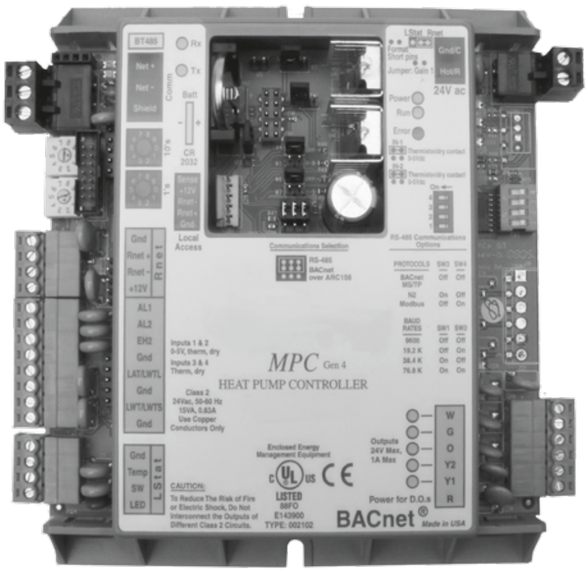
MPC MULTIPROTOCOL DDC CONTROLS



MPC Controller

MPC Digital Wall Sensors

Application, Operation & Maintenance

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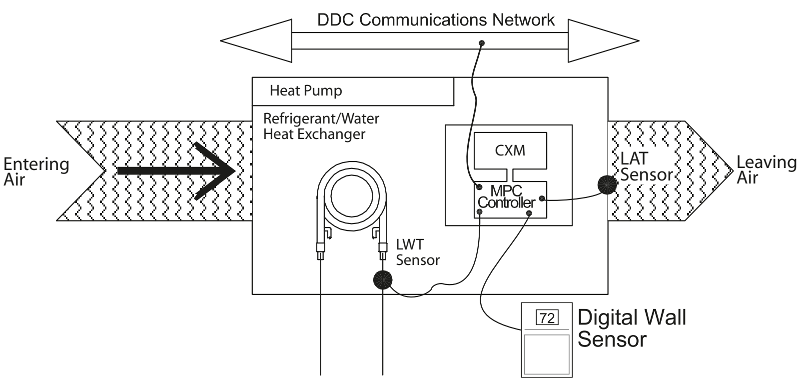
MPC Controller Overview

The MultiProtoCol (MPC) Heat Pump controller is designed to allow the integration of water source heat pump equipment into DDC systems. The MPC Controller has the ability to communicate through a choice of three widely used protocols: BACnet MS/TP, Johnson Controls N2, and Modbus. The protocol of choice for the particular system is selected by simply configuring DIP switches on the MPC Controller. This flexibility allows one controller, the MPC, to be used in a multitude of buildings which use any of these three common protocols.

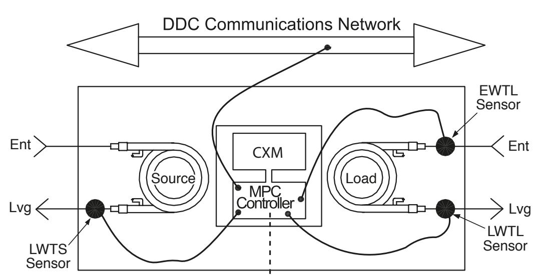
The MPC serves as a node of information processing between the heat pump and the DDC network. See Figure 1 below. The MPC commands the heat pump to heat and cool based upon sensor inputs. The MPC then monitors operation of the heat pump and communicates the operating parameters to the DDC network. The MPC will always work in conjunction with a CXM or DXM controller, which also resides in the heat pump control box. The MPC has factory pre-loaded application software which allows optimal control of the heat pump equipment. The MPC can run in stand-alone operation as well as with the DDC network. Therefore, when the heat pump arrives at the jobsite with the factory installed MPC Controller, the heat pump is ready to run stand-alone and then can be connected to the DDC network at any time.

Figure 1: Typical System

Water-to-Air Heat Pump



Water-to-Water Heat Pump



FEATURES & BENEFITS

Multi-Protocol communications provides DDC system flexibility.

- Supports native BACnet MS/TP communications (the ASHRAE standard protocol for interoperability).
- Supports Johnson Controls N2 communications (for integration into Johnson Controls Metasys DDC systems).
- Supports Modbus communications for integration into Modbus DDC networks.
- Four baud rate levels offer flexible communications speeds of 9600, 19.2k, 38.4k, or 76.8k baud.
- Employs a 16-bit bus Hitachi processor with 512kB RAM and 1024kB Flash Memory which allows, if needed, MPC programs to be upgraded and easily downloaded in the field.
- Removable field wiring connectors for ease of field service.
- Engineered for quality and reliability
- Enables building operators to easily upgrade firmware in the future.

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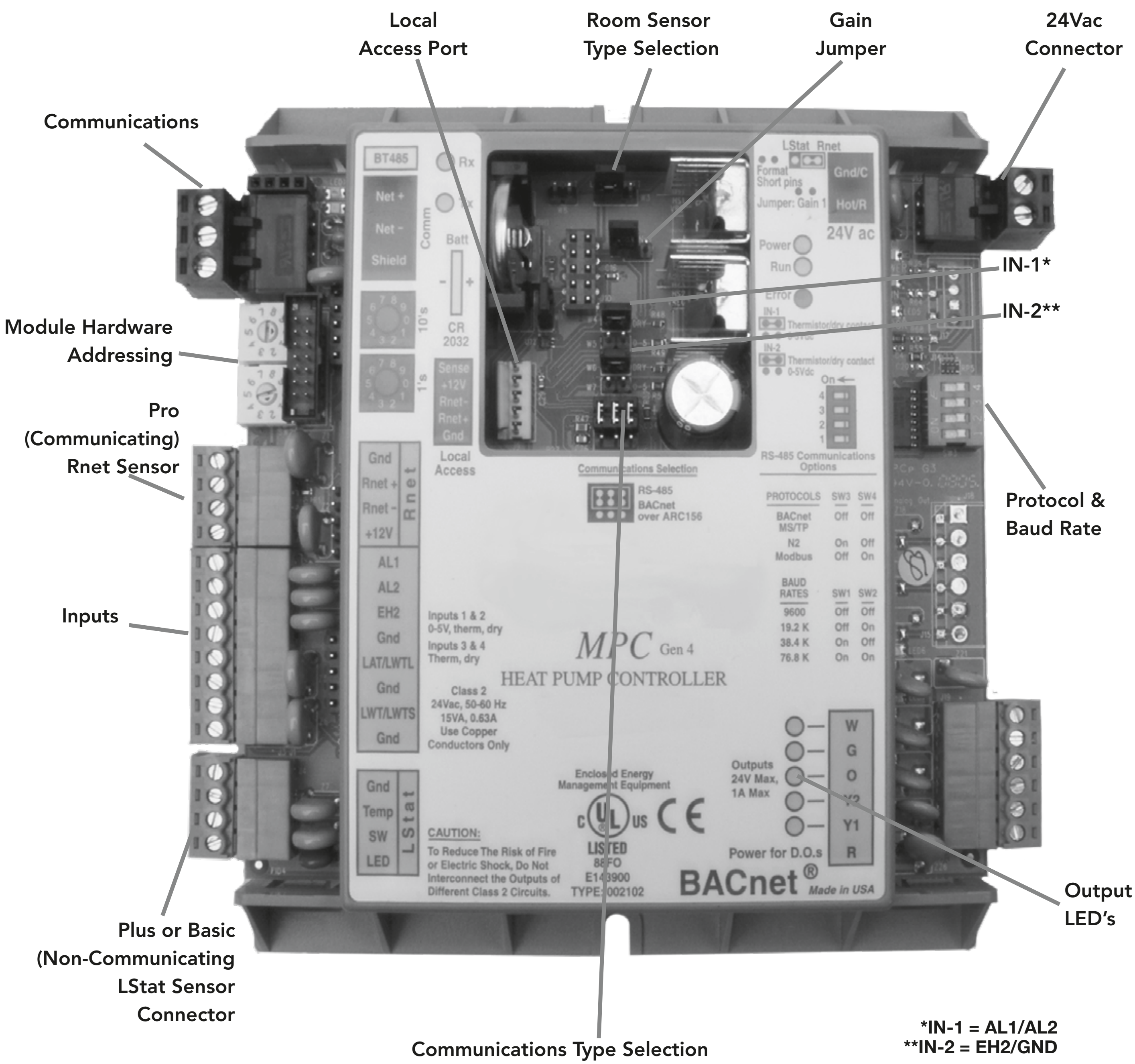
System Features

In conjunction with the wall sensors, the MPC offers features such as:

- Room temperature sensing
- Local setpoint adjustment
- Local override into Occupied Mode
- LED for alarm status
- LED for fault status type
- Heat pump reset at the wall sensor
- Digital room temperature display

Information from the wall sensors can then be reported to the DDC network system.

Figure 2: MPC Layout



MPC Hardware Specifications

Power: 24VAC ± 10%, 50 or 60Hz, 15VA max. power consumption.

Size: 5-1/16” [129mm] width x 5-11/16” [144mm] height x 1-1/2” [38mm] (minimum panel depth).

Housing: Rugged GE C2905HG Cycoloy plastic housing (complies with UL 94 V-O).

Environmental: 0-130°F (-17.8 to 54.4 °C), 10% to 95% non-condensing.

Protection: Surge & transient protection circuitry for the power and I/O. Optical isolation for communications port.

Processor/Memory: High speed 16-bit Hitachi Processor with 512kB RAM and 1024kB Flash Memory.

LED Indicators: Individual LEDs for digital outputs, power, run, error, transmit, and receive.

Pending Listings: UL916, CE (1997), FCC (Part 15-SubpartB-ClassA).

I/O Point Count: 5 digital outputs (on-board relays rated for 1A resistive at 24VAC).
6 universal inputs (IN-1 and IN-2 are jumper selectable for dry contact or 0-5VDC).
1 analog wall sensor port for non-communicating (Lstat) wall sensors.
1 digital wall sensor port for communicating (Rnet) wall sensors.

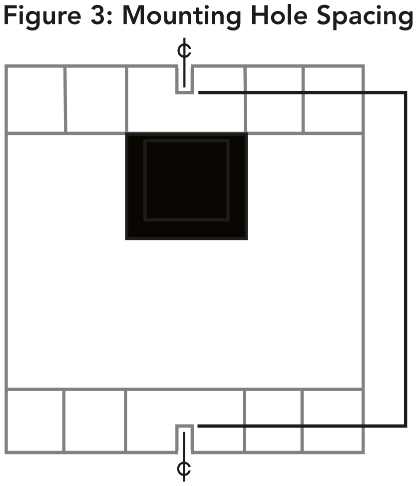
Communications: EIA-485 communications port using twisted pair. A two position DIP switch allows for manual selection of desired protocol. Available protocols are BACnet MS/TP, Johnson Controls N2, and Modbus. Another 2 position DIP switch allows for manual selection of desired baud rate. Available baud rates are 9600, 19.2k, 38.4k, and 76.8k.

Addressing: 2 rotary switches are provided for setting the individual controller’s primary network address (for more information on network addressing, see Addressing & Power Up).

Wall Sensor: The wall sensors provide room temperature sensing with digital display, local setpoint adjust, local override, LED for alarm status and fault type indication, and heat pump reset. The wall sensors require a 4 or 5 wire connection and are non-communicating.

Mounting Hole Dimensions: Two mounting holes center line as below with 5-9/16 ” [141mm] height spacing.
Factory mounted.

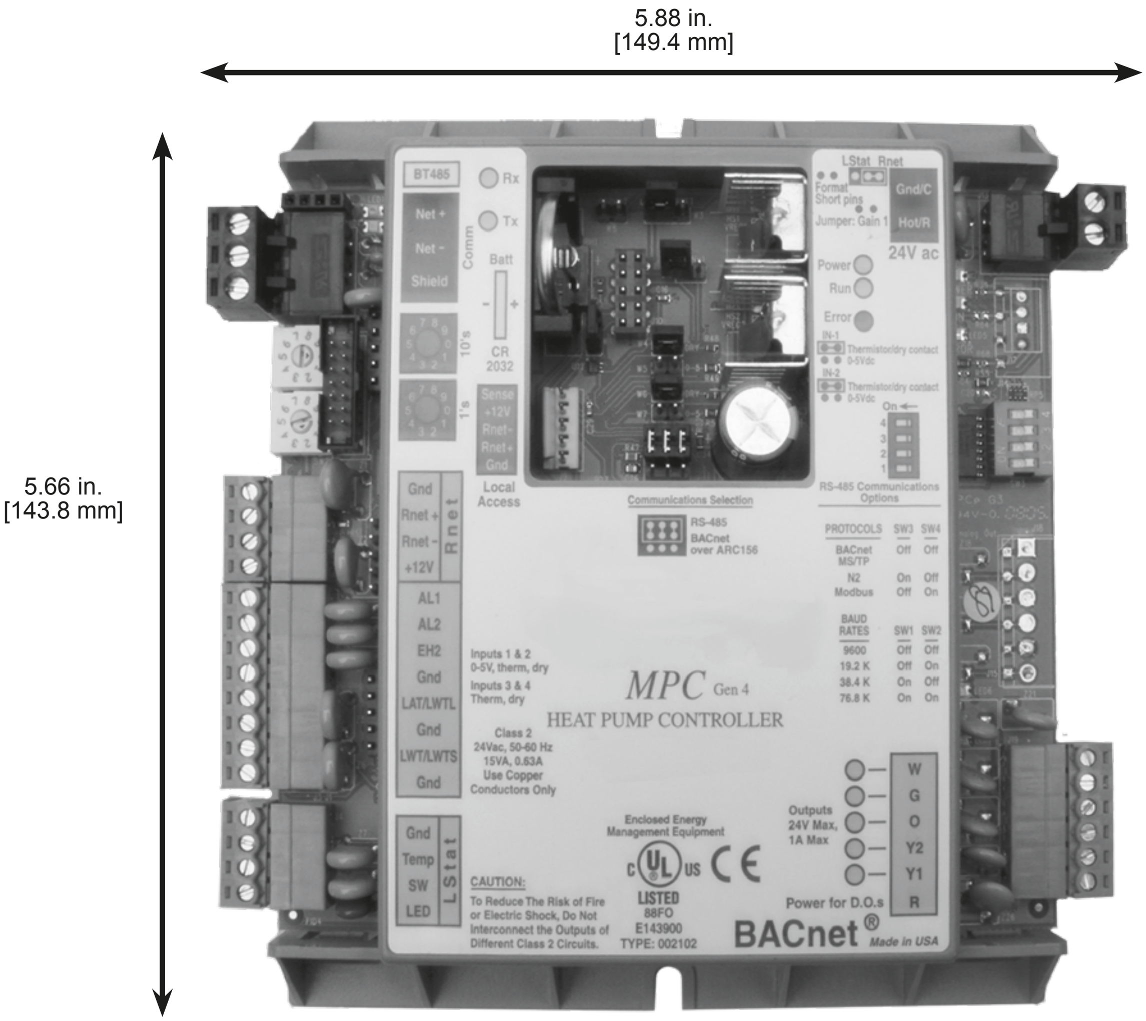
Figure 3: Mounting Hole Spacing



Mounting hole spacing
5-9/16" [141.2 mm]

Physical Dimensions

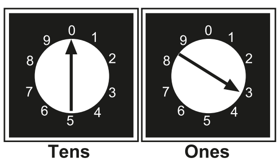
Figure 4: Physical Dimensions



Addressing & Power Up

Before setting or changing the module's hardware address, make sure the MPC Controller power is off. The MPC only reads the address when the module is turned on. The MPC has two rotary switches for assigning the module's hardware address. One switch corresponds to the "tens" digit and the second switch corresponds to the "ones" digit, allowing for hardware-based addressing of up to address 99. For example, if the module's address is three, set the tens switch to zero and the ones switch to three, as shown in Figure 5. The station ID for each MS/TP node must be unique on a MS/TP segment. The MPC's rotary address switches are used to set this unique ID.

