient peaks during startup.
- Using multiple conductor wires for all inputs (e.g., six conductor) and outputs (e.g., 12 conductor) is recommended. Grounds for all the inputs can be combined on one wire.

Mounting

For optimum temperature sensor performance, the MAR7000 must be mounted on an interior wall and away from heat sources, sunlight, windows, air vents, and air circulation obstructions (e.g., curtains or furniture). Install it where the motion sensor will have unobstructed view of the most typical traffic area.

If replacing an existing thermostat, label wires as needed for reference when removing the existing thermostat.

**CAUTION**
- Installing a 6-input model on a (powered) 3-input backplate (see page 5) will permanently damage the controller.
- To prevent mounting screw heads from touching the circuit board in the thermostat, use only the supplied mounting screws. Using screws other than the type supplied may damage the controller.

1. Complete rough-in wiring at each location prior to thermostat installation. Cable insulation must meet local building codes.
2. Push in on the tabs (two on top and bottom), and pull the cover away from the backplate (mounting base).
3. Route the wiring through the backplate.
4. With the embossed UP toward the ceiling, fasten the backplate directly to a vertical 2 x 4 inch wall handy-box.
5. Make the appropriate connections to the terminal blocks. (See Connections and Wiring on page 4.)
6. Seal the hole for wires behind the mounting base with non-flammable insulation or putty.
7. Snap the MAR7000 cover over the backplate while being careful not to pinch or dislodge any wiring.

**WARNING**
ALWAYS TURN OFF POWER AT THE MAIN POWER SUPPLY BEFORE INSTALLING, CLEANING, OR REMOVING THE MAR7000. TURN OFF POWER AT THE MAIN SERVICE PANEL BY REMOVING THE FUSE OR SWITCHING THE APPROPRIATE CIRCUIT BREAKER TO THE OFF POSITION BEFORE REMOVING AN EXISTING THERMOSTAT OR INSTALLING A NEW ONE.
Network Wiring
For MS/TP communications, connect the EIA-485 wiring to –A and +B terminals on the backplate. Connect the –A terminals in parallel with all other –A terminals on the network and the +B terminals in parallel with all other +B terminals. (See MS/TP Network End-Of-Line Termination on page 5 and Terminals and Connections on page 6.) Connect the shields of the cable (Belden cable #82760 or equivalent) together at each device with a wire nut or equivalent.

For Ethernet or IP communications, plug an Ethernet cable directly into the RJ-45 jack on the back of the MAR7000.

MS/TP EOL (End-Of-Line) Termination
The controllers/thermostats on the physical ends of the EIA-485 wiring segment must have end-of-line termination installed for proper network operation. (See MS/TP Network End-Of-Line Termination and EOL and Pull-Up Switch Resistor Positions on page 5.) If an MAR7000 is at the physical end of the MS/TP network line, set both the EOL termination switches to On (to the right/up) on the back of the circuit board. If not on the end, ensure that both switches are Off (left/down).

Input Connections
Passive input devices require pull-up resistors in the circuit. For passive input devices (e.g., switch contacts and Type III 10K ohm thermistors) on the external inputs, set the pull-up switches on the back of the circuit board to the 10K position. For active voltage devices, set the switches to the 0–12 VDC position. (See EOL and Pull-Up Switch Resistor Positions on page 5 and Terminals and Connections on page 6.)

NOTE: Unlike the EOL switch pairs, the INPUT switch pairs must NOT have both switches set in the same direction. ALL the input pull-up resistor switch pairs must be fully latched in either 10K Ohm or 0–12 VDC position even if a switch pair has no input connected! A single incorrect switch position may cause errors in multiple inputs.

NOTE: Inputs do not support 1K ohm RTDs.

NOTE: IN1 is the room temperature sensor AI1.
Output Connections

⚠️ CAUTION

Relays are for Class-2 voltages (24 VAC) only. Do not connect line voltage to the relays!

Connect the device under control between the desired output terminal and the related SC (Switched Common for relays). For the bank of three relays, there is one Switched (relay) Common connection. (See Switched (Relay) Common and Relays on page 6.) Connect the SC terminal to the PHASE side of 24 VAC.

One Switched Common Connection Per Bank of Three Normally Open Relays

Do not attach a device that draws current exceeding the MAR7000's output capacity. Maximum output current is 1 A for individual relays @ 24 VAC/VDC or a total of 1.5 A per bank of 3 relays (relays 1–3 and 4–6). Relays are NO, SPST (Form “A”).

Power Connection

The MAR7000 requires an external, 24 volt, AC power source. Use a Class-2 transformer to supply power. Connect the transformer’s neutral lead to the 24 VAC Common/~C terminal and the AC phase lead to the 24 VAC Phase/~R terminal. (See Terminals and Connections on page 6.) Power is applied to the MAR7000 when the transformer is powered.

