USER'S GUIDE

Series RHPX

Humidity/Temperature Communicating Transmitter

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Bulletin AQ-RHPX-C

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Dwyer®
a **DwyerOmega** brand

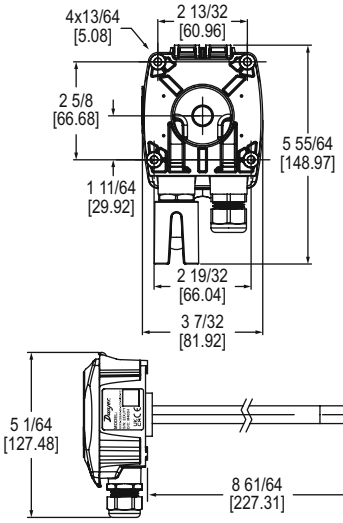
Wall Mount with HDPE filter with shield

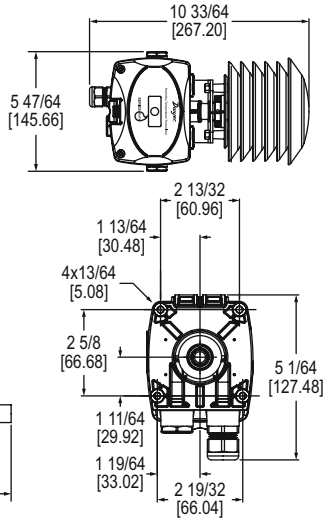
Wall Mount HDPE Filter

Wall Mount with Bronze Filter

Duct Mount

Large Enclosure with Heat Radiation Shield





The **Series RHPX Humidity and Temperature Transmitte**r accurately monitors the humidity and temperature for building control functions to maximize occupant comfort and minimize operating costs. Featuring capacitive polymer humidity sensors, models are available in 2% and 3% accuracies. An optional two-line alphanumeric LCD display is available.

The high accuracy, long term stability and reliable operation in multiple enclosure styles make the Series RHPX an excellent choice to monitor humidity and temperature in building energy management systems, commercial HVAC systems, clean rooms, museums and data enters. The optional display allows the user to read both the temperature and humidity simultaneously.

The Series RHPX can be optionally configured to supply absolute or relative humidity or dew point in addition to enthalpy.

NOTICE For best results, our model RHRS radiation shield is recommended for sintered filter versions of the outside air transmitter.

NOTICE Sensor is sensitive to electrostatic discharge (ESD). Follow industry standard practice for control and protection against ESD. Failure to exercise good ESD practices may cause damage to the sensor.

INSTALLATION

⚠ WARNING Disconnect power supply before installation to prevent electrical shock and equipment damage. Make sure all connections are in accordance with the job wiring diagram and in accordance with national and local electrical codes. Use copper conductors only.

CAUTION Use electrostatic discharge precautions (e.g., use of wrist straps) during installation and wiring to prevent equipment damage.

NOTICE Avoid locations where severe shock, vibration, excessive moisture, corrosive or volatile organic compounds are present. NEMA Type 4X (IP66) housings are intended for outdoor use primarily to provide a degree of protection against wind-blown dust, rain, and hose-directed water.

NOTICE Do not exceed ratings of this device, permanent damage not covered by warranty may result.

Duct Mount

The transmitter should be mounted away from fans, corners, heating and cooling coils, and other equipment that will affect the measurement of the relative humidity. It should also be mounted in a location that receives adequate air flow for proper operation. The transmitter should be mounted such that the conduit connection points down to prevent moisture from entering.

1. Drill a 1″ diameter hole into the duct at the desired location.
2. Insert the transmitter probe through the hole such that the base of the enclosure is flush to the duct.
3. Use four #8 x 1/2″ pan head sheet metal screws to attach the enclosure to the duct. Do not over tighten.
4. Open the enclosure by pressing on the snap and lifting the lid.
5. Proceed with wiring according to the desired output configuration.