Figure 5: Setting Module Address



After setting the address, turn power on to the MPC. The Run, Error, and Power LEDs should turn on. The Run LED should begin to blink and the Error LED should turn off. Use Table 1 to troubleshoot the LEDs.

NOTE: Set address for heat pump #1 (HP-1) at 02 per typical BMS naming conventions. All other heat pump addresses should be assigned as HP# + 1.

Table 1: LED Codes

Run LED	Error LED	Condition
2 flashes per second	OFF	Normal
2 flashes per second	2 flashes, alternating with Run LED	Five minute auto-restart delay after system error
2 flashes per second	3 flashes then OFF	Module has just been formatted
2 flashes per second	4 flashes then pause	Two or more devices on this network have the same ARC156 network address
2 flashes per second	6 flashes then OFF	Module's response to a LonTalk 'wink' command received from a LonWorks Network Management Tool
2 flashes per second	ON	Exec halted after frequent system errors or GFB's halted
5 flashes per second	ON	Exec start-up aborted, Boot is running
5 flashes per second	OFF	Firmware transfer in progress, Boot is running
7 flashes per second	7 flashes per second, alternating with Run LED	Ten second recovery period after brownout
14 flashes per second	7 flashes per second, alternating with Run LED	Brownout

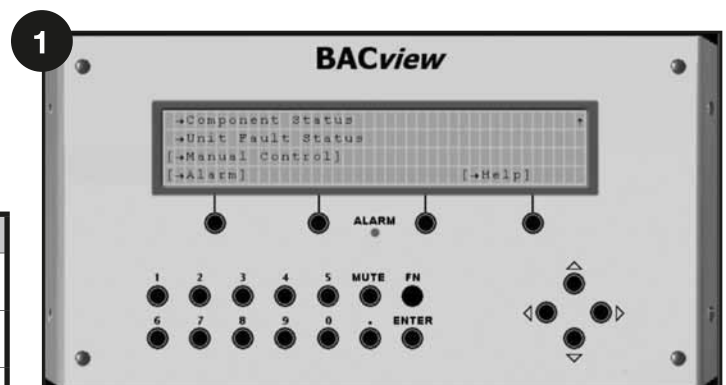
Changing the device instance when using a network of more than 99 MPC units

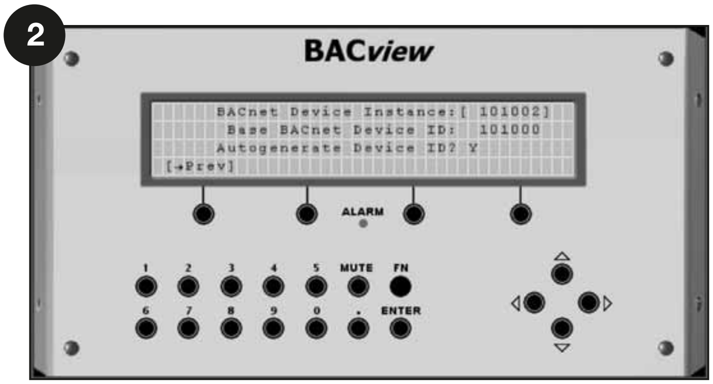
Note – This applies to Gen4 MPC's only. When using Gen3 MPC's, to allow for more than 99 unique addresses, a special request should be made through the Product Management and Applications team.

The Gen 4 MPC allows the device instance to be changed using the BACview6 service tool. This feature allows an installation with more than 99 MPC-based units to be set and managed on-site rather than factory preset.

In order to change the device instance, the MPC must be powered up. Connect the BACview6 service tool to the MPC using the local access port. When the main screen appears, scroll down to "Manual Control" using the down arrow and press "Enter";

At the "Manual Control" screen, press "Enter" with "Unit Configuration" highlighted and again with "BAC-net" highlighted. The following screen should appear;

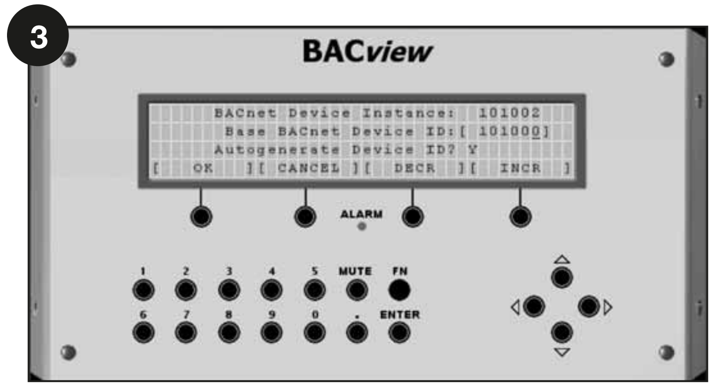




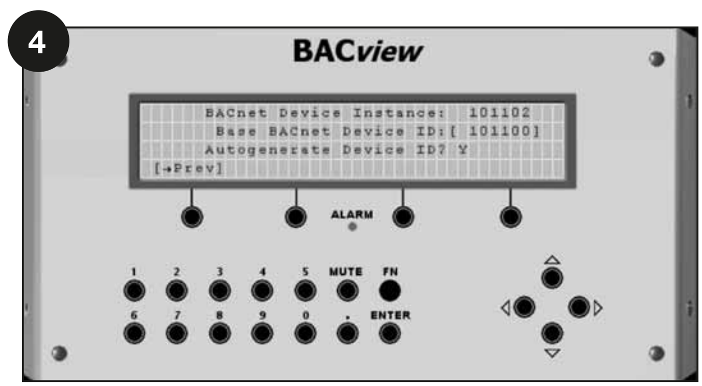
The device instance is typically six digits long. The last two digits correspond to the hardware's module address so these should not be changed using the BACview6.

To change the device instance, use the down arrow to highlight the numbers beside "Base BACnet Device ID" and press "Enter". You will be prompted for an Admin Password, the password is 1111. A cursor underlining the final digit of the "Base BACnet Device ID" will appear. Use the left and right arrow keys to move this cursor to the digit you wish to change and press the number that you wish to change it to and then press "OK" or "Enter";

Before change (fourth digit is 0);



After change (fourth digit is changed to 1);



Repeat the steps as necessary for each MPC.

COMMUNICATIONS WIRING & SETUP

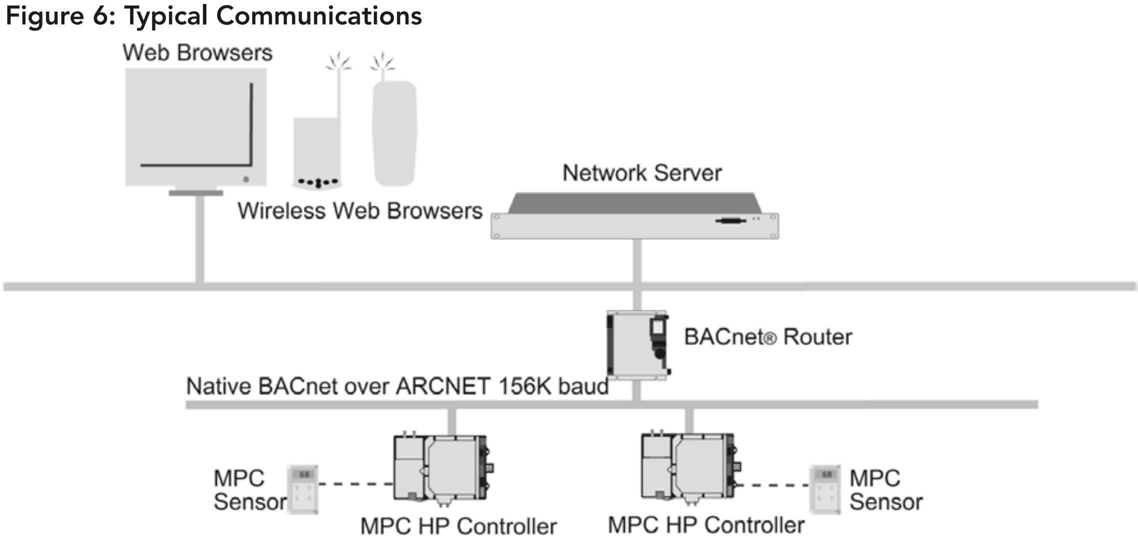
Port Configure

The "Comm" port on the MPC can be configured to communicate via:

a) RS-485 communications (BACnet, N2, ModBus), or
b) BACnet over ARC156 at 156 kbps communications (BACnet only).

This is selected with the "Communications Selection" jumper on the MPC. ARC156 is a unique implementation of the industry standard ARCNET protocol. For detailed instructions regarding ARC156 wiring, refer to Appendix A.

Figure 6: Typical Communications



Protocol & Baud Rate Set Up

Figure 7: Communications Jumpers

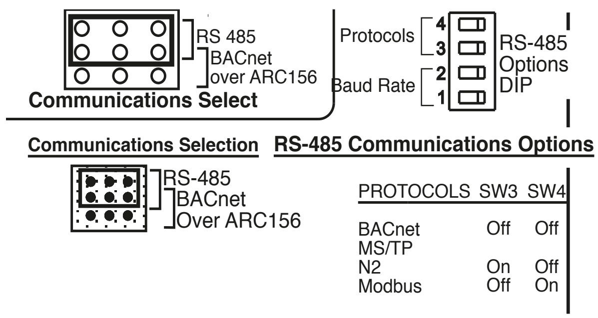
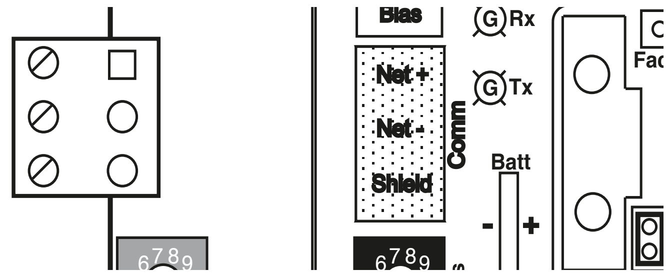


Figure 8: Communications Port



Communications Selection

When the Communications Selection Jumper is in the "BACnet over ARC156" position, DIP switch selectors SW1, SW2, SW3, and SW4 are all disabled. When the Communications Selection Jumper is in the "BACnet over ARC156" position, BACnet protocol is selected and the baud rate is also selected to be 156 kbps. In this scenario, when the comm. port is configured for "BACnet over ARC156" communications, use an A3ARC156 wire available from:

Magnum Cable Corporation
8200 Sweet Valley Drive #104-105
Valley View, Ohio 44125
(800) 421-0820

When the comm. port is configured for RS-485 communications, use standard dedicated 22AWG-18AWG twisted pair wire.

For complete details on wiring, termination, and biasing for BACnet MS/TP, refer to ANSI/ASHRAE 135-1995, clause 9.2.2. Refer to the Application Note for the BACnet devices that you will be interfacing with for specific wiring.

Communications Wiring Instructions

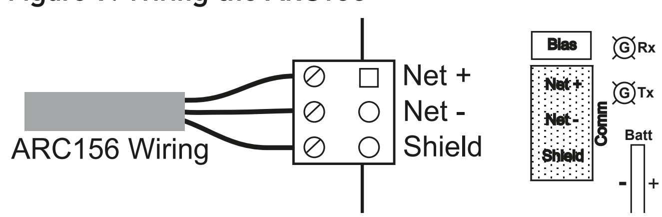
1. Be sure the module's power is off before wiring it to the ARC156 or RS-485 communications bus.
2. Check the network communication wiring for shorts and grounds.
3. Connect the ARC156 or RS-485 wires and shield to the module's screw terminals as shown in Figure 9. Be sure to follow the same polarity as the rest of the ARC156 or RS-485 communications network.
4. Power up the module.
5. Proper communications for all protocols and baud rates can be verified by making sure the transmit (Tx) and receive (Rx) LEDs are active. See Figure 8.

Protocol Configure

The comm. port on the MPC has MultiProtoCol capability which means the MPC can be configured to communicate via BACnet, Johnson Controls N2, or ModBus communication protocols. This configuration is done via the "Communications Selection" jumper and the 4-position DIP switch package (SW1, SW2, SW3, SW4) located on the MPC. The comm. port's baud rate is also set with this same 4-position DIP switch package. See Figure 9 below.

Note: If using ARC156 wiring, then only BACnet protocol can be used. When using RS-485 wiring, any of the 3 protocols (BACnet, N2, ModBus) can be used.

Figure 9: Wiring the ARC156



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BACnet Setup – The MPC can be set up to communicate via "BACnet over ARC156" or "BACnet MS/TP". Refer to Table 2 for setup.

N2 Setup – N2 must be configured for RS-485 communications with a baud rate of 9600, using 8 data bits, no parity, and 1 stop bit. The MPC is always an N2 slave. Refer to Table 2 for setup.

ModBus Setup – ModBus must be configured for RS-485 communications. Baud rate can be selected from 38.4 kbps, 19.2 kbps, or 9.6 kbps. Refer to Table 2 for setup.

Figure 10: Communications Selections

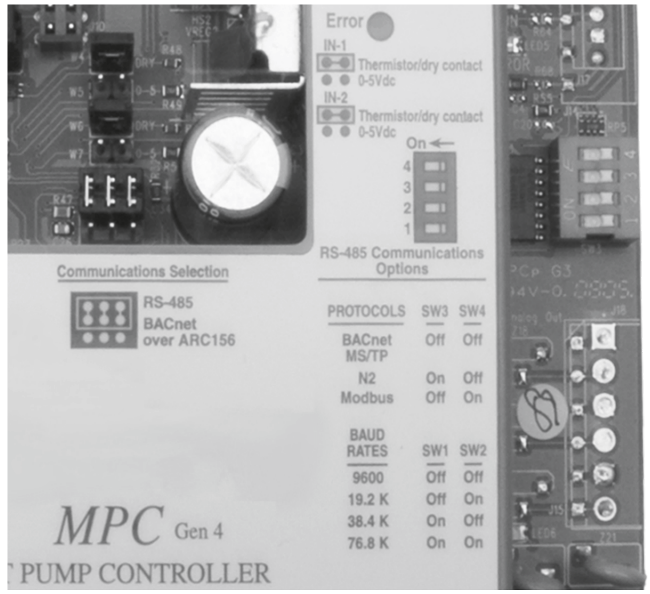


Table 2: Communications Set Up

Desired Setup	Communications Selection Jumper	RS-485 Communication Options DIP			
		Baud Rate		Protocol	
		SW1	SW2	SW3	SW4
BACnet Setup					
BACnet over ARC156 (156kbps baud rate)	BACnet over ARC156	Does Not Apply		Does Not Apply	
BACnet MS/TP (76.8kbps baud rate)	RS-485	ON	ON	OFF	OFF
BACnet MS/TP (38.4kbps baud rate)	RS-485	ON	OFF	OFF	OFF
BACnet MS/TP (19.2kbps baud rate)	RS-485	OFF	ON	OFF	OFF
BACnet MS/TP (9.6kbps baud rate)	RS-485	OFF	OFF	OFF	OFF
N2 Setup					
N2 (9.6kbps baud rate)	RS-485	OFF	OFF	ON	OFF
MODbus Setup					
MODbus (38.4kbps baud rate)	RS-485	ON	OFF	OFF	ON
MODbus (19.2kbps baud rate)	RS-285	OFF	ON	OFF	ON
MODbus (9.6kbps baud rate)	RS-485	OFF	OFF	OFF	ON

LEDs

The MPC Controller has the following LEDs:

Power - indicates when power is on.
Run - blinks when the processor is running.
Error - lights when an error is detected.
Receive (Rx) - lights when the Comm Port receives data.
Transmit (Tx) - lights when the Comm Port transmits data.
Digital Output - lights when the associated digital output turns on.