Powering only one controller/thermostat from each transformer is recommended. If installing a MAR7000 in a system with other controllers/thermostats powered from a single transformer, however, phasing must be correct and the total power drawn from the transformer must not exceed its rating.
Configuration and Basic Operation

Home, Main Menu, and Override Screens

Navigation

Navigate the menus and change settings by pressing a combination of various arrow buttons and the Enter button. Push the:

- **Enter** button to select and/or exit value editing.
- **Up** or **Down** button to move among entries.
- **Right** or **Left** button to move among value fields.
- **Left** button to return to the Home screen.

NOTE: Access to the Main Menu, setpoint adjust, and System/Occupancy/Fan override may require a password.

Room Temp. Setpoint Adjustment

From the Home (temperature display) screen, press the **Up** or **Down** arrow button **once** to view the existing setpoint.

To temporarily change the setpoint, press the **Up** or **Down** arrow button repeatedly until the desired setting is displayed and press **Enter**. (If **Enter** is not pressed, the display will return to the Home screen after about ten seconds and the new setpoint value will still be saved.) The new setpoint will hold until the next schedule change.

To permanently change the setpoint for occupied mode, go to the Setpoints section under the Main Menu. (In the Setpoints menu, heating/cooling setpoints/setbacks and deadband can be changed with, if required, the correct password access.)

Main Menu and Settings

From the Home (temperature display) screen, press the **Right** arrow button to enter the Main Menu. You may need to enter a password to change any settings.

H/C, Fan, Occupancy, and Override

When the fan is commanded to run, the animated “FAN” icon rotates. When the fan command stops, the fan icon is motionless.

The “OCC” icon shows a sun when in Occupied mode and a quarter moon when in Unoccupied mode.

HEAT or COOL will show (and be animated when there is an active command), depending on the current mode. This can also be turned OFF.

To override these modes from the Home (temperature display) screen, press the **Left** arrow button. Press **Up** or **Down** to get to the desired line and then **Enter** (twice) to edit the mode setting. Press **Left** to exit to Home.
Configuration, General

To configure the MAR7000, navigate the menus and change settings by pressing a combination of buttons. Press the **Right** (Menu) button and then the:

- Enter button to select and/or exit value editing.
- Up/Down button to move among entries (up/down lines).
- Left/Right button to move among value fields (left/right spaces).
- Left button to return to the Home screen.

**NOTE:** If **▲ ▼** appear at the top of the screen (such as in the Main Menu), scroll up or down to see the rest of the menu’s off-screen choices.

**NOTE:** IMPORTANT NOTES ABOUT SOME OF THE MENUS ARE ON THE FOLLOWING PAGES. BUT NOT ALL THE MAR7000 MENUS HAVE NOTES HERE!

Advanced Menu

The Advanced Menu displays various submenus. Not all submenus can be seen on the screen at one time. Scroll up or down to see additional submenus.

**(Advanced) Application Options**

Be sure to select the correct °F/°C temperature scale FIRST! To change the temperature scale after the application is configured, the selected application will need to be reset to Not Configured.

The type of application (as well as the model of MAR7000) affects the context-sensitive options under Additional Setup.

**Auxiliary Heat (Heat Pump Only) Setup**

For HPUs, auxiliary heat can be set for none, with compressor lockout, or without compressor lockout.

The **Delay** time controls how long the space temperature must be below the auxiliary heat’s start temperature before auxiliary heat will turn on.
Comp OAT Low (AV17) is the outside air temperature value, below which the compressor is locked out (when lockout is enabled). The user interface min./max. limits are 5 and 50 degrees, with a default value of 40 degrees F.

**Damper Setup**

Enable an economizer for “free” cooling. Even if disabled, CO₂ models will still operate the damper?

**Fan Setup**

**NOTE:** For a Fan Fail Alarm, see Sensor Setup on page 10 and Alarms on page 14.

**Humidity Setup**

**NOTE:** If a dehumidification option is enabled, the Space Humidity Alarm will also be enabled. See Alarms on page 14.

**IOA (Intelligent Occupancy Anticipation)**

IOA is a substitute for manually entering schedules. When IOA is enabled, it “learns” a schedule by sensing motion.

The IOA turns occupancy mode on (for 15 minutes as a default) whenever motion is detected. (See System Setup on page 16.) But a single detection does not modify the schedule. For IOA to learn/modify the schedule, it must detect motion at least once during four consecutive “quarter windows” (1800 seconds or 30 minutes is the default for a full window). To change the schedule (with the default setting) after an initial detection, motion must also be detected at least once during the second quarter of the window (approximately minutes 8–15), third quarter (minutes 16–22), and fourth quarter (minutes 23–30).

When IOA is enabled, schedules manually entered in the Schedule menu will be overridden and modified. During a learned “occupied” time, if no motion is sensed for 15 minutes (default), IOA will switch the system to unoccupied. (To adjust the motion sensing time, see System Setup on page 16.)