LED Power-Up Sequence

During power-up, the module goes through an initialization and self test sequence.

Proper module power-up can be verified by observing the LEDs as follows:

1. The Run and Error LEDs turn on and begin blinking.
2. The Error LED then turns off.
3. The Run LED continues blinking.

Note: The Error LED flashes three times in sync with the Run LED when the module is being formatted. The Run LED should never stop flashing. If it stops flashing for 1.5 seconds, the watchdog timer will reset the module.

Overcurrent Protection

The MPC Controller is protected by internal solid state polyswitches (polymeric PTC, resettable overcurrent protection device, also called PPTC) on the incoming power. The overcurrent protection circuitry is a positive temperature coefficient (PTC) thermistor that increases in resistance as it warms up and stays in that mode until the power is removed. Once the power is removed, the polyswitch resistance lowers to operational level as the device cools down. After power has been re-applied, the unit will operate properly if the fault condition has been removed.

It is not necessary to remove power on the communication line in order to reset the solid state overcurrent circuit. Once the power level is low enough, the overcurrent circuit cools down to operating temperature. A blown polyswitch can indicate incorrect wiring if the polyswitch is blown during installation. Generally, a blown polyswitch indicates a power surge was received by the board.

Figure 11: Digital Output LEDs

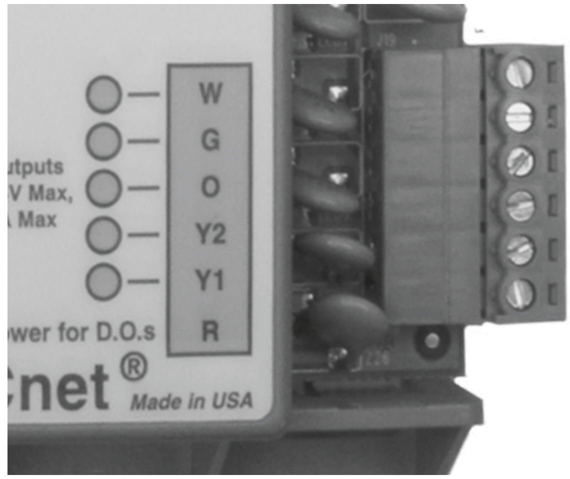


Table 3: LED Signals

Run LED	Error LED	Condition
2 flashes per second	OFF	Normal
2 flashes per second	2 flashes, alternating with Run LED	Five minute auto-restart delay after system error
2 flashes per second	3 flashes then OFF	Module has just been formatted
2 flashes per second	4 flashes then pause	Two or more devices on this network have the same ARC156 network address
2 flashes per second	6 flashes then OFF	Module's response to a LonTalk 'wink' command received from a LonWorks Network Management Tool
2 flashes per second	ON	Exec halted after frequent system errors or GFB's halted
5 flashes per second	ON	Exec start-up aborted, Boot is running
5 flashes per second	OFF	Firmware transfer in progress, Boot is running
7 flashes per second	7 flashes per second, alternating with Run LED	Ten second recovery period after brownout
14 flashes per second	7 flashes per second, alternating with Run LED	Brownout

Jumper Selection

All jumper settings should be field-verified and set as needed during setup and installation.

Figure 12: Jumper Selection

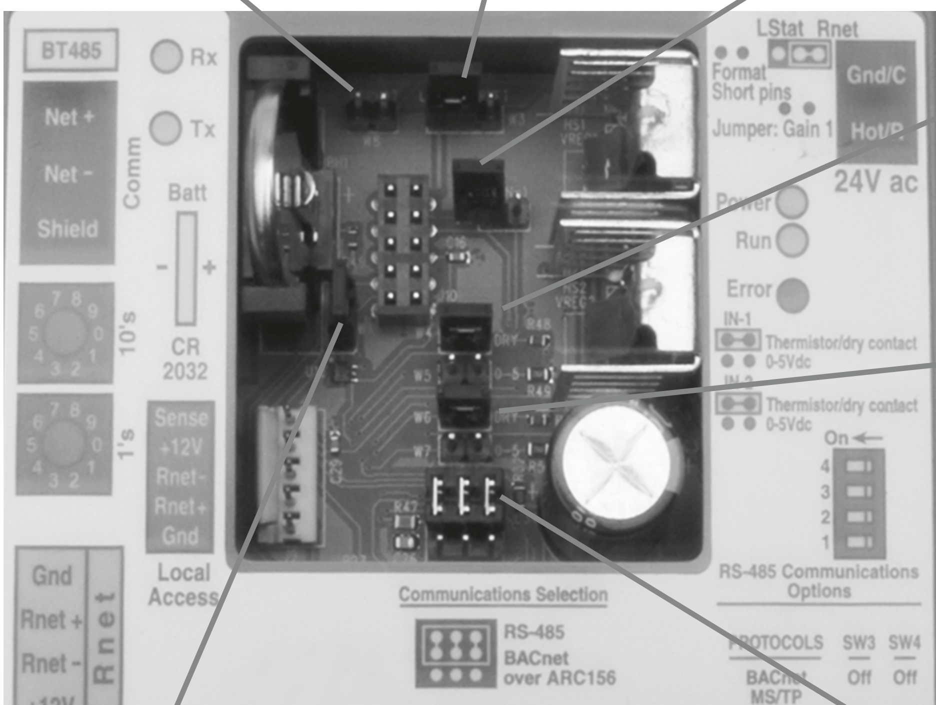
Factory Use Only - 1
Default = No Jumper

Selects “Pro or Basic Space Sensor Connection” or “Loginet” port as the active port for room sensor.
Default = Basic Sensor

Selects 1x (jumpered) for use with thermistor-only applications or 3x (no jumper) for applications where a wall sensor is used.
Default = Wall Sensor Applications (no jumper)

Selects “Thermistor/Dry Contact" or “0 to 5Vdc” input for IN-1
Default = Thermistor/Dry Contact

Selects “Thermistor/Dry Contact" or “0 to 5Vdc” input for IN-2
Default = Thermistor/Dry Contact



Factory Use Only - 2
Default = jumpered

Selects “RS-485 MS/TP” or “ARC156”
Default = “RS-485 MS/TP”

Operation Overview

Fan Operation – Digital output point G(D04) is the fan output and is connected to the “G ” terminal on the CXM or DXM control. If Fan Mode (software point within the MPC) is set to “On ” Mode, then the fan is energized continuously during occupied times and intermittently during unoccupied times. If Fan Mode is set to “Auto” Mode, then the fan is energized only during a call for heating or cooling. “Auto“ Mode is the default mode of operation.

Heating/Cooling Changeover – Digital output point O(D03) is the RV output and is connected to the “O” terminal on the CXM or the “O/W2“ terminal on the DXM. O(D03) is energized during a call for cooling. The MPC Controller employs “smart RV“ control. This ensures that the RV will only switch positions if the MPC Controller has called for a heating/Cooling Mode change.

Compressor Operation – Digital output points Y1(D01) and Y2(D02) are the outputs for compressor stage 1 and compressor stage 2, respectively. Y1(D01) is connected to the “Y” terminal on the CXM or the “Y1 ” terminal on the DXM. If the heat pump is a dual stage heat pump, then Y2(D02) is used to control the Stage 2 compressor. Y2(D02) (if used) is connected to the “Y” terminal on the stage 2 CXM or the “Y2” terminal on the stage 1 DXM.

Y1(D01) and Y2(D02) are Off when the zone temperature is between the heating and cooling setpoints (zone temperature is in the dead band). As the zone temperature rises above the cooling setpoint, Y1(D01) and Y2(D02) are turned on via PID control methods to ensure that the zone temperature is maintained within 1°F [0.6°C] of the cooling setpoint. As the zone temperature falls below the heating setpoint, Y1(D01) and Y2(D02) are turned on via PID control methods to ensure that the zone temperature is maintained within 1°F [0.6°C] of the heating setpoint.

Table 4: MPC LED Readouts

LED or LCD Indicator	Operation Indication
LED “ON” or “Occupied” LCD display	Occupied Mode with no heat pump faults
LED “OFF” or “Unoccupied” LCD display	Unoccupied Mode with no heat pump faults
Flashing code on LED or display code (LCD)	Heat pump has locked out

Note: All 5 digital outputs have associated LEDs to indicate operating status. If the digital output is on, then the associated LED will be on.

Occupied/Unoccupied Changeover – When the MPC is in the stand-alone mode of operation, the MPC defaults to the Occupied Mode. Occupancy changeover may be provided through the communications network.

Troubleshooting Tips – If the BMS is having trouble communicating with the MPC, check the following items before contacting Technical Support:

- Make sure the MPC wiring is correct. In more complex systems, make sure that all cables involved are attached correctly.
- Make sure the MPC and other network controllers have power and are turned on. In more complex systems, make sure all equipment has power and is turned on. Some devices, especially communication devices, receive power from a source other than a power cable or adapter (for example, some devices receive power through communication lines). Some panels can be reinitialized by resetting the panel.
- Verify operation of all the LEDs on the MPC. Check the Power, Run, Error, Rx, and Tx LEDs per Table 3.
- Perform overview check of Digital Output LEDs. Digital output LEDs should turn on indicating calls for fan, heating, or cooling.

Water-to-Air Sequence of Operation

1. Unit start-up.
2. LED Power-Up sequence.
3. Program will check schedule status for either Occupied Mode (default) or Unoccupied Mode to determine the setpoint range. The default mode is occupied, 72°F - 74°F, 24 hours/day 7 days/week. If a schedule is implemented then the default setpoints become 65°F - 82°F in the Unoccupied Mode.
4. Program will determine if the unit is either a Master (default) or Slave.
5. Program will check for a valid 4-wire sensor at either the Pro Sensor Port (for use with RS wall sensors) or the Plus/Basic Sensor Port (for use with ASW sensors) during the first 5 minutes after start-up. If valid sensor is not detected the program will default to 45°F in Heating Mode.
6. Current zone temperature will be checked against the default setpoint range of 72°F - 74°F (occupied) or 65°F - 82°F (unoccupied).

Sequence of Operation

7. Temperature adjustment at the wall sensor will be taken into account when determining the actual setpoint range. The temperature adjustment range default is +/- 5°F. For example, if the setpoint adjustment is + 2°F then the setpoint range becomes 74°F - 76°F. If the setpoint adjustment is – 3°F then the setpoint range becomes 69°F - 71°F. These same setpoint adjustments are added/subtracted to the unoccupied setpoints when the zone is unoccupied. The temperature adjustment range default can be customized via the Manual SP Adjust Value (Separate Manual SP Adjust point provided for Metric Mode. *See Section 17 of Water-to-Air Sequence of Operation **See Point List).
8. The setpoints are then compared to the actual zone temperature at the RS sensor. Based on this a PID algorithm is implemented to determine when to energize the unit in either heating or Cooling Mode. The PID algorithm calculates a value in percent based on the zone temperature and where it is with respect to the heating/cooling setpoint.
9. The fan will turn on at 30% off at 25%. Compressor 1 will turn on at 50% off at 48%. Compressor 2 will turn on at 75% off at 73%. Electric Heat will turn on at 90% off at 88%.
10. There is a software delay of 5 minutes to prevent the unit from cycling between heating and cooling and vice versa.
11. Once there is a call for heating/cooling and the PID % increases to 30%, the fan will energize. There is a rate of climb for the PID % that equals 1% for every 2 seconds. Thus, it will take a minimum of 60 seconds before the fan will come on. Then when the PID % increases to 50% compressor 1 will energize after 10 seconds if the 5 minute anti cycle timer on the CXM/DXM has expired.
12. There is a 5 minute software timer that ensures 5-minutes has elapsed after compressor 1 energized before allowing compressor 2 to energize. When the PID % increases to 75% compressor 2 will energize after 10 seconds if the 5 minute anti cycle timer on the CXM/DXM has expired.
13. If the unit is in Heating Mode and has electric heat, when the PID % increases to 90% the electric heat will be energized.
14. When the zone is satisfied then the PID % will start to decrease at a rate of 1% for every 2 seconds. Each component will turn off at the same percentage it turned on minus the hysteresis. There are no additional time delays when turning off components.
15. While the unit is on, the program will continue to monitor the CXM/DXM board for faults. If a fault should occur and the unit is in lockout then the alarm relay will close (IN-1/Gnd) and the fault code is transmitted via EH2 output to the IN-2 input on the MPC. This information is readily available via network points.
16. A history counter will keep track of each fault code that has occurred since unit start-up. The time & date for the current fault and last fault can be seen with WebCtrl only. The counters can be viewed via the BACview 6 or network points.
17. The MPC can also function in Celsius Mode. This is achieved by setting the Metric Mode Value to ON. Once in Metric Mode operation, the application logic is controlled by the Celsius control values. (Master ZT Celsius, Unoccupied CL SP Celsius, Occupied Deadband Celsius, Slave CL SP Celsius, Slave HT SP Celsius, Occupied CL SP Celsius, and Manual SP Adjust Celsius. *See Point List). Because the Metric Mode is for input and output calculation only, the logic operates the same (in Fahrenheit Mode) for both configurations.

Network Variable Points List (Water-to-Air)

Table 5a: Network Variable Points List (Water-to-Air)

Gen	Point Name	BACnet			Read Only	Modbus		N2		Default Value	Description
		Name	Point Type	Instance		Object Type	Register	Type	ID		
<=4	Zone Temp / Zone Temp	zone_temp_1	Analog Input	1	✓	Float Value	30001	Analog In	1	N/A	Raw Space Temp from Wall Sensor
<=4	Actual CL SP	actual_cl_ sp_1	Analog Value	1	✓	Float Value	30007	Data Float	1	74ºF	Actual cooling setpoint based upon occupancy status, setpoint adjustment, and metric conversion.
<=4	Actual HT SP	actual_ht_ sp_1	Analog Value	2	✓	Float Value	30009	Data Float	2	72ºF	Actual heating setpoint based upon occupancy status, setpoint adjustment, and metric conversion.
<=4	Occupied CL SP	occupied_cl_ sp_1	Analog Value	3		Float Value	40001	Data Float	3	74ºF	Network input for the cooling setpoint in the occupied mode. Fahrenheit mode.
<=4	Master ZT	master_zt_1	Analog Value	4		Float Value	40003	Data Float	4	73ºF	Network input for multiple WSHP sharing the same space temperature sensor. This input is only for slave units where the M/S Switch must be on. Fahrenheit mode.
<=4	Occupied Deadband	occupied_ deadband_1	Analog Value	5		Float Value	40005	Data Float	5	2ºF	Creates the heating setpoint using occupied cooling setpoint minus current value. Minimum value is 2 deg F with a default of 2 deg F. Fahrenheit mode.
<=4	Pulse Signal Value	pulse_signal_ value_1	Analog Value	6	✓	Unsigned Int	30011	Data Int	1	1	Indicates the last fault code in memory on the CXM/DXM board. Refer to CXM/DXM manual for fault codes.
<=4	Unoccupied CL SP	unoccupied_ cl_sp_1	Analog Value	7		Float Value	40007	Data Float	6	82ºF	Network input for the cooling setpoint in the unoccupied mode. Fahrenheit mode.
<=4	Slave HT SP	slave_ht_sp_1	Analog Value	9		Float Value	40011	Data Float	8	72ºF	Network input for the actual heating setpoint when used as a slave unit. This input is only used for slave units where the M/S Switch must be on. Fahrenheit Mode
<=4	Slave CL SP	slave_cl_sp_1	Analog Value	10		Float Value	40009	Data Float	7	74ºF	Network input for the actual cooling setpoint when used as a slave unit. This input is only used for slave units where the M/S Switch must be on. Fahrenheit Mode
<=4	HP Fault Counter	hp_fault_ counter_1	Analog Value	11	✓	Unsigned Int	30014	Data Int	2	0	Indicates the number of HP faults that have occurred since unit startup or resetting the Fault Count Reset (BV:24)
<=4	LP Fault Counter	lp_fault_ counter_1	Analog Value	12	✓	Unsigned Int	30015	Data Int	3	0	Indicates the number of LP faults that have occurred since unit startup or resetting the Fault Count Reset (BV:24)
<=4	FP1 Fault Counter	fp1_fault_ counter_1	Analog Value	13	✓	Unsigned Int	30016	Data Int	4	0	Indicates the number of FP1 faults that have occurred since unit startup or resetting the Fault Count Reset (BV:24)
<=4	FP2 Fault Counter	fp2_fault_ counter_1	Analog Value	14	✓	Unsigned Int	30017	Data Int	5	0	Indicates the number of FP2 faults that have occurred since unit startup or resetting the Fault Count Reset (BV:24)
<=4	CO Fault Counter	co_fault_ counter_1	Analog Value	15	✓	Unsigned Int	30018	Data Int	6	0	Indicates the number of CO faults that have occurred since unit startup or resetting the Fault Count Reset (BV:24)
<=4	Over/Under Voltage Fault Counter	over_under_ voltage_fault_ counter_1	Analog Value	16	✓	Unsigned Int	30019	Data Int	7	0	Indicates the number of over/under voltage faults that have occurred since unit startup or resetting the Fault Count Reset (BV:24)
<=4	UPS Fault Counter	ups_fault_ counter_1	Analog Value	17	✓	Unsigned Int	30020	Data Int	8	0	Indicates the number of UPS faults that have occurred since unit startup or resetting the Fault Count Reset (BV:24)
<=4	Swapped FP1/ FP2 Fault Counter	swapped_ fp1_fp2_fault_ counter_1	Analog Value	18	✓	Unsigned Int	30021	Data Int	9	0	Indicates the number of swapped FP1/FP2 faults that have occurred since unit startup or resetting the Fault Count Reset (BV:24)

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Gen	Point Name	BACnet			Read Only	Modbus		N2		Default Value	Description
		Name	Point Type	Instance		Object Type	Register	Type	ID		
<=4	C1 Cycle Counter	c1_cycle_ counter_1	Analog Value	19	✓	Unsigned Int	30022	Data Int	10	0	Indicates the number of times that compressor 1 has cycled on/off more than 6 times in 60 minutes since unit startup or resetting the Fault Count Reset (BV:24).
<=4	C2 Cycle Counter	c2_cycle_ counter_1	Analog Value	20	✓	Unsigned Int	30023	Data Int	11	0	Indicates the number of times that compressor 2 has cycled on/off more than 6 times in 60 minutes since unit startup or resetting the Fault Count Reset (BV:24)
<=4	HT PID	ht_pid_1	Analog Value	28	✓	Float Value	30024	Data Float	17	0%	Heating PID output based on the setpoint and actual space temperature.
<=4	CL PID	cl_pid_1	Analog Value	29	✓	Float Value	30026	Data Float	18	0%	Cooling PID output based on the setpoint and actual space temperature.
<=4	Dirty Filter Interval	dirty_filter_ interval_1	Analog Value	30		Float Value	40027	Data Float	19	1500 hrs	Represents the time interval for changing air filters.
<=4	AUX CFG	aux_cfg_1	Analog Value	31		Float Value	40029	Data Float	20	1	Configuration parameter for the aux output relay (W): 1 = Electric Heat, 2 = Cycle w/ Y1, 3 = Cycle w/ G, 4 = Slow opening water valve, 5 = High speed fan, 6 = Alarm Relay, 7-10 = Reheat Modes, 11 = Manual Control.
<=4	TSTAT Mode	tstat_mode_1	Analog Value	32		Float Value	40031	Data Float	21	1	Configuration parameter for controlling the zone temperature. 1 = MPC. 2 = Thermostat.
<=4	SF CFG	sf_cfg_1	Analog Value	33		Float Value	40033	Data Float	22	1	Configuration parameter for controlling the supply fan: 1 = Cycle with Compressor. 2 = On during occupancy, cycle with compressor during unoccupied. 3 = On all the time.
4	Zone Temp Status	zone_temp_ status_1	Analog Value	34	✓	Float Value	30028	Data Float	23	N/A	Network Output for Space Temperature. Celsius/Fahrenheit.
4	LVG Air Temp Status	lvg_air_temp_ status_1	Analog Value	35	✓	Float Value	30030	Data Float	24	N/A	Leaving Air Temperature for the WSHP. Celsius/Fahrenheit.
4	LVG Water Temp Status	lvg_water_ temp_status_1	Analog Value	36	✓	Float Value	30032	Data Float	25	N/A	Leaving Water Temperature for the WSHP. Celsius/Fahrenheit.
4	Manual SP Adjust	manual_sp_ adjust_1	Analog Value	37		Float Value	40035	Data Float	26	5ºF	Network input for User defined Setpoint adjustment. Should not be used with RS PRO sensors. Fahrenheit Mode.
4	Master ZT Celsius	master_zt_ celsius_1	Analog Value	38		Float Value	40037	Data Float	27	22.78ºC	Network input for multiple WSHP sharing the same space temperature sensor. This input is only for slave units where the M/S Switch must be on. Celsius mode.
4	Unoccupied CL SP Celsius	unoccupied_ cl_sp_ celsius_1	Analog Value	39		Float Value	40039	Data Float	28	27.78ºC	Network input for the cooling setpoint in the unoccupied mode. Celsius mode.
4	Occupied Deadband Celsius	occupied_ deadband_ celsius_1	Analog Value	40		Float Value	40041	Data Float	29	1.11ºC	Creates the heating setpoint using occupied cooling Celsius setpoint minus current value. Minimum value is 1.11 deg C with a default of 1.11 deg C. Celsius Mode.
4	Slave CL SP Celsius	slave_cl_sp_ celsius_1	Analog Value	41		Float Value	40043	Data Float	30	23.33ºC	Network input for the actual cooling setpoint when used as a slave unit. This input is only used for slave units where the M/S Switch must be on. Celsius Mode
4	Slave HT SP Celsius	slave_ht_sp_ celsius_1	Analog Value	42		Float Value	40045	Data Float	31	22.22ºC	Network input for the actual heating setpoint when used as a slave unit. This input is only used for slave units where the M/S Switch must be on. Celsius Mode
4	Occupied CL SP Celsius	occupied_cl_ sp_celsius_1	Analog Value	43		Float Value	40047	Data Float	32	23.33ºC	Network input for the cooling setpoint in the occupied mode. Celsius mode.
4	Manual SP Adjust Celsius	manual_ sp_adjust_ celsius_1	Analog Value	44		Float Value	40049	Data Float	33	2.78ºC	Network input for User defined Setpoint adjustment. Should not be used with RS PRO sensors. Celsius Mode.
4E	Unoccupied Deadband	unoccupied_ deadband_1	Analog Value	45		Float Value	40015	Data Float	10	17ºC	Creates the heating setpoint using unoccupied cooling setpoint minus current value. Minimum value is 2 deg F with a default of 17 deg 5. Fahrenheit mode.

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Gen	Point Name	BACnet			Read Only	Modbus		N2		Default Value	Description
		Name	Point Type	Instance		Object Type	Register	Type	ID		
4E	Unoccupied Deadband Celsius	unoccupied_ deadband_ celsius_1	Analog Value	46		Float Value	40017	Data Float	28	9.44ºC	Creates the heating setpoint using unoccupied cooling setpoint minus current value. Minimum value is 1.11 deg C with a default of 9.44 deg C. Celsius mode.
<=4	Alarm Relay	alarm_relay_1	Binary Input	1	✓	Discrete In	10021	Binary Out	20	OFF	Dry contact signal indicating if the Alarm relay on the CXM/DXM is currently closed (ON) or open (OFF) via inputs AL1 & AL2. Jumper IN-1 must be in the dry position.
<=4	Pulsed Alarm	pulsed_ alarm_1	Binary Input	2	✓	Discrete In	10022	Binary Out	21	OFF	Pulses the alarm code from the CXM/DXM via EH2 output. The Pulse Signal Value is read from input EH2.
<=4	Valid Sensor	valid_ sensor_1	Binary Input	3	✓	Discrete In	10023	Binary Out	22	OFF	Verifies whether a 4-wire sensor is connected to the MPC. If a valid sensor is not detected within 5 minutes of power-up, then the MPC will default to 45ºF in heating mode.
<=4	Alarm State	alarm_state_1	Binary Value	1	✓	Discrete In	10001	Binary In	1	OFF	ON indicates a Lockout condition exists. Off indicates normal operation.
<=4	C1 Reset	c1_reset_1	Binary Value	2		Discrete Out	1	Binary Out	1	OFF	Network input used to reset the C1 Runtime Alarm once the event is triggered.
<=4	C1 Status	c1_status_1	Binary Value	3	✓	Discrete In	10002	Binary In	2	OFF	Indicates if compressor 1 is ON/OFF.
<=4	System Reset	system_ reset_1	Binary Value	4		Discrete Out	2	Binary Out	2	OFF	Network input used to reset the unit from lockout mode. Turn ON to reset, then turn OFF.
<=4	C2 Reset	c2_reset_1	Binary Value	5		Discrete Out	3	Binary Out	3	OFF	Network input used to reset the C2 Runtime Alarm once the event is triggered.
<=4	C2 Status	c2_status_1	Binary Value	6	✓	Discrete In	10003	Binary In	3	OFF	Indicates if compressor 2 is ON/OFF.
<=4	Dirty Filter Reset	dirty_filter_ reset_1	Binary Value	7		Discrete Out	4	Binary Out	4	OFF	Network input used to reset the Dirty Filter Alarm.
<=4	Emergency Shutdown	emergency_ shutdown_1	Binary Value	8		Discrete Out	5	Binary Out	5	OFF	Network input for emergency shutdown. When emergency shutdown is turned on, then Y1, Y2, G & W output relays turn off.
<=4	SF Operation Mode	sf_operation_ mode_1	Binary Value	9		Discrete Out	6	Binary Out	6	OFF	Network input to determine if the SF is in Auto (Off) mode or on continuously.
<=4	SF Status	sf_status_1	Binary Value	10	✓	Discrete In	10004	Binary In	4	OFF	Indicates if the supply fan is ON/OFF.
<=4	Occupied Status	occupied_ status_1	Binary Value	11	✓	Discrete In	10005	Binary In	5	ON	Indicates whether the WSHP is in occupied(ON) mode or unoccupied (OFF) mode.
<=4	Occupied Mode	occupied_ mode_1	Binary Value	12		Discrete Out	7	Binary Out	7	ON	Network input to put the heat pump in unoccupied (OFF) or occupied (ON) mode. Can be used instead of work schedule.
<=4	RV Status	rv_status_1	Binary Value	13	✓	Discrete In	10006	Binary In	6	OFF	Indicates if the reversing valve is ON/OFF.
<=4	Work Schedule	work_ schedule_1	Binary Value	14		Discrete In	10024	Binary In		OFF	Reads schedules from WebCTRL and informs controls whether they are in occupied or unoccupied mode. WebCTRL ONLY.
<=4	UPS Signal	ups_signal_1	Binary Value	15	✓	Discrete In	10007	Binary In	7	OFF	Indicates if the UPS mode is ON/OFF. Refer to CXM/DXM AOM for UPS definition.
<=4	M/S Switch	m_s_switch_1	Binary Value	16		Discrete Out	8	Binary Out	8	OFF	Master / Slave network input to enable the use of Master ZT. Master unit is defined as one WSHP per sensor and the value is OFF. Slave unit is defined as unit that shares a sensor with the Master Unit and the value is ON.
<=4	C1 Runtime Alarm	c1ralm_1	Binary Value	17	✓	Discrete In	10008	Binary In	8	OFF	Indicates that the number of operational hours for compressor 1 has exceeded 50,000. Reset via C1 reset.

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Gen	Point Name	BACnet			Read Only	Modbus		N2		Default Value	Description
		Name	Point Type	Instance		Object Type	Register	Type	ID		
<=4	C2 Runtime Alarm	c2ralm_1	Binary Value	18	✓	Discrete In	10009	Binary In	9	OFF	Indicates that the number of operational hours for compressor 2 has exceeded 50,000. Reset via C2 reset.
<=4	Dirty Filter Alarm	dirty_filter_alarm_1	Binary Value	19	✓	Discrete In	10010	Binary In	10	OFF	Indicates that the number of operational hours for the supply fan has exceeded the Dirty Filter Interval setting. Reset via Dirty Filter Reset.
<=4	Valid Sensor Alarm	vs_alm_1	Binary Value	20	✓	Discrete In	10011	Binary In	11	OFF	Indicates that there is no valid room sensor connected to the MPC control board. The signal is sent via Valid Sensor (BI:3)
<=4	C1 Cycle Reset	c1_cycle_reset_1	Binary Value	21		Discrete Out	9	Binary Out	9	OFF	Network input used to reset the C1 Cycle Counter back to 0.
<=4	C2 Cycle Reset	c2_cycle_reset_1	Binary Value	22		Discrete Out	10	Binary Out	10	OFF	Network input used to reset the C2 Cycle Counter back to 0.
<=4	Lockout Alarm	lo_alm_1	Binary Value	23	✓	Discrete In	10012	Binary In	12	OFF	Indicates that the CXM/DXM is currently in Lockout Mode.
<=4	Fault Count Reset	fault_count_reset_1	Binary Value	24		Discrete Out	11	Binary Out	11	OFF	Network Input used to reset all of the historical counters for each error code back to 0.
<=4	C1 Cycle Alarm	c1calm_1	Binary Value	25	✓	Discrete In	10013	Binary In	13	OFF	Indicates that compressor 1 has cycled ON/OFF more than 6 times during one hour.
<=4	C2 Cycle Alarm	c2clam_1	Binary Value	26	✓	Discrete In	10014	Binary In	14	OFF	Indicates that compressor 2 has cycled ON/OFF more than 6 times during one hour.
<=4	AUX Status	aux_status_1	Binary Value	27	✓	Discrete In	10015	Binary In	15	OFF	Indicates if the auxiliary output is ON/OFF.
<=4	SF Manual	sf_manual_1	Binary Value	28		Discrete Out	12	Binary Out	12	OFF	Manual Switch to turn the supply fan ON/OFF.
<=4	RV Manual	rv_manual_1	Binary Value	29		Discrete Out	13	Binary Out	13	OFF	Manual Switch to turn the reversing valve ON/OFF.
<=4	C1 Manual	c1_manual_1	Binary Value	30		Discrete Out	14	Binary Out	14	OFF	Manual Switch to turn compressor 1 ON/OFF.
<=4	C2 Manual	c2_manual_1	Binary Value	31		Discrete Out	15	Binary Out	15	OFF	Manual Switch to turn compressor 2 ON/OFF.
<=4	AUX Manual	aux_manual_1	Binary Value	32		Discrete Out	16	Binary Out	16	OFF	Manual Switch to turn the auxiliary output ON/OFF.
<=4	Prod Test	prod_test_1	Binary Value	36		Discrete Out	17	Binary Out	17	OFF	Network input to turn the production testing ON/OFF.
<=4	Test Mode	test_mode_1	Binary Value	34		Discrete Out	18	Binary Out	18	OFF	Network input used to bypass the normal logical operations in order to operate the unit manually. Maximum on time is 60 minutes.
<=4	Test Mode Alarm	tm_alm_1	Binary Value	38	✓	Discrete In	10025	Binary In	21	OFF	Indicates that the unit is still in Test Mode after the Test Mode Timer has expired.
4	Metric	metric_1	Binary Value	39		Discrete Out	21	Binary Out	28	OFF	Network input used to define inputs and outputs. Celsius (ON) Fahrenheit (OFF).
4E	Aux Toggle	aux_toggle_1	Binary Value	40		Discrete Out	17	Binary Out	17	OFF	Used to toggle the auxiliary output relay (W) on and off. Used when AUX CFG (AV:31) is set to a value of 11.