After IOA creates a particular schedule, it makes further modifications as needed. If no motion during a scheduled On time is detected two consecutive weeks on the same day of the week, that On time is cleared. (For example, if no one is present in a room for two consecutive Tuesdays, then the scheduled IOA start time for Tuesday is cleared.)

When Optimum Start is enabled, the FlexStat soon “learns” the amount of time required to reach the setpoint from the setback/setup temperature. It will then adjust the actual start time needed to reach the desired setpoint at the beginning of the scheduled On times. It will also make seasonal temperature adjustments if an outside air temperature sensor is connected appropriately.

**Motion Sensor**

During scheduled “off” times, the motion sensor will start occupancy override (for 1 hour as a default) when it detects motion. Occupancy override will end (with the default setting) 1 hour after
motion was last detected. The length of occupancy override is configurable in the System menu. See System Setup on page 16.

The State field monitors whether motion has been detected during the last scan of the motion sensor input (Bl6). Detected motion will show an “occupied” state. This can be used during troubleshooting to determine if motion is being detected.

Sensor Setup

Input 2 (A12) can be configured for fan status (dry contact) or unused. If set for fan status and no closed contact is detected when there is a call for fan operation, a Fan Fail Alarm is created. See Alarms on page 14.

Input 7 (A17) can be configured for discharge air temperature (Type III thermistor) or unused. If the discharge air temperature is below 40° F, the compressors will be locked out.

Input 8 (A18) can be configured for a remote motion sensor (dry contact) or unused. If both internal and external motion sensors are active, motion detected by either will be used to determine occupancy.

Vent Setup

If OCC VENT is enabled, during occupied periods an automatic fresh air purge x minutes in length occurs with an interval of every y minutes according to the values selected. (UNOCC VENT would work similarly.) In addition to the standard periodic purge, see the pre-start purge in IOA (Intelligent Occupancy Anticipation) on page 9.

For MS/TP communications, connect the EIA-485 wiring to –A and +B terminals on the backplate (see the relevant model’s installation guide). For Ethernet IP, and Foreign Device communications (on relevant “E” models), plug an Ethernet cable directly into the RJ-45 modular jack on the back.

To set protocol and parameters for BACnet communications:

1. Select Configure.
2. Select desired protocol and settings.
3. Restart the MAR7000 for the new protocol to become active. (See Resetting the MAR7000 on page 21.)

NOTE: Even if MS/TP is the only option in firmware R2.0.0.x and later, CONFIGURE MUST FIRST BE SELECTED before any of the values can be changed! Otherwise the values are read only.

Only one protocol can be enabled at any time. The IP/Ethernet modes do not serve as routers for the MS/TP connection.

For MS/TP EIA-485 communications, the Max Master is the highest MAC address a device will attempt to locate when polling for master devices on the local network. To avoid possible communication issues with the network, the Max Master number should be the lowest number needed for that network.
Max Info Frames (view only) is the maximum number of information frames (data packets) that a controller may send out before it must pass the token.

For IP and IP Foreign Device communications, consult with the system administrator for the appropriate settings for the IP Address, Subnet Mask, Gateway, and UDP Port.

Ethernet communications are essentially plug-and-play, and the MAC address is not changeable.

(Advanced) CO₂ Sensor

Set the desired CO₂ setpoint under the Setpoints menu. See Setpoints on page 16.

For maximum sensor accuracy, enter the elevation (altitude) above sea level of the building’s location. (The default value is 0.) Elevation for any particular location can be found at such sources as www.earthtools.org. (For very tall buildings, the upper floors would have a higher elevation than lower floors.)

After power is first applied or the FlexStat is restarted, the sensor goes through a warm-up for approximately half a minute. During the time the sensor count will be 0 ppm and the Status line would display WARMUP instead of NORMAL.

The sensor and its firmware are identified by the model, the compilation subvolume (SUB VOL), compilation date (SW DATE in yymmdd format), and serial number.

NOTE: With the CO₂ sensor enabled, a trend log is automatically generated. See Trend Viewer on page 16.

The CO₂ models have a patented self-calibration technique designed to be used in applications where concentrations will drop to outside ambient conditions (approximately 400 ppm) at least three times in a 14 day period, typically during unoccupied periods.

(Advanced) Date/Time

If the MAR7000 is used in a BACnet network with UTC (Coordinated Universal Time) synchronization (via broadcasting or addressing a single thermostat) set the UTC Offset value. The UTC Offset value is in minutes and corresponds to the distance of the local time zone to the zero degree meridian. For example, USA/Canada Pacific Standard Time (8 hours) = 480 minutes and USA/Canada Eastern Standard Time (5 hours) = 300 minutes.

In stand-alone operation or networks that do not have UTC broadcasts, setting this value is not necessary.

NOTE: The BACnet standard for this offset value is: “The time zones to the west of the zero degree meridian shall be positive values, and those to the east shall be negative values.” The value is in minutes, not hours.

For areas that observe DST (Daylight Saving Time), select True/On for DST ENABLE and DST AUTO. The DST period is currently the second Sunday of March through the first Sunday of November, but these rules can be changed in the menu if the official period changes or if the installed location needs a schedule adjustment for better operation.

NOTE: If DST is enabled but the Auto setting is not, the actual calendar dates (instead of using the general rules) will need to be entered every year.
Inputs vary according to model, selected application, and selected application options. See (Advanced) Application Options on page 8.

Value will show a temperature reading or a voltage (0.0 to 3.0), depending on the sensor.

Analog sensors can be calibrated changing the value in Calibration Offset.

“Out-of-Service: False” means the input is active (not out of service). If it is “true,” the input is inactive. The menu only shows the status.

(Advanced) Security Levels and Passwords

Access to the Main Menu, Setpoint Adjust, and System/Occupancy/Fan settings have a default password level of User. This level can be changed for each function to None, Operator, or Administrator through the Access Levels menu. Passwords are set in the Passwords menu.

Any person can view the display but might not be able to change any settings without logging in with one of the three levels of passwords:

- None (Level “0”): No password is required (everyone has access). (For example, anyone can adjust a setpoint with Access Level None even if all other functions require a password.)
- User (Level 1): See the Menu Items Access Levels chart on the next page.
- Operator (Level 2): See the Menu Items Access Levels chart.
- Administrator (Level 3): Can access all menus and change all editable values. DO NOT FORGET THIS PASSWORD!

If no password is set for ADMIN, no password prompt will occur. If any password is set for ADMIN, the menu items accessible at the various levels are shown in the following chart.

NOTE: Setting a password to (the default) 0000 eliminates the password prompt and allows full access for that level. If no password is set for ADMIN, no password prompt will occur. If any password is set for ADMIN, the menu items accessible at the various levels are shown in the following chart.

NOTE: Changes in security levels and/or passwords take effect when the current Administrator log-in has timed out. Log-ins last until 60 seconds (default) after the last button press. Desired length of inactivity time-out can be changed in the Systems submenu.

NOTE: When setting a password, the Up button increases the alphanumeric value (0 through 9 and then A through Z).
The Down button decreases the value.

DO NOT FORGET THE ADMIN PASSWORD!

The required password level is specified in the prompt.

For additional physical security and protection from vandalism, install the MAR7000 inside a third-party locking thermostat guard/cover (but proper airflow must be maintained).

The chart shows conditions in which an administrator password is set (is not 0000) and default password levels are used.

### Menu Items Access Levels

<table>
<thead>
<tr>
<th>Menus</th>
<th>User</th>
<th>Operator</th>
<th>Administrator</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Home Screen</strong></td>
<td>* = Selectable, Default is User</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Setpoint Adjust (Up/Down)</td>
<td>x*</td>
<td>x*</td>
<td>x*</td>
</tr>
<tr>
<td>System Mode (Auto/H/C/Off)</td>
<td>x*</td>
<td>x*</td>
<td>x*</td>
</tr>
<tr>
<td>Occupancy Override (On/Off)</td>
<td>x*</td>
<td>x*</td>
<td>x*</td>
</tr>
<tr>
<td>Fan Modes (Auto/On/Off)</td>
<td>x*</td>
<td>x*</td>
<td>x*</td>
</tr>
</tbody>
</table>

### Main Menu* (Default is User)

| About              | x | x | x |
| Advanced           | x | x | x |
| Alarm              | x | x | x |
| Date/Time          | x | x | x |
| Schedule           | x | x | x |
| Setpoints          | x | x | x |
| System             | x | x | x |
| Trend Viewer       | x | x | x |

### Advanced Menu

| Application | x |
| Additional Setup | x |
| Control Basic Programs | x | x |
| Communication | x |
| Date/Time     | x | x | x |
| Device        | x | x | x |
| Inputs        | x | x | x |
| Limits        | x | x | x |
| Motion Sensor | x | x | x |
| Security      | x | x | x |
| Trend Logs    | x | x | x |
| Test          | x | x | x |

NOTE: Space temperature (AI1) is the default trend log #1. Depending on configuration and options, other default trend logs might exist.

The trend log buffer may be viewed by scrolling down and selecting View Log Buffer. The buffer may also be viewed from the Main Menu by scrolling down to the Trend Viewer (see page 16).

NOTE: The BACnet standard for log intervals is hundredths of seconds. The simplified display on the MAR7000 converts the value to minutes. However, building automation software may display hundredths of seconds and in different ways.