BACnet reference name format = Point Name_1
Modbus 1-10,000 binary read & write
Modbus 10,000-19,999 binary read
Modbus 30,000-39,999 analog read
Modbus 40,000-49,999 analog read & write
Minimum required points

Sequence of Operation

Water-to-Water Sequence of Operation

1. Unit start-up.
2. LED Power-Up sequence.
3. Program will check schedule status for either Occupied Mode (default) or Unoccupied Mode to determine the setpoint range. The default mode is occupied, 48°F - 53°F (cooling), 105°F - 110°F (heating), 24 hours/day, 7 days/week. The actual setpoints are 53°F (cooling) & 105°F (heating) with a cooling/heating differential of 5°F. In Heating Mode the differential is added to the setpoint and in Cooling Mode the differential is subtracted from the setpoint. If a schedule is implemented, then the default setpoints become 73°F (cooling), 85°F (heating) with 5°F differential in the Unoccupied Mode.
4. Program will determine if the unit is either a Master (default) or Slave.
5. Program will control the water temperature via EWT-Load sensor. If the unit is to be controlled via LWT-Load then calculate the DT using the flow rate and capacity information and calculate the EWT-Load. Then write the EWT-Load value calculated to the network point and this will maintain the desired LWT-Load.
6. Program will check for which water temperature setpoint to use based on Heating Mode or Cooling Mode determined by the state of the RV.
7. Current water temperature will be checked against the default setpoint range, 48°F - 53°F (cooling), 105°F - 110°F (heating) occupied or 68°F - 73°F (cooling), 85°F - 90°F (heating) unoccupied.
8. The water temperature is controlled as follows in Heating Mode: when the water temperature is less than the setpoint compressor 1 will activate. With 50% demand or more, compressor 2 will activate. As demand falls below 50%, compressor 2 will shut off and compressor 1 shuts off when the demand differential is reached. The unit will not restart until the EWT has decreased to below the initial setpoint.
9. The water temperature is controlled as follows in Cooling Mode: when the water temperature is greater then the setpoint compressor 1 will activate. With 50% demand or more, compressor 2 will activate. As demand falls below 50%, compressor 2 will shut off and compressor 1 shuts off when the demand differential is reached. The unit will not restart until the EWT has increased to above the initial setpoint.
10. There is a software delay of 5 minutes to prevent the unit from cycling between heating and cooling and vice versa.
11. While the unit is on, the program will continue to monitor the CXM/DXM board for faults. If a fault should occur and the unit is in lockout then the alarm relay will close (IN-1/Gnd) and the fault code is transmitted via EH2 output to the IN-2 input on the MPC. This information is readily available via network points.
12. A history counter will keep track of each fault code that has occurred since unit start-up. The time & date for the current fault and last fault can be seen with WebCtrl only. The counters can be viewed via the BACview 6 or network points.
13. The MPC can also function as a Celsius Mode. This is achieved by setting the Metric Mode Value to ON. Once in Metric Mode operation, the application logic is controlled by the Celsius control values. (Master WT/Celsius, Unoccupied HT SP/Celsius, Occupied HT SP/ Celsius, Unoccupied CL SP/ Celsius, Occupied CL SP/ Celsius, Slave HT SP/ Celsius, and Slave CL SP/ Celsius. *See Point List). Because the Metric Mode is for input and output calculation only, the logic operates the same (in Fahrenheit Mode) for both configurations.

Network Variable Points List (Water-to-Water)

Table 5b: Network Variable Points List (Water-to-Water)

Gen	Point Name	BACnet			Read Only	Modbus		N2		Default Value	Description
		Name	Point Type	Instance		Object Type	Register	Type	ID		
<=4	Zone Temp	zone_temp_1	Analog Input	1		Float Value	30001	Analog In	1	NA	Space temperature corresponding to sensor location.
<=4	LWT Load	lwt_load_1	Analog Input	2	✓	Float Value	30003	Analog In	2	NA	Load coil leaving water temperature
<=4	EWT Load	ewt_load_1	Analog Input	3	✓	Float Value	30005	Analog In	3	NA	Load coil entering water temperature
<=4	LWT Source	lwt_source_1	Analog Input	4	✓	Float Value	30007	Analog In	4	NA	Source coil leaving water temperature
<=4	Actual CL SP	actual_cl_sp_1	Analog Value	1	✓	Float Value	30009	Data Float	1	74°F	Actual cooling setpoint based upon occupancy status, setpoint adjustment, and metric conversion.
<=4	Actual HT SP	actual_ht_sp_1	Analog Value	2	✓	Float Value	30011	Data Float	2	72°F	Actual heating setpoint based upon occupancy status, setpoint adjustment, and metric conversion.
<=4	Occupied CL SP / Fahrenheit	occupied_cl_ sp_1	Analog Value	3		Float Value	40001	Data Float	3	74°F	Network input for the cooling setpoint in the Occupied Mode. Fahrenheit Mode.
<=4	Master WT / Fahrenheit	master_wt_1	Analog Value	4		Float Value	40003	Data Float	4	105°F	Network input for multiple Water to Water units sharing the same water temperature sensor. This input is only for slave units where the M/S Switch must be on. Fahrenheit Mode.
<=4	Occupied HT SP / Fahrenheit	occupied_ht_ sp_1	Analog Value	5		Float Value	40005	Data Float	5	105°F	Network input for the heating setpoint in the Occupied Mode. Fahrenheit Mode.
<=4	Pulse Signal Value	pulse_signal_ value_1	Analog Value	6	✓	Unsigned Int	30013	Data Int	1	1	Indicates the last fault code in memory on the CXM/DXM board. Refer to CXM or DXM manual for fault codes.
<=4	Unoccupied CL SP / Fahrenheit	unoccupied_cl_ sp_1	Analog Value	7		Float Value	40007	Data Float	6	82°F	Network input for the cooling setpoint in the Unoccupied Mode. Fahrenheit Mode.
<=4	Override Time Remaining	override_time_ remaining_1	Analog Value	8	✓	Float Value	30014	Data Float	7	0	Number of minutes to override the local zone's unoccupied state. Maximum override time is 180 minutes.
<=4	Slave HT SP / Fahrenheit	slave_ht_sp_1	Analog Value	9		Float Value	40009	Data Float	8	72°F	Network input for the actual heating setpoint when used as a slave unit. This input is only used for slave units where the M/S Switch must be on. Fahrenheit Mode.
<=4	Slave CL SP / Fahrenheit	slave_cl_sp_1	Analog Value	10		Float Value	40011	Data Float	9	74°F	Network input for the actual cooling setpoint when used as a slave unit. This input is only used for slave units where the M/S Switch must be on. Fahrenheit Mode.
<=4	HP Fault Counter	hp_fault_ counter_1	Analog Value	11	✓	Unsigned Int	30016	Data Int	2	0	Indicates the number of HP faults that have occurred since unit startup or resetting the Fault Count Reset (BV:22)
<=4	LP Fault Counter	lp_fault_ counter_1	Analog Value	12	✓	Unsigned Int	30017	Data Int	3	0	Indicates the number of LP faults that have occurred since unit startup or resetting the Fault Count Reset (BV:22)
<=4	FP1 Fault Counter	fp1_fault_ counter_1	Analog Value	13	✓	Unsigned Int	30018	Data Int	4	0	Indicates the number of FP1 faults that have occurred since unit startup or resetting the Fault Count Reset (BV:22)
<=4	FP2 Fault Counter	fp2_fault_ counter_1	Analog Value	14	✓	Unsigned Int	30019	Data Int	5	0	Indicates the number of FP2 faults that have occurred since unit startup or resetting the Fault Count Reset (BV:22)
<=4	CO Fault Counter	co_fault_ counter_1	Analog Value	15	✓	Unsigned Int	30020	Data Int	6	0	Indicates the number of CO faults that have occurred since unit startup or resetting the Fault Count Reset (BV:22)
<=4	Over/Under Voltage Fault Counter	over_under_ voltage_fault_ counter_1	Analog Value	16	✓	Unsigned Int	30021	Data Int	7	0	Indicates the number of over/under voltage faults that have occurred since unit startup or resetting the Fault Count Reset (BV:22)
<=4	UPS Fault Counter	ups_fault_ counter_1	Analog Value	17	✓	Unsigned Int	30022	Data Int	8	0	Indicates the number of UPS faults that have occurred since unit startup or resetting the Fault Count Reset (BV:22)

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Gen	Point Name	BACnet			Read Only	Modbus		N2		Default Value	Description
		Name	Point Type	Instance		Object Type	Register	Type	ID		
<=4	C1 Cycle Counter	c1_cycle_ counter_1	Analog Value	19	✓	Unsigned Int	30024	Data Int	10	0	Indicates the number of times that compressor 1 has cycled on/off more than 6 times in 60 minutes that have occurred since unit startup or resetting the Fault Count Reset (BV:22)
<=4	C2 Cycle Counter	c2_cycle_ counter_1	Analog Value	20	✓	Unsigned Int	30025	Data Int	11	0	Indicates the number of times that compressor 2 has cycled on/off more than 6 times in 60 minutes that have occurred since unit startup or resetting the Fault Count Reset (BV:22)
<=4	Unoccupied HT SP / Fahrenheit	unoccupied_ht_ sp_1	Analog Value	21		Float Value	40013	Data Float	10	85°F	Network input for the heating setpoint in the Unoccupied Mode. Fahrenheit Mode.
<=4	CLD	cld_1	Analog Value	22		Float Value	40015	Data Float	11	5°F	Cooling Differential network input; for example, if the setpoint is 53°F and the CLD is 5°F then the unit will remain on until the water reaches 48°F.
<=4	HTD	htd_1	Analog Value	23		Float Value	40017	Data Float	12	5°F	Heating Differential network input; for example, if the setpoint is 105°F and the CLD is 5°F then the unit will remain on until the water reaches 110°F.
<=4	Slave CLD	slave_cld_1	Analog Value	24		Float Value	40019	Data Float	13	48°F	Network input for the actual cooling setpoint minus CLD when used as a slave unit. This input is only used for slave units where the M/S switch must be on.
<=4	Slave HTD	slave_htd_1	Analog Value	25		Float Value	40021	Data Float	14	110°F	Network input for the actual heating setpoint plus HTD when used as a slave unit. This input is only used for slave units where the M/S switch must be on.
<=4	AUX CFG	aux_cfg_1	Analog Value	26		Float Value	40023	Data Float	15	1	Configuration parameter for the AUX output terminal: Water to Water (G) 1=cycle w/ compressor. 2=slow opening water valve (60 sec). 3=Alarm relay.
4	Master WT / Celsius	master_wt_c_1	Analog Value	27		Float Value	40025	Data Float	16	40.56	Network input for multiple Water to Water units sharing the same water temperature sensor. This input is only for slave units where the M/S Switch must be on. Celsius Mode.
4	Unoccupied HT SP / Celsius	unoccupied_ht_ sp_c_1	Analog Value	28		Float Value	40027	Data Float	17	29.44	Network input for the heating setpoint in the Unoccupied Mode. Celsius Mode.
4	Occupied HT SP / Celsius	occupied_ht_ sp_c_1	Analog Value	29		Float Value	40029	Data Float	18	40.56	Network input for the heating setpoint in the Occupied Mode. Celsius Mode.
4	Unoccupied CL SP / Celsius	unoccupied_cl_ sp_c_1	Analog Value	30		Float Value	40031	Data Float	19	22.78	Network input for the cooling setpoint in the Unoccupied Mode. Celsius Mode.
4	Occupied CL SP / Celsius	occupied_cl_ sp_c_1	Analog Value	31		Float Value	40033	Data Float	20	11.67	Network input for the cooling setpoint in the Occupied Mode. Celsius Mode.
4	Slave HT SP / Celsius	slave_ht_sp_c_1	Analog Value	32		Float Value	40035	Data Float	21	40.56	Network input for the actual heating setpoint when used as a slave unit. This input is only used for slave units where the M/S Switch must be on. Celsius Mode.
4	Slave CL SP / Celsius	slave_cl_sp_c_1	Analog Value	33		Float Value	40037	Data Float	22	11.67	Network input for the actual cooling setpoint when used as a slave unit. This input is only used for slave units where the M/S Switch must be on. Celsius Mode.
4	LWT Load Status	lwt_load_ status_1	Analog Value	34	✓	Float Value	30026	Data Float	23	NA	Indicates the leaving water temperature of the load coil.
4	EWT Load Status	ewt_load_ status_1	Analog Value	35	✓	Float Value	30028	Data Float	24	NA	Indicates the entering water temperature of the load coil.
4	LWT Source Status	lwt_source_ status_1	Analog Value	36	✓	Float Value	30030	Data Float	25	NA	Indicates the leaving water temperature of the source coil.
4	ZT Status	zt_status_1	Analog Value	37	✓	Float Value	30032	Data Float	26	NA	Indicates the current zone temperature.
4	HT PID	ht_pid_1	Analog Value	38	✓	Float Value	30036	Data Float	29	0	Heating PID output based on setpoint and the actual water temperature in Heating Mode.
4	CL PID	cl_pid_1	Analog Value	39	✓	Float Value	30034	Data Float	28	0%	Cooling PID output based on the setpoint and actual water temperature in the Cooling Mode