NOTE: Other objects that can also be configured for trend logs include:
- Humidity sensor = AI5
- Discharge air temperature = AI7
- Motion sensor = BI6
- Motion sensor occupancy override = BV24
- See also the list of objects in Terminals and Connections on page 6
(Advanced) User Interface (UI)

**Display Blanking**

When Display Blanking is enabled (Y), the display turns off at the same time the backlight goes off (after reset, initial power-up, or time-out). When any button is pressed, the display will reappear until the time-out is reached again.

**Inactivity**

The menu/display/backlight time-out (seconds since the last button is pushed) is set in Inactivity.

**Rotation Values**

The Rotation Values menu allows easy setting of what applicable optional values (e.g., humidity, outside air temperature, and/or CO\textsubscript{2} level) will display on the lower right of the screen (such as “HUM: 46% RH” shown on the Hospitality Mode sample screen). If more than one value is shown, the values will rotate approximately every five seconds.

In applicable models, humidity and CO\textsubscript{2} levels are shown by default but can be hidden if desired.

UI4, the fourth rotation value, is available for custom programming.

**Show Temperature Tenths (Decimals)**

With R2.0.3.x and later firmware, Fahrenheit temperature values on the display change in whole degree increments by default, and Celsius values change in 0.5° increments. Changing the default No to Yes will show tenths of a degree values for both scales.

This does not affect setpoint adjustments, which are always in whole degree increments for Fahrenheit and half degree increments for Celsius.

**Alarms**

A flashing “SERVICE” on the Home screen indicates an alarm. Built-in alarms are triggered under these conditions:

- **Space Temp Alarm**—temperature outside the range of 56 to 86° F for over 300 seconds.
- **Space Humidity Alarm**—humidity above 65% for over 300 seconds. This is available only when a dehumidification option is selected in the Humidity setup). See Humidity Setup on page 9.
- **Fan Fail Alarm**—no fan status signal within five seconds of call for fan (and Input 2 is configured for the fan status sensor option). See Sensor Setup on page 10.
- **CO\textsubscript{2} Alarm**—carbon dioxide level has been above the setpoint (default 1000 ppm—see Setpoints on page 16) or below 250 ppm for over 30 minutes. If the sensor reading is below 250 ppm, the sensor is not working properly—see (Advanced) CO\textsubscript{2} Sensor on page 11.
Date/Time

More options (such as UTC offset and daylight saving time options) are available in the (Advanced) Date/Time menu (see page 11).

Schedules

This menu allows manual creation of schedules. For automated creation, see IOA (Intelligent Occupancy Anticipation) on page 9. IOA overrides any Off times in a manual schedule.

The Holiday entries will override the normal occupied weekly schedule entries and keep those days’ settings at their setback values. Setback values are entered in the Setpoints section of the Main Menu. (See also the maximum and minimum setpoint values in (Advanced) Temp. Setpoint Limits on page 12.)

NOTE: For maximum efficiency, if Optimum Start is enabled, set On times in schedules for when the room temperature should reach the setpoint, not when heating/cooling equipment should start (which would be earlier). See IOA (Intelligent Occupancy Anticipation) on page 9.

The Holiday entries will override the normal occupied weekly schedule entries and keep those days’ settings at their setback values. Setback values are entered in the Setpoints menu (see Setpoints on page 16). (See also the maximum and minimum setpoint values in (Advanced) Temp. Setpoint Limits on page 12.)

NOTE: If a day of a week (e.g., Friday) has a different schedule than the rest, using the Weekdays menu first and then modifying that one day in the Individual Days menu may be easier (two entries) than entering schedules for each day separately in the Individual Days menu (five entries).

NOTE: The last overlapping entry overrides any other. For example, suppose the WEEKDAYS menu is used to add some additional evening meeting ON times for Tuesday and Wednesday. If the WEEKDAYS menu is later used to change the ON time from 7:00 to 7:15, schedules for all the individual week days will be reset to conform to what appears in the WEEKDAYS menu and any special times for individual days will be erased. (Special day schedules will then need to be added again through the INDIVIDUAL DAYS menu).
### Setpoints

In the Setpoints menu, setpoints and setbacks for various values are set. (The current room temperature setpoint can also be manually changed from the Home menu.)

### System Setup

Setpoint Override on this menu is the amount of time (in hours) a manual change in the setpoint (via the Up and Down buttons) will be allowed to override the scheduled setpoint. When the time is set to 0, the override state will last until the next schedule change.

Motion Override on this menu is the amount of time (in minutes) detected motion will temporarily place the system into occupied mode. The time is measured since the last motion detection.

NOTE: Occupancy override can also be removed while on the Home screen by pushing the left button, navigating to OCC, hitting Enter twice, and changing ON to OFF. See H/C, Fan, Occupancy, and Override on page 7.

### Trend Viewer

Trend logs are set up in the (Advanced) Trend Logs menus (see page 13).
Troubleshooting

Alarm Issues

Alarm, (False) Fan Fail

- Check configuration. Be sure the Fan Status option is not selected when there is no sensor/switch for it.
- Check that the IN2 (fan status) input pull-up resistor switches are fully latched in the correct positions. Any passive, dry contact should use the 10K Ohm setting. (See Input Connections on page 5.)
- Check IN2 (fan status) input wiring.
- Check the connected fan status sensor/switch.

Alarm, (False) Space Temp. or Humidity

- See Alarms on page 14.
- See Temperature Reading Is Incorrect on page 18.
- See Temperature Setpoint Is Not Maintained on page 19.

Cover, Display, and Reset Issues

Cover Binds on Backplate

- Be sure top and bottom tabs are both pushed in when removing the cover.
- Carefully remove the MAR7000 cover from the backplate and inspect for bent pins and/or terminal socket connectors. If cover pins are bent, use a needle-nose pliers to straighten them. If socket connectors are bent, use a pointed object (such as a thumbtack or straightened paperclip) to straighten them. (Pushing the pointed object into the socket from the back side can be helpful.)
- When installing the cover, it may be helpful to apply more pressure toward the bottom of the cover.
- Replace the backplate.

NOTE: When installing the cover on the backplate, be sure to not pinch or dislodge any wiring. Do not use excessive force. If there is any binding, pull out cover and examine pins and terminal socket connectors.

Display Is Blank (or Erratic)

- If the display comes on when a button is pushed, Display Blanking is enabled. (See System Setup on page 16.)
- Carefully remove the MAR7000 cover from the backplate, check pins and connectors, and reinset. (See Cover Binds on Backplate on page 17.)
- Check for a tripped circuit breaker to the transformer.
- Check for proper supply voltage from the transformer and that the transformer has enough capacity (VA) for all connected devices (see their respective specifications).

NOTE: Wiring must be adequate to avoid excessive voltage drop on long runs! Allow plenty of “cushion.” A meter may be too slow to register transient dips or peaks during startup. See Wiring Issues on page 20.
- Put another MAR7000 on the installed backplate, and if the second MAR7000 functions properly, replace the first MAR7000.
- See also Display Keeps Resetting on page 18.
Display Freezes (Buttons Have No Effect)

- Carefully remove the MAR7000 cover from the backplate and ensure the WD (watch dog) jumper is installed on the two pins toward the center of the board. The jumper is temporarily removed during a firmware installation/update and should be reinstalled when the process is completed. Reinstalling the cover on the backplate will restart the MAR7000.

Display Keeps Resetting

- Carefully remove the MAR7000 cover from the backplate, check pins and connectors, and reinsert. (See Cover Binds on Backplate on page 17.)

- Check for proper supply voltage from the transformer and that the transformer has enough capacity (VA) for all connected devices. (See their respective specifications.)

NOTE: Wiring must be adequate to avoid excessive voltage drop on long runs! Allow plenty of “cushion” in measurements A meter may be too slow to register transient dips or peaks during startup. See Wiring Issues on page 20.

- Put the MAR7000 on a backplate connected to a (test) transformer with short wiring and no other connected devices. If the MAR7000 works with the test transformer, the wiring and/or transformer in its previous location is inadequate. If it does not work with the test transformer, replace the MAR7000.

- Put another MAR7000 on the installed backplate, and if the second MAR7000 functions properly, replace the first MAR7000.

Input, Sensor, and Value Issues

Input Values Are Outside Expected Range

- Check that ALL the input pull-up resistor switches are fully latched in the correct positions. (See Input Connections on page 5.) A single incorrect switch position may affect multiple inputs. All input switches must be latched in either 10K Ohm or 0–12 VDC positions even if no input is connected! Input switch pairs (3-4, 5-6, and 7-8) must never have both switches set in the same direction—if switch 3 is set to the left, for example, 4 must be set to the right (or vice versa).

- Check that the correct input type is selected on the Inputs screen. A Type III thermistor is the default for external inputs. See (Advanced) Inputs on page 12.

- Check input wiring. See Wiring Issues on page 20.

- Check connected sensors.

- Restore the MAR7000 to factory settings (see Resetting the MAR7000 on page 21) and reconfigure.

Motion/Occupancy Sensor Does Not Work

- After an initial power-up or restart, the motion/occupancy sensor requires about 30 seconds before it will begin responding to motion.

- The motion/occupancy sensor initiates override only during “off” times in the schedule. See Schedules on page 15.

- Check that the motion sensor is enabled and detects motion. See Motion Sensor on page 9.

- The MAR7000 must be installed where there is a clear view of typical traffic area (reliable range is out to about 33 feet). Remove or move obstacles. Reinstall the MAR7000 in a more optimal location if necessary.

Temperature Reading Is Incorrect

- Check that the correct °F/°C temperature scale is selected—see (Advanced) Application Options on page 8.

- After applying power for the first time (or after an outage), allow the MAR7000 to self-calibrate a few minutes before verifying temperature reading.

- If the discrepancy is small, adjust the calibration offset—see (Advanced) Inputs on page 12.