Table Continued on Next Page

MPC MultiProtoCol DDC Controls

Rev.: 18 April, 2011

Gen	Point Name	BACnet			Read Only	Modbus		N2		Default Value	Description
		Name	Point Type	Instance		Object Type	Register	Type	ID		
<=4	Alarm Relay	alarm_relay_1	Binary Input	1	✓	Discrete In	10001	Binary Out	1	OFF	Dry contact signal indicating if the Alarm Relay on the CXM/DXM is currently closed (ON) or open (OFF) via inputs AL1 & AL2 (Jumper IN-1 must be in the DRY position)
<=4	Pulsed Alarm	pulsed_alarm_1	Binary Input	2	✓	Discrete In	10002	Binary Out	2	OFF	Reads the pulsed alarm code from CXM/DXM via the EH2 input.
<=4	Mode Control	mode_control_1	Binary Input	3	✓	Discrete In	10003	Binary Out	3	OFF	Dry contact switch wired between the Gnd and SW on the Lstat connector. Allows manual control the RV to switch from/to heating and cooling
<=4	LED	led_1	Binary Output	1	✓	Discrete In	10004	Binary In	1	OFF	Reads the Pulse Signal Value from the CXM/DXM and displays fault status on the unit mounted red LED.
<=4	C1	c1_1	Binary Output	2	✓	Discrete In	10005	Binary In	2	OFF	Sends the ON/OFF value for the compressor 1 to the Y1 output.
<=4	C2	c2_1	Binary Output	3	✓	Discrete In	10006	Binary In	3	OFF	Sends the ON/OFF value for the compressor 2 to the Y2 output.
<=4	RV	rv_1	Binary Output	4	✓	Discrete In	10007	Binary In	4	OFF	Sends the ON/OFF value for the reversing valve to the O output.
<=4	AUX	aux_1	Binary Output	5	✓	Discrete In	10020	Binary In	17	OFF	Sends the ON/OFF value for the Auxiliary Output terminal (G for Water-Water).
<=4	Alarm State	alarm_state_1	Binary Value	1	✓	Discrete In	10008	Binary In	5	OFF	ON indicates a Lockout condition exists. OFF indicates normal operation.
<=4	C1 Reset	c1_reset_1	Binary Value	2		Discrete Out	1	Binary Out	4	OFF	Network input used to reset the C1 Runtime Alarm event once the event is triggered.
<=4	System Reset	system_reset_1	Binary Value	4		Discrete Out	2	Binary Out	5	OFF	Network input used to reset the unit from Lockout Mode. Turn ON to reset then turn OFF. Minimum ON time is 3 seconds.
<=4	C2 Reset	c2_reset_1	Binary Value	5		Discrete Out	3	Binary Out	6	OFF	Network input used to reset the C2 Runtime Alarm event once the event is triggered.
<=4	MC Switch	mc_switch_1	Binary Value	7		Discrete Out	4	Binary Out	7	OFF	Mode Control network input to turn the reversing valve ON/OFF.
<=4	Emergency Shutdown	emergency_ shutdown_1	Binary Value	8		Discrete Out	5	Binary Out	8	OFF	Network input for emergency shutdown. When emergency shutdown is turned on, then compressor 1 (Y1), compressor 2 (Y2), supply fan (G), aux heat (W) outputs turn off.
<=4	CC Mode	cc_mode_1	Binary Value	9		Discrete Out	6	Binary Out	9	OFF	Cooling Control network input to determine which sensor on the load coil will control the water temperature in Cooling Mode. EWT (OFF) /LWT (ON).
<=4	HC Mode	hc_mode_1	Binary Value	10		Discrete Out	7	Binary Out	10	OFF	Heating Control network input to determine which sensor on the load coil will control the water temperature in Heating Mode. EWT (OFF) /LWT (ON).
<=4	Occupied Status	occupied_ status_1	Binary Value	11	✓	Discrete In	10011	Binary In	8	ON	Indicates whether the WSHP is in Occupied Mode (ON) or Unoccupied Mode (OFF).
<=4	Occupied Mode	occupied_ mode_1	Binary Value	12		Discrete Out	8	Binary Out	11	ON	Network input to put the heat pump in Unoccupied (OFF) or Occupied (ON) Mode.
<=4	UPS Signal	ups_signal_1	Binary Value	15	✓	Discrete In	10013	Binary In	10	OFF	Indicates if the UPS Mode is ON/OFF. Refer to CXM or DXM AOM for UPS definition.
<=4	M/S Switch	m_s_switch_1	Binary Value	16		Discrete Out	10	Binary Out	13	OFF	Master/Slave network input to enable the use of Master ZT. Master unit is defined as one WSHP per sensor and the value is OFF. Slave unit is defined as a unit that shares a sensor with a Master unit and the value is ON.
<=4	C1 Runtime Alarm	c1ralm_1	Binary Value	17	✓	Discrete In	10014	Binary In	11	OFF	Indicates that the number of operational hours for compressor 1 has exceeded 10,000. Less than 10,000 hours (OFF) and more than 10,000 hours (ON). Reset via C1 Reset.
<=4	C1 Cycle Reset	c1_cycle_ reset_1	Binary Value	19		Discrete Out	11	Binary Out	14	OFF	Network input used to reset the C1 Cycle Counter back to 0.
<=4	C2 Cycle Reset	c2_cycle_ reset_1	Binary Value	20		Discrete Out	12	Binary Out	15	OFF	Network input used to reset the C2 Cycle Counter back to 0.

Table Continued on Next Page

Gen	Point Name	BACnet			Read Only	Modbus		N2		Default Value	Description
		Name	Point Type	Instance		Object Type	Register	Type	ID		
<=4	Lockout Alarm	lo_alm_1	Binary Value	21	✓	Discrete In	10016	Binary In	13	OFF	Indicates that the CXM/DXM is currently in Lockout Mode.
<=4	Fault Count Reset	fault_count_ reset_1	Binary Value	22		Discrete Out	13	Binary Out	16	OFF	Network input used to reset all of the historical counters for each error code back to 0.
<=4	C1 Cycle Alarm	c1calm_1	Binary Value	23	✓	Discrete In	10017	Binary In	14	OFF	Indicates that compressor 1 has cycled ON/ OFF more than 6 times during one hour.
<=4	C2 Cycle Alarm	c2calm_1	Binary Value	24	✓	Discrete In	10018	Binary In	15	OFF	Indicates that compressor 2 has cycled ON/ OFF more than 6 times during one hour.
<=4	RV Manual	rv_manual_1	Binary Value	25		Discrete Out	14	Binary Out	17	OFF	Manual switch to turn the reversing valve ON/OFF.
<=4	C1 Manual	c1_manual_1	Binary Value	26		Discrete Out	15	Binary Out	18	OFF	Manual switch to turn compressor 1 ON/OFF.
<=4	C2 Manual	c2_manual_1	Binary Value	27		Discrete Out	16	Binary Out	19	OFF	Manual switch to turn compressor 2 ON/OFF.
<=4	Prod Test	prod_test_1	Binary Value	28		Discrete Out	17	Binary Out	20	ON	Network input used to turn the production testing control OFF/ON.
<=4	Test Mode	test_mode_1	Binary Value	29		Discrete Out	18	Binary Out	21	OFF	Network input used to bypass normal sequence of operations in order to operate the unit manually. Maximum ON time is 60 minutes.
<=4	Test Mode Alarm	tm_alm_1	Binary Value	30	✓	Discrete In	10019	Binary In	16	OFF	Indicates that the unit is still in Test Mode after the Test Mode timer has expired.
<=4	AUX Manual	aux_manual_1	Binary Value	32		Discrete Out	19	Binary Out	22	OFF	Manual switch to turn the auxiliary output ON/OFF.
4	Metric Mode	metric_mode_1	Binary Value	33		Discrete Out	20	Binary Out	23	OFF	Network input used to turn Metric Mode ON/ OFF.

BACnet reference name format = Point Name_1
Modbus 1-10,000 binary read & write
Modbus 10,000-19,999 binary read
Modbus 30,000-39,999 analog read
Modbus 40,000-49,999 analog read & write
Minimum required points

MPC ASW Wall Sensor Features

ASW Sensors are wall-mounted temperature sensors for use with the MPC Controller with Water-to-Air units. The ASW is available in 3 different models to allow for application flexibility. Features such as room temperature sensing, digital LCD readout, setpoint adjustment, override pushbutton, heat pump reset, lockout recognition, fault type, LED indicator, and occupancy status can be supplied by the ASW wall sensors. The ASW wall mounted sensors are low profile, which provides a distinguished look for building architects and engineers.

The ASW wall sensors feature easy to use analog connections to the MPC. With only 4 or 5 wire connections, the field technician can easily troubleshoot the ASW to determine if it is operating properly.

Room temperature is measured using a 10k ohm thermistor and can be indicated on an easy-to-read LCD display (ASW08). The setpoint adjust is a slidepot which provides an analog output and is available with a Warm/Cool legend imprinted on the unit's base. The override is a momentary, normally open, push button contact.

ASW wall sensors are suitable for direct-wall mount or 2"x 4" electrical box mounting. Terminations are easily made at the screw terminal block located on the wall sensor backplate.

ASW06

ASW07

ASW08

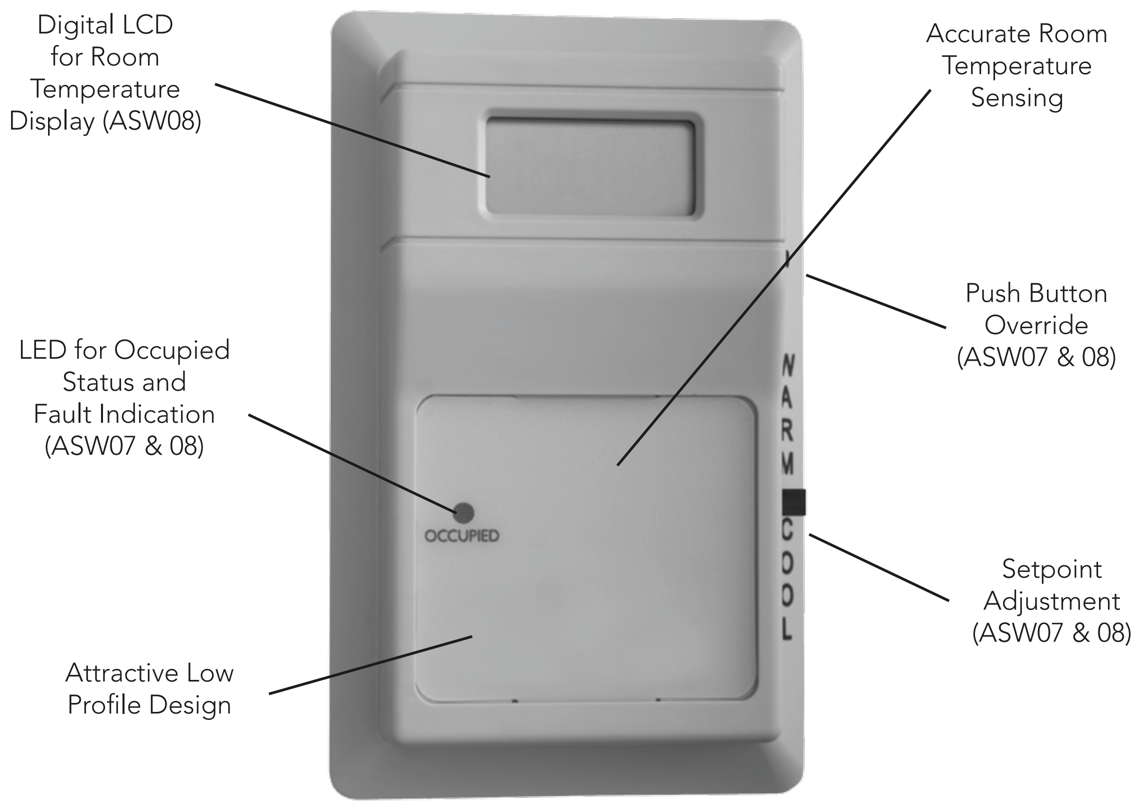
Features:

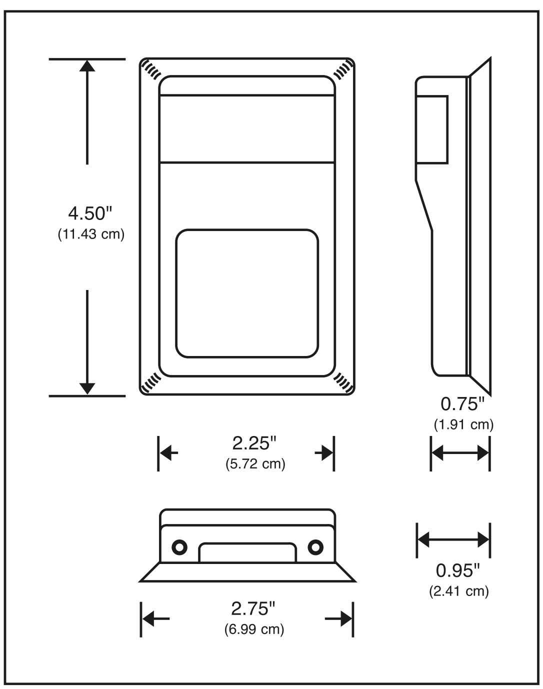
- Low Profile Design
- Room Temperature Sensing
- Push Button Override (ASW07 and 08)
- Setpoint Adjust (ASW07 and 08)
- Digital LCD Readout (ASW08)
- Heat pump Lockout Signal (ASW07 and 08)
- Lockout Reset (ASW07 and 08)
- Fault Type Indication (ASW07 and 08)
- LED Indicator (ASW07 and 08)
- Occupancy Status Indication (ASW07 and 08)

Table 6: ASW Features

Model	Description	Display
ASW06	Sensor Only	None
ASW07	Sensor with setpoint adjustment and override	LED for occupancy status and fault indication
ASW08	Sensor with setpoint adjustment and override	LED for occupancy status and fault indication, digital LCD display

Wall Sensor Features & Layout





MPC ASW Wall Sensor Installation

Installation instructions are provided inside the ASW shipping box. The ASW Sensor is packaged in one shipping box and consists of only two major parts:

- A pre-wireable base plate for wiring to the MPC.
- A removable cover.

Inspection

Inspect carton for damage. If damaged, notify carrier immediately. Inspect sensors for damage. Return damaged products.

Location

ASW Sensors are suitable for indoor use only. Locate the ASW Sensor on an inside wall about 5 ft. [1.5m] above the floor in an area with good air circulation. The location should represent the average temperature in the room or space. Make certain sensor is located out of direct sunlight, away from sources of heat or cold, and away from concealed ducts or pipes.

Push button Override

Mounting hardware is provided for junction box and drywall installation. In a wall mount application, the wall temperature and the temperature of the air contained within the wall cavity can cause erroneous readings. Moreover, the mixing of room air and air from within the wall cavity can lead to condensation and premature failure of the sensor. To prevent these conditions, seal the conduit leading to the junction box and seal the hole in the drywall by using an adhesive backed, foam insulating pad such as the BA/ Foamback.