- Check that the MAR7000 is NOT mounted on an exterior wall, mounted on or near a large thermal mass (e.g., concrete block wall), blocked from normal air circulation by obstructions, exposed to heat sources (e.g., lights, computers, copiers, coffee makers) or to sunlight (at any time of the day), exposed to drafts from windows or air vents, or exposed to air flow through the conduit from leaks in plenum ducts (put plumber’s putty inside conduit to block air leaks).

- See also Input Values Are Outside Expected Range on page 18.
Temperature Setpoint Is Not Maintained

- Select Occupied mode from the Home Menu—see H/C, Fan, Occupancy, and Override on page 7.
- Override the fan to On from the Home Menu—see H/C, Fan, Occupancy, and Override on page 7.
- Check that the appropriate application is selected—see (Advanced) Application Options on page 8.
- Check that room temperature is being sensed correctly—see Temperature Reading Is Incorrect on page 18.

CO₂ Level Seems Incorrect

- After power is first applied or the FlexStat is restarted, the sensor goes through a warm-up for approximately half a minute. During the time the sensor count will be 0 ppm.
- Check the remote CO₂ sensor setup (if applicable). For both internal and external sensors, the highest of the two readings will be used to control ventilation. The CO₂ ppm display (if enabled) also shows the highest of the two levels.
- To reduce nuisance complaints by occupants of levels being “too high,” turn off the visibility of the CO₂ level rotation in the display. See (Advanced) User Interface (UI) on page 14.

MS/TP Communication Issues

- Check MAC address and device instance numbers (especially for duplicate numbers on the network)—see (Advanced) Communications (BACnet) on page 10.
- Check that EOL switches are fully latched in the correct positions (see MS/TP EOL (End-Of-Line) Termination on page 5).
- Check baud rate—see (Advanced) Communications (BACnet) on page 10.
- Reduce the Max Master number down to the minimum needed for that network—see (Advanced) Communications (BACnet) on page 10.
- See Wiring Issues on page 20.

Output, Fan, and Relay Issues

Fan Does Not Run

NOTE: The animated fan icon is coupled with BV18 in the packaged programming (not the actual fan output terminal).

- Select Occupied mode from the Home Menu—see H/C, Fan, Occupancy, and Override on page 7.
- Override the fan to On from the Home Menu—see Home, Main Menu, and Override Screens on page 7.
- See Wiring Issues on page 20.
- Check that the appropriate application is selected—see (Advanced) Application Options on page 8.
- Check the fan configuration—see Fan Setup on page 9.
- Restart the MAR7000. After a low limit alarm is generated, the fan will not run until after the MAR7000 is restarted. (SeeResetting the MAR7000 on page 21.)

Relay (Internal) Does Not Work

⚠️ CAUTION

Relays are for Class-2 voltages (24 VAC) only. Do not connect line voltage to the relays!

NOTE: Max. output current is 1 A for individual relays @ 24 VAC/VDC or a total of 1.5 A per bank of 3 relays (relays 1–3 and 4–6). Do not attach a device that draws current that exceeds the corresponding value. Relays are NO, SPST (Form “A”).

- Check current draw of load. Substitute an output device that draws less current.
- Check that the output is on.
- See Wiring Issues on page 20.
- Restart the MAR7000. (See Resetting the MAR7000 on page 21.)
- If Restore Factory has just been performed, see the Note and Cautions in Restore Factory on page 21.
Wiring Issues

Installation Wiring Considerations

⚠️ CAUTION

To avoid damage from ground loops and other communication issues in networked MAR7000s, correct phasing on network and power connections on ALL the networked controllers is critically important.

- Because of the many connections (power, network, inputs, outputs, and their respective grounds or switched commons), be sure wiring is well planned before installation of conduit!
- To prevent excessive voltage drop, use a conductor size that is adequate for the wiring length! Allow plenty of “cushion” to allow for transient peaks during startup.
- Make sure that conduit for all wiring has adequate diameter for all necessary wiring. Using 1-inch conduit and junction boxes is recommended!
- Use external junction boxes above the ceiling or in another convenient location as needed to make connections that run to the MAR7000’s junction box.
- Using multiple conductor wires for all inputs (e.g., six conductor) and outputs (e.g., 12 conductor) is recommended. Grounds for all the inputs can be combined on one wire.

Troubleshooting Wiring Problems

- Review Connections and Wiring on page 4.
- Remove the MAR7000 from the backplate and inspect the terminals for loose or shorted wires.
- Use a voltmeter and ohmmeter to check the terminals for expected values. See the illustration below.

NOTE: Voltage on the BACnet MS/TP terminals changes according to the signals (passing of the token) between controllers on the network. No voltage may indicate a bad connection or simply no active network.

NOTE: Wiring must be adequate to avoid excessive voltage drop on long runs! Allow plenty of “cushion” in measurements A meter may be too slow to register transient dips or peaks during startup.