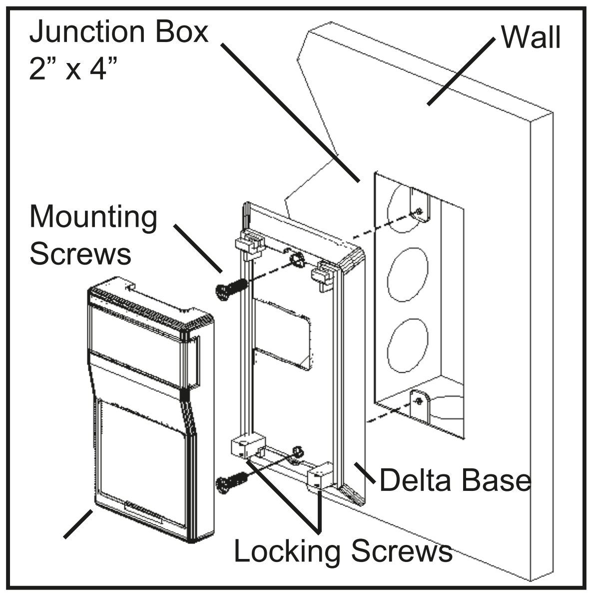
1. Pull the wires through the wireway hole in the base plate.
2. For junction box installation, secure the base to the box using the #6 x 1/2” mounting screws provided.
3. For drywall installation, pre-drill two 3/16” [4.8mm] holes 3.275” [83.2mm] apart on center. Insert the drywall anchors and secure the base using the #6 x 1” sheet metal screws provided.
4. Terminate the unit following the instructions provided.
5. Attach the cover by latching it to the top of the base, rotating the cover down, and snapping it into place.
6. Secure the cover by backing out the lock down screws using a 1/16” Allen wrench until they are flush with the bottom of the cover.

Termination

Thermistors are resistive elements, and therefore, are NOT polarity sensitive. It is recommended that wiring for these units not be run in the same conduit as line voltage wiring or with wiring used to supply highly inductive loads such as motors, generators and coils.

The instructions above are only meant to serve as a general guideline of how to wire room units. When terminating a room unit, always refer to the specific wiring sheet provided to determine the function of each terminal.

Figure 13: Mounting Wall Sensor



ASW Sensor Operation

ASW LED indicator on the wall sensor turns 'on' during Occupied Mode and turns 'off' during "Unoccupied" Mode.

Push Button Override (if equipped)

During the Unoccupied Mode of operation, if the "Override" button on the ASW07 or ASW08 sensor is pressed for 1 second, then the MPC switches to the Occupied Mode of operation and the ASW LED will turn 'on'. Control is now based upon occupied attribute values. The occupant will acquire 60 minutes of override for each time the "Override" button is pushed; with a maximum of 180 minutes of override time. If the "Override" button is pressed and held for at least 3 seconds during the override operation, then the override period is cancelled and the MPC is returned to Unoccupied Mode of operation.

To override the Unoccupied Mode: Press override button for 1 second. The LED indicator on the ASW wall sensor will turn 'on' to indicate occupied status. The controller goes into Occupied Mode for 60, 120, or 180 minutes, determined by the number of times the override button is pressed by the occupant.
To increase the override time: If override time has not expired, press the override button for additional minutes of override time. The maximum override time will always be 180 minutes.
To cancel override: Press and hold the override button for 3 seconds or more. The override time is cancelled and the ASW LED indicator will turn off. The MPC will return to Unoccupied Mode.

Reading Lockout Code at ASW Wall Sensor

If a heat pump experiences a lockout condition (for example, "high pressure" refrigeration failure), a corresponding code will be displayed at the wall sensor (providing a sensor with LED/display is used). See CXM or DXM Application Manual for detailed description of operation and fault types.

The Lockout code will be displayed as long as the alarm relay on the CXM or DXM is closed, meaning that the CXM or DXM remains locked out. When the CXM or DXM is reset from Lockout Mode, the ASW LED/display will return to indicating "Occupied" or "Unoccupied" mode.

Note: If the MPC Controller is connected to a dual compressor heat pump with 2 CXM controls, the wall sensor will only display the lockout information with regards to the CXM which is connected to compressor stage 1. Lockout information from the CXM controlling the second stage compressor will never be displayed. If the MPC is connected to a dual compressor heat pump with 2 DXM controls, the wall sensor will always display the lockout code for the compressor stage 1, even if the stage 2 compressor locks out. If the second stage DXM Control locks out, a warning code, of some type will always be displayed at the wall sensor.

Table 7: LED and Fault Indications

LED or LCD Indicator	Operation Indication
LED "ON" or "Occupied" LCD display	Occupied Mode with no heat pump faults
LED "OFF" or "Unoccupied" LCD display	Unoccupied Mode with no heat pump faults
2 flashes (E2 display)	High pressure lockout
3 flashes (E3 display)	Low pressure lockout
4 flashes (E4 display)	Water coil low temperature lockout
5 flashes (E5 display)	Air coil low temperature lockout
6 flashes (E6 display)	Condensate overflow lockout
7 flashes (E7 display)	Over / Under voltage shutdown
8 flashes (E8 display)	UPS (Unit Performance Sentinel) warning
9 flashes (E9 display)	Thermistor swapped position

Resetting Lockout at ASW wall sensor

The "Override" or "Manual On" button can be used to reset a heat pump lockout at the wall sensor.
a) The LED or indicator will indicate a lockout code.
b) Push the "Override" or "Manual On" button for 1 second.
c) The MPC will interpret the button a manual reset and the MPC will reset the heat pump.
d) The MPC will return the heat pump to normal operating mode.

Note: If the MPC was in Unoccupied Mode before the heat pump lockout, then once the heat pump is reset via the "Override"/"Manual On" button, the MPC will reset (as stated above) AND will now have 60 minutes of override time.

Setpoint Adjust

The setpoint adjust is a slidepot which provides an analog output and is available with a Warm/Cool legend imprinted on the unit's base. The user can adjust the setpoint by up to the negative user set value (default -5) by sliding the adjust to the "cool" position. The user can adjust the setpoint by up to the positive user set value (default +5) by sliding the adjust to the "heat" position. The setpoint adjust operation can be modified by changing the function block programming within the MPC (See Section 7 of the Water-to-Air Sequence of Operation).

Fail Safe Mode

If the connections between the MPC and ASW wall sensor are interrupted or disconnected, the MPC will force the digital outputs to the "Off" state. When the connections to the wall sensor thermistor are restored, the MPC resumes normal control.

MPC Technical FAQ

Q. Can a 2-wire remote sensor be used with a MPC Controller for controlling the air temperature?

A. No. Only the recommended ASW06, ASW07, ASW08 sensors should be used to monitor the air temperature. The MPC program was designed to be used with a 4-wire sensor. The firmware (MPC operating system) checks for a valid resistance between the Gnd and SW terminals on the MPC board.

Q. Why does the setpoint go to 45°F in Heating Mode 5 minutes after unit startup?

A. This is the default condition if there is not a valid resistance between the Gnd and SW terminals on the MPC. The resistance for each sensor is shown on the wall plate. This condition will occur if a sensor is not connected, or if 2-wires are reversed between the MPC and the wall sensor.

Q. Why does the compressor not restart after a period of 3-6 hours?

A. This occurred when the unit was in a stand-alone configuration or when using the Modbus protocol. Logic in the program dictates that if the compressor should cycle on/off more than six times in any 60 minute period then lock out the compressor until the 60 minute timer expired. The timing counter does not reset by itself because it can not find a system time due to a flaw in the original firmware program, drv_cmhpc_1-60-001.driver. The other way of resetting the 60 minute timer is to cycle power to the unit. This problem does not occur when using N2 or BACnet protocols. When the updated driver drv_cmhpc_1-70-007 driver was released the problem was resolved. The release date of drv_cmhpc_1-70-007 was 02/2003.

Q. Why does the occupied LED not light up on the ASW08 sensor?

A. The sensor controls as designed except no occupied light. A trace on the ASW08 was going to the 5 VDC connection instead of the ground connection. This was confirmed by wiring up the ASW08 as shown on a wire diagram and then placing a jumper between the Gnd and LED1 terminals on the ASW08 and the occupied light would then come on. Our vendor has resolved the problem as of 03/2003.

Q. Why am I receiving the wrong value for the Fan Status?

A. The Point Name for the Binary Value Alarm State in the Eikon program was omitted. These point names are listed in alphabetical order in the network points lists in the AOM. This point name was listed in the AOM; however, it was omitted in the program that operates the MPC. Thus, when a control contractor would try to access a specified binary value via a 3rd party front-end GUI then they would actually be reading/writing to the preceding binary value. This would only be a problem for any customer using a 3rd party GUI. This was not noticed if the customer was using WebCtrl. The point name was added for the Alarm State Binary Value in the Eikon program and this resolved the problem.

Q. I replaced a CXM/DXM control board and when I applied power the MPC board was destroyed. Why?

A. By default the AL1 & AL2 terminals are powered by R (24 V) on the CXM/DXM. If the JW1 (CXM) or JW4 (DXM) jumper is not cut BEFORE APPLYING POWER then the 24 V is going from AL2 (CXM/DXM) to Gnd (MPC) and the MPC board will be destroyed. When the JW1/JW4 jumper is cut a dry contact situation will be present; thus, no voltage will be present on the wire going from AL2 (CXM/DXM) to Gnd (MPC).

Q. Why does the alarm relay indicate the unit is in an alarm state on the BMS while the CXM indicates no alarm condition?

A. The jumper on the IN-1 terminal is in the 0-5 VDC position instead of the DRY position.

Q. My unit is not communicating on the network? Why?

A. Verify that all jumpers and switches are in the correct position on the MPC board. All Baud rates between all nodes must be set to the same speed. If the BMS is using BACnet over ARC156 then make sure that the jumper is in the BACnet over ARC156 position.

Q. Why can't I address the first MPC in the BMS to 01?

A. This is a legacy issue. The first node is usually reserved for the router or Web portal. Thus, always address the first unit in each network as unit number + 1 = 02.

Q. Why is my unit not communicating with the network even though I have confirmed that all switches, jumpers, and addresses are correct?

A. If everything is configured properly then look at the communications segment for the BMS. Go to the communications port on any MPC and put a voltmeter between the Net + and Net – terminals and you should get a value greater than 1 VDC. ALC recommends a particular type of communications wire for the best results. This is shown in the AOM. Check the polarity between nodes. If the polarity is reversed throughout the system this may lead to poor communication. Verify that the communication wires are not touching between the Net + and Net – terminals. This will cause communications failure. It was mentioned above that you should be above 1 VDC; however, this is not imperative. This voltage value is an indication of the signal strength in the communications network. As more nodes are added to the network the signal strength will be reduced. Each router can handle up to 99 nodes; however, for any network segment with more than 32 nodes then a repeater must be used with terminators to help boost the signal strength. To verify this, unplug the network from the router and measure the voltage at the Net + and Net – terminals. This value should be around 2.0 – 2.5 VDC. Then plug the network back into the router and go to unit #1. Remove the daisy chain from the communications plug so only the router and unit #1 are connected to the network. Measure the voltage. This approach can then be applied to each node on the network until the faulty node is discovered. Also, when unplugging the communications from an MPC while it is powered up and then plugging the communications back into the MPC may indicate unit is not communicating. Simply recycle the power to the MPC board.

Q. My temperature reads incorrectly, the actual temperature is higher/lower than the reading. Why?

A. When using a wall sensor with the MPC, the gain jumper on the MPC should be removed for standard operation. If this jumper is in place, the wall sensor will read 3°F to 5°F higher than the actual zone temperature.

If a thermistor is used for zone temperature readings or in a Water-to-Water application, the gain jumper will need to be in place. This configuration is used in Water-to-Water and special applications in place of a typical wall sensor. (***Note: if a thermistor is used in a Water-to-Air application, the gain jumper needs to be in place and a 14K ohm resistor should be placed between SW and GND on input #5 of the MPC***).

Appendix A

ARC156 Wiring

Technical Instructions

What is ARC156?

For communications on the ExecB or Exec 6 CMnet, ALC uses ARC156 which is a unique implementation of the industry standard ARCNET (Attached Resource Computer Network) protocol.

ARC156 vs. ARCNET

	ARC156	ARCNET
Speed	156K bits/second	2.5M bits/second
Coupling	Opto coupled, d.c.	Transformer coupled
Mode	Backplane	Dipulse Hybrid
Connector type	3 pos screw terminal	BNC
Wire type	twisted pair	RG-59/U coax
Topology	daisy chain	star, with active hub
Termination	120 Ohm	75 Ohm

ARC156 CMnet network requirements

Unlike our legacy CMnet (which communicates at a rate of 9600 bps or 38.4 kbps), the ARC156 network requires:

- Exec 6 or later firmware and control module driver for each control module
- A daisy-chain configuration for each network segment
- Terminators at each end of a segment to prevent signal distortions due to echoing
- A REP485 repeater after every 32 control modules or at each branch of the network to extend the length of the network
- A DIAG485 on each segment to supply network bias and to provide visual indication of signal levels
- A PROT485 for surge protection at each place wire enters or exits the building and within 250 feet (76 meters) of every control module.

The ARC156 CMnet supports a maximum of 99 control modules excluding repeaters.

Specifications

Below are the specifications for ARC156 wiring. The wire jacket and UL temperature rating specifications list two acceptable alternatives. Halar has a higher temperature rating and a tougher outer jacket than SmokeGard, and is appropriate for use in applications where you are concerned about abrasion. Halar is also less likely to crack in extreme low temperatures.

NOTE Use the specified type of wire and cable for maximum signal integrity.

MPC MultiProtoCol DDC Controls

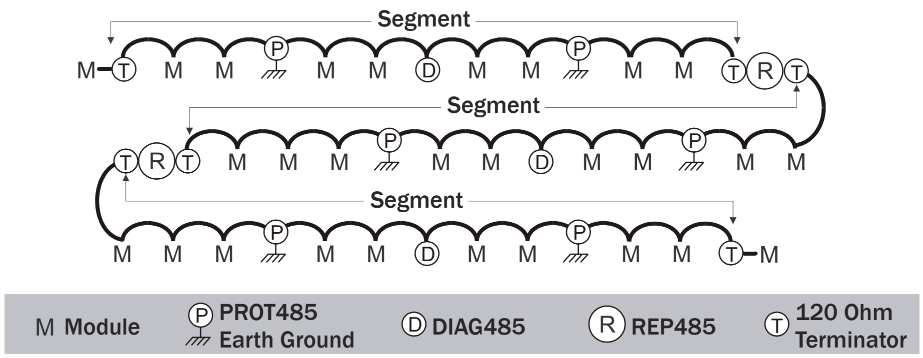
Rev.: 18 April, 2011

Description	Single twisted pair, low capacitance, CL2P, 22 AWG (7x30), TC foam FEP, plenum rated cable
Conductor	22 AWG (7x30) stranded copper (tin plated) 0.030 in. (0.762 mm) O.D.
Insulation	Foamed FEP 0.015 in. (0.381 mm) wall 0.060 in. (1.524 mm) O.D.
Color code	Black/white
Twist lay	2 in. (50.8 mm) lay on pair 6 twists/foot (20 twists/meter) nominal
Shielding	Aluminum/Mylar shield with 24 AWG (7x32) TC drain wire
Jacket	**SmokeGard** (SmokeGard PVC) 0.021 in. (0.5334 mm) wall 0.175 in. (4.445 mm) O.D. **Halar** (E-CTFE) 0.010 in. (0.254 mm) wall 0.144 in. (3.6576 mm) O.D.
Jacket color	Neon green
Marking	Automated Logic ARC156
DC resistance	15.2 Ohms/1000 feet (50 Ohms/km) nominal
Capacitance	12.5 pF/ft (41 pF/meter) nominal conductor to conductor
Characteristic impedance	100 Ohms nominal
Weight	12 lb/1000 feet (17.9 kg/km)
UL temperature rating	**SmokeGard** 167°F (75°C) **Halar** -40 to 302°F (-40 to 150°C)
Voltage	300 Vac, power limited
Listing	UL: NEC CL2P, or better

ARC156 network segments

Each segment of the ARC156 CMnet must:

- be wired in a daisy-chain.