- Check the wiring at the connected devices.

⚠️ CAUTION

Relays are for Class-2 voltages (24 VAC) only. Do not connect line voltage to the relays!

NOTE: Values Shown Are Approximate!

NOTE: Backplate Terminals Shown with MAR7000 Removed; Outputs and Inputs Vary According to Application

NOTE: SC = Switched (Relay) Common, Should Have the Phase Side of 24 VAC Connected

<table>
<thead>
<tr>
<th>BACnet</th>
<th>MS/TP</th>
<th>Network</th>
<th>Inputs</th>
<th>(Wiring Inputs and Outputs Dependent on Application)</th>
<th>24 VAC Common/–/C Phase/~IR</th>
</tr>
</thead>
<tbody>
<tr>
<td>+B</td>
<td>–A</td>
<td>IN4</td>
<td>IN3</td>
<td>GND</td>
<td>24 VAC</td>
</tr>
<tr>
<td>10K Ohms (Thermistor), 0 Ohms (Closed Contact), Megohms (Open Contact), or Voltage (Active Input Device)</td>
<td>10K Ohms (Thermistor), 0 Ohms (Closed Contact), Megohms (Open Contact), or Voltage (Active Input Device)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.1–0.2 VDC (If Network Token Passing is Present)</td>
</tr>
</tbody>
</table>

Outputs

- (Not Connected)
- SC 7
- (Not Connected)
- Relay 7
- Relay 6
- SC 4–6
- Relay 5
- Relay 4
- Relay 3
- SC 1–3
- Relay 2
- Relay 1

Terminal Voltages and Resistances with MAR7000 REMOVED from Backplate
Resetting the MAR7000

Types of Reset

If the MAR7000 is not operating correctly or if a low limit alarm has occurred, the MAR7000 should be reset (reinitialized). Any reset interrupts normal operation, and three types of reset exist:

- A **warm start** is generally the least disruptive option (restarting normal operation the quickest).
- If problems still persist, try a **cold start**.
- If problems still persist (or major changes in a firmware update have taken place) **restoring factory defaults** (and reconfiguring and reprogramming the MAR7000) may be required.

Warm and Cold Starts

⚠️ **CAUTION**

During a restart, relays go to their normally open state. The restart process lasts about ten seconds, and it may result in several changes of state for an output, turning equipment off and on abruptly. Before resetting the MAR7000, manually override equipment as needed. If a large fan is controlled by the MAR7000, for example, set a minimum off delay time in the Advanced > Application > Additional Setup > Fan Setup menu.

A warm start (after zeroing out objects during the restart process) restores present values of objects to their last values before the restart (until they are updated by the MAR7000’s programs), restarts the controller’s Control Basic programs, and leaves configuration and programming intact.

⚠️ **CAUTION**

If the checksum test in RAM fails during a warm start, a cold start is performed instead.

A cold start (after zeroing out objects during the restart process) returns all object values to their relinquished defaults (until they are updated by the MAR7000’s programs), restarts the controller’s Control Basic programs, and leaves configuration and programming intact.

**NOTE:** Menu changes may take up to about two minutes to write to nonvolatile Flash memory. If power to the MAR7000 is lost during this time, changes may be lost.

**NOTE:** When power is restored after an outage, the MAR7000 will attempt to do a warm start as long as the values in RAM are retained (up to about four hours). If the RAM checksum test fails, a cold start will be done instead.

**To perform a WARM start,** from the MAR7000 menu, select Advanced > Device > Restart > Warm Start (or momentarily remove power to the MAR7000).

**To perform a COLD start** from the MAR7000 menu, select Advanced > Device > Restart > Cold Start.

### Restore Factory

**Restore Factory** (restoring the MAR7000 to the factory settings) clears present values, restores the object database/configuration to the defaults, restarts the controller’s (factory installed) Control Basic programs.

**NOTE:** The MAC address and device instance are **not** restored to their original defaults.

⚠️ **CAUTION**

When returned to factory defaults, relays will go to their normally open state. Before restarting the thermostat, manually override equipment as needed.

⚠️ **CAUTION**

After a return to factory defaults, applications are unconfigured. You must select the desired application and appropriate settings before connected equipment will operate properly. (See (Advanced) Application Options on page 8.)
To **restore the MAR7000 to factory settings**, select Restore Factory from the Advanced > Device menu. When prompted for the required restart, press Enter. (To Cancel, press the right button and then Enter or just let the display time-out). After the MAR7000 has restarted, review the settings and reconfigure as needed.

### Maintenance

Remove dust as necessary from the holes in the top and bottom. Clean the display with a soft, damp cloth and mild soap.

To maintain maximum sensitivity of the built-in motion sensor, occasionally wipe dust or dirt off the lens—but do not use any fluid on the sensor.

### Important Notices

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