- Be less than 2000 feet (610 meters) in length.
- Use 32 or fewer control modules, including repeaters.
- Have a 120 Ohm terminator at each end, unless the segment is less than 10 feet (3 meters) long. See *Using terminators* (page 5).
- Use one DIAG485 to add network bias.

  NOTES

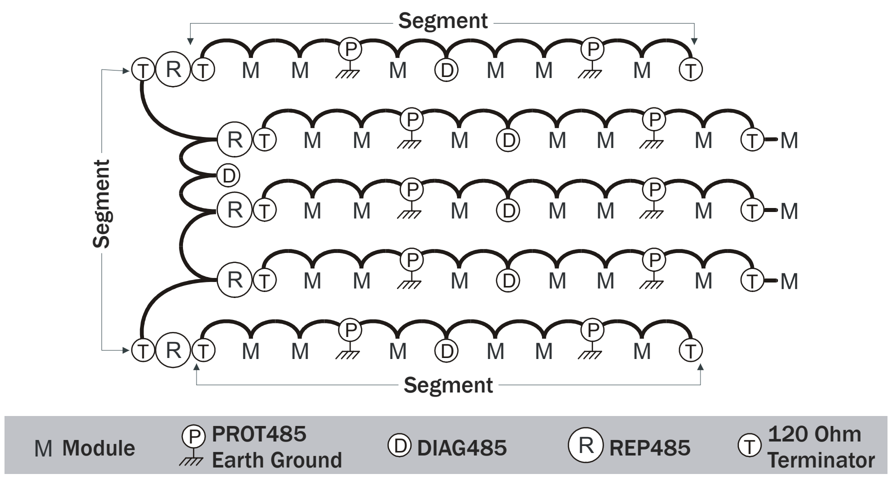
  - You can use more than one DIAG485 on a segment, but only one of these can have the bias jumper in place. See the *DIAG485 Technical Instructions* (http://info.automatedlogic.com) for more information.
  - The ARCNET backbone for AAR control modules is also an ARC156 network segment and must follow the rules above.

Using repeaters

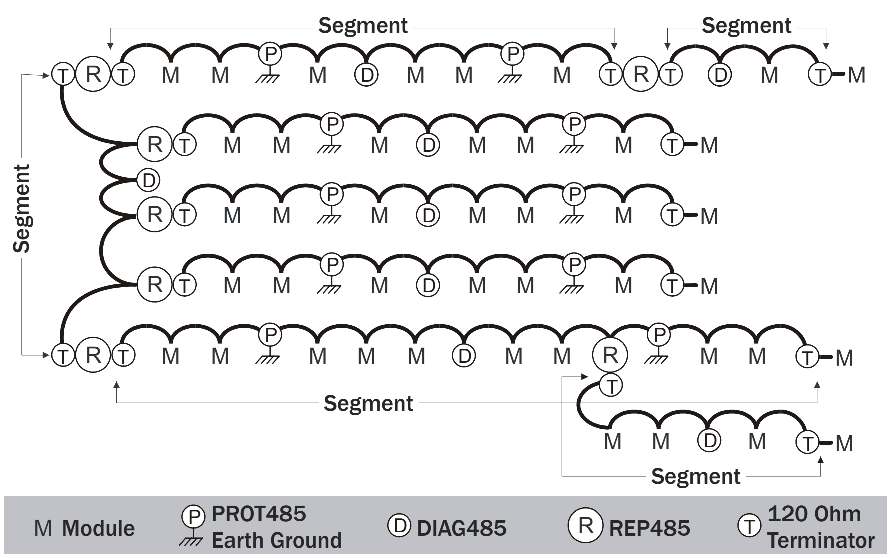
To branch from a network segment in a star or hybrid configuration, you must use a REP485 to start a new network segment. See *ARC156 network segments* (page 4).

In a star configuration, the REP485 counts as a control module towards the 32-unit maximum. The opposite side of the REP485 begins the new segment.

Sample star CMnet configuration:



Sample hybrid CMnet configuration:



You can wire a maximum of four REP485s in series. You should never have more than two pairs of wires connected to a control module without using a REP485.

Using terminators

At 156 kbps, a signal reaching the end of an unterminated cable can echo or reflect back, creating a distortion in the signal and degrading the quality of the communications. To prevent this, every segment on an ARC156 network must have a 120 Ohm terminator placed at each end of the segment. See

ARC156 network segments (page 4). A 120 Ohm terminator will not degrade the performance of a CMnet at 38.4 kbps or 9600 bps if used with a DIAG485.

To insert the 120 Ohm terminator:

1 Turn off the control module's power

2 Attach the terminator to the **CMnet +** and **–** terminals.

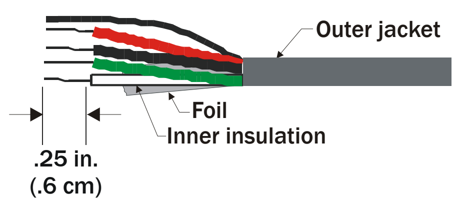
Communications wiring

ExecB and Exec 6 control modules can communicate on a high speed 156 kbps control module network (CMnet).

NOTE Use the specified type of wire and cable for maximum signal integrity. See *What is ARC156?* (page 2) for wire specifications.

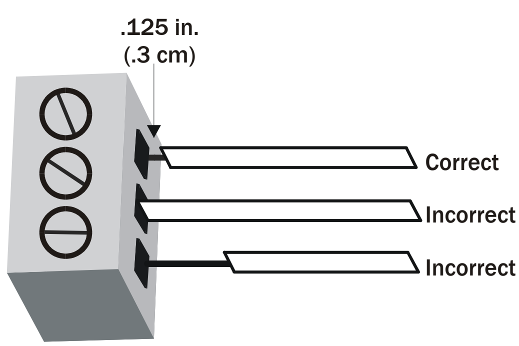
To wire the communication cable

1 Partially cut, then bend and pull off the outer jacket of the cable(s). Do not nick the inner insulation.



2 Strip about .25 inch (.6 cm) of the inner insulation from each wire.

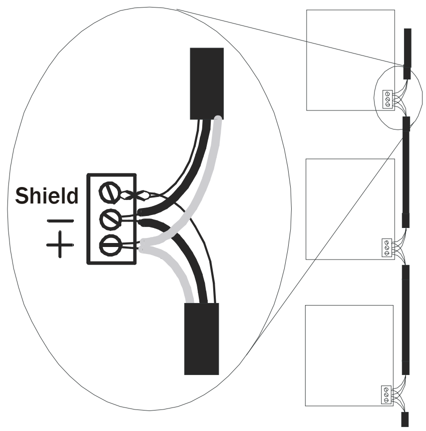
3 Insert the wires into the terminal block. Do not allow more than .125 inch (.3 cm) bare communication wire to protrude.



CAUTION If bare communication wire contacts the cable's foil shield, shield wire, or a metal surface other than the terminal block, communications may fail.

Cable shields

Twist together the shield wires from both cables, then insert them into the control module's terminal block.



Do not ground the shield to earth ground or to the control module's power ground. The PROT485 and the individual control modules allow the shield to float a limited amount so that there are no ground loops. If the voltage on the shield becomes too great relative to the earth ground, then the excess voltage is bled off with protective devices on the PROT485 or on the control modules.

Avoiding noise

Avoid running communication wires or sensor input wires next to AC power wires or the control module's relay output wires. These can be a source of noise that can affect signal quality.

Common sources of noise are:

Spark ignitors	Induction heaters
Radio transmitters	Large contactors (i.e., motor starters)
Variable speed drives	Video display devices
Electric motors (> 1hp)	Lamp dimmers
Generators	Fluorescent lights
Relays	Parallel runs with power lines
Transformers	Other electronic modules

If noise is a problem and you cannot move the wiring, use ferrite clamp-on chokes on the cabling to improve signal quality.

Token passing

On an ARC156 CMnet, each control module's ARCNET coprocessor controls the token passing scheme. The token passes rapidly from control module to control module without intervention. Because the token passes only to control modules that exist on the network, control modules do not need to be sequentially addressed.

If a control module does not respond to its token, the control module drops from the loop and does not receive its token again until the network is reconfigured. A network reconfiguration allows control modules that were not participating in the token passing to enter their address into the token passing loop. This process takes about 3 seconds. If a control module has just been powered up, or has not received the token for about 13 seconds, the control module initiates a network reconfiguration.

Each control module can send only one data packet each time it gets the token, then the control module passes the token. No control module can keep or "grab" the token. The longest time a control module typically waits for its token is 0.5 seconds, even on a CMnet with the maximum of 98 control modules.

Unlike the legacy CMnet, workstations can communicate with the ARC156 CMnet without stopping or grabbing the token. Control modules can continue to communicate global points, colors, alarms, and heat/cool requests even while a workstation transfers memory to a control module. Of course, two workstations cannot transfer memory to the same control module at the same time.

Upgrading to ARC156

PREREQUISITES

- Verify that wiring is adequate. See *What is ARC156?* (page 2).
- Verify the network configuration is acceptable. See *ARC156 network segments* (page 4).
- Verify that all control modules can use Exec 6.0 or later. To determine this, see each control module's *technical instructions* (http://info.automatedlogic.com) or the *Technical Handbook*.

To upgrade:

1 With the CMnet running at 38.4 kbps or 9600 bps, download an Exec 6.0 (or higher) driver into every control module. Do this over a direct connection through a router, or set the control module to 38.4 kbps or 9600 bps and connect to the control module's local access port using an APT in 485 mode.

2 Add a 120 Ohm terminator to each end of the network segment.

3 Add at least one DIAG485 to the middle of the network segment. Set the **Bias** jumper to add bias.

You can have more than one DIAG485 per network segment, but only one DIAG485 should have the **Bias** jumper set to add bias.

4 On each control module, set the CMnet baud rate jumper for 156 kbps communication. The control modules will not be able to communicate on the control module network until all control modules are set to 156 kbps and a network reconfiguration starts the ARC156 CMnet.

5 To reconfigure the CMnet immediately, remove and then restore power to one of the control modules. Otherwise, wait up to 30 minutes for the control modules to reconfigure themselves.

NOTE A CMnet divided into segments may experience several reconfigurations until all the segments are synchronized.

6 Add other devices (like a REP485 or PROT485) to the CMnet as necessary to improve the signal quality.

Troubleshooting

If you do not receive signals from a control module on an ARC156 network or if the network continually reconfigures itself:

- Verify that the entire segment uses the recommended cable. See *What is ARC156?* (page 2) for wire specifications.
- Verify the following aspects of wiring. See *Communications wiring* (page 6).
  - The shields on all control modules and gateways are connected properly. The shield must not touch the metal housing or tie to earth ground.
  - The cable's outer jacket is not stripped more than one inch. If so, the wires may have become untwisted, causing signal reflections.
  - The wires are connected correctly to the terminal blocks.
    Black wire to **Net -**
    White wire to **Net +**
    Shield wire to **Shield**
  - No other communication signal is causing noise or interference. See *Communications wiring* (page 6).
- Check for a control module damaged by an electrical surge.

Locating the problem network segment

The network segment most likely to cause a problem is the segment that:

- Contains the most control modules
- Covers the longest distance
- Contains a variable speed controller, spark ignitor, or other major noise source

To isolate the problem, divide the questionable segment in half, placing a 120 Ohm terminator at both ends of each segment and adding a DIAG485 to the new segments. If the problems appear on one of the new segments, split this segment in half and repeat this test. Keep splitting the problem segment in half until you identify the cause.

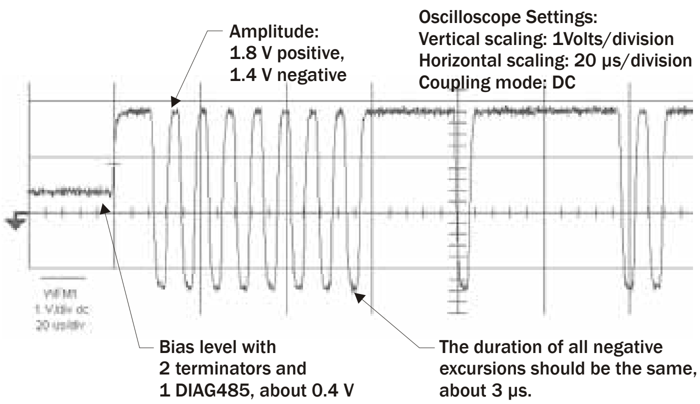
Problems after installation

If the network frequently reconfigures, identify any recent changes to the network to try to isolate the cause. If you suspect a particular control module is causing the problem, watch the LED signals on the control module. During a reconfiguration, the transmit and receive LEDs turn off for 1 second. If the control module caused the reconfiguration, the transmit LED blinks brightly for one second. If another control module caused the reconfiguration, the receive LED lights for one second and then continues to blink as normal. The more control modules the segment has, the paler the receive LED is. See *Troubleshooting* in the control module’s *technical instructions* (http://info.automatedlogic.com) for more information about LED signals.

Using an oscilloscope to troubleshoot the network

To help diagnose problems with the ARC156 network, you can use an oscilloscope to check communication waveform characteristics. The figure below shows an example of a good waveform. The table describes some waveform characteristics. See the *Technical Handbook* for help using an oscilloscope and analyzing waveforms.

Good ARC156 Communication Waveform:



Signal Characteristic	Description	Possible Cause
Amplitude	In differential mode, the signal swings from 1 to 2 volts in both the positive and negative directions.	Normal waveform.
	Small amplitude (less than ± 0.75V)	Too many terminators on the segment.
	Large amplitude (greater than ± 2.5V)	The segment may not have two terminators or may be a very short segment.
	Lack of symmetry around reference point	The cable may not be the recommended type, or a non-ALC protection device may be on the segment. Also, more than one DIAG485 with its **Bias** jumper in place might be on the segment.
Wave shape	Corners are near 90 degree transitions.	Normal waveform.
	Excessive rounding at the corners.	The cable may be too long or may not be the recommended type, or a non-ALC protection device may be on the segment.
	Reflections	Cable may be unterminated or have only one terminator.

Revision History

Date:	Item:	Action:
04/18/11	Network Variable Points List (Water-to-Air)	Updated
01/03/11	Format - All Pages	Updated
06/11/10	Format - All Pages	Updated
06/23/09	Network Variable Points List (Water-to-Water) Table	HT PD Rows Added
06/23/09	Water-to-Water Sequence of Operation	Compressor Verbiage Updated
02/09/09	MPC ASW Wall Sensor Features	Verbiage Updated
02/09/09	Water-to-Water Sequence of Operation	Updated
09/03/08	Sequence of Operation	Water-To-Water Sequence of Operation Moved
07/28/08	Addressing & Power Up	Added Address BACview Setup
07/28/08	Sequence of Operation, ASW Sensor Operation	Minor Verbiage Updates
03/25/08	Hardware Specs, LEDs, Appendix A	Minor Verbiage Updates
01/01/07		Minor Formatting Updates
01/01/07	First Published	

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