SPECIFICATIONS

Humidity Measurement Range: 0 % to 100 % humidity.
Temperature Measurement Range: -40 °C to 60 °C (-40 °F to 140 °F).
Humidity Sensor Accuracy: Model specific, ±2 % or ±3 %, at 10 % - 90 % RH and 25 °C (77 °F).
Temperature Sensor Accuracy, Solid State Band Gap: ±0.9°F @ 77°F (±0.5°C @ 25°C).
Resolution: Relative humidity: 0.1%; temperature: 0.1°F/°C; absolute humidity: 0.1 g/m3.
Network Communication: BACnet MS/TP protocol or Modbus® RTU.
Supported BAUD Rates: 9600, 19200, 38400, 57600, 76800, 115200.
Termination Load: 120 Ω.
Operating Temperature Range: -40°C to 60°C (-40°F to 140°F); With LCD: -20°C to 60°C (-4°F to 140°F).
Power Requirements: 14 to 35 Vdc or 10 to 32 Vac.
Wiring Connection: Removable 5P terminal block.
Electrical Entry: 1/2″ NPS thread. Cable gland included.
Humidity Sensor: Capacitive polymer.
Enclosure Material: UL 94 V-0.
Enclosure Rating: IP66.
Optional Display: Two (2) lines of alphanumeric characters with eight (8) characters per line.
Weight: Duct: 198.4 g (0.44 lb); wall mount: 170 g (0.38 lb); large housing: 340.2 g (0.75 lb); large housing with radiation shield: 1247.4 g (2.75 lb).
Storage Temperature: -40°C to 70°C (-40°F to 158°F); With LCD: -30°C to 70°C (-22°F to 158°F).
Additional calculations: Absolute humidity: (0 to 50) g/m3 or (0 to 3000) lb/mmcf; dew point -75 °C to 60 °C (-102 °F to 140 °F); enthalpy (-40 to 411) kj/kg or (-17 to 177) Btu/lb.
Compliance: BTL, CE, UL 2043*, UL-60335-2-40**.

* UL 2043 compliance limited to models:
RHPX-XS(B,S,W) Wall Mount
RHPX-XS(D,E)-XX-X Plastic Probe Duct Mount without LCD
RHPX-XS(F,G)-XX-X SSTL Duct Mount with LCD
RHPX-XL(B,S,W) Large Wall Mount without LCD
RHPX-XL(H) Large Wall Mount without LCD & Solar Radiation Shield
** Meets UL-60335-2 clause 30.103DV.1 through UL2043 compliance

Surface and Outdoor Mount

Note: For outdoor mounting the transmitter should be mounted under an eave, shield, or in an area that is out of the elements or direct sunlight. The transmitter should be mounted with the sensor pointing down to prevent water collection in the sensor cavity.

For surface mounting the transmitter should be mounted away from fans, corners, heating and cooling coils, and other equipment that will affect the measurement of the relative humidity. It should also be mounted in a location that receives adequate air flow for proper operation with the sensor pointing down to prevent water collection in the sensor cavity. A vertical mounting surface is preferred but not required.

1. Position the transmitter where it is to be mounted and mark the mounting holes in each corner of the housing.
2. Drill or punch out marked locations.
3. Place the transmitter box over mounting holes on wall and align. Install unit with screws (not provided) in mounting holes.
4. Open lid by pressing in on tab at bottom of front of lid.
5. Proceed to wiring information section. .
6. Close lid by pressing down on lid surface until the snap engages into the lower housing (To ensure IP67 compliance, use 10-32 X 5/16″ machined screws or #10 X 5/16″ plastite screws).

Wiring
Use maximum 18 AWG wire for wiring terminals. Refer to **Figure 1** for wiring information. Terminal blocks are removable for ease of wiring.

BACnet\Modbus®
To make connections for a BACnet or Modbus® installation connect wiring as shown in **Figure 1**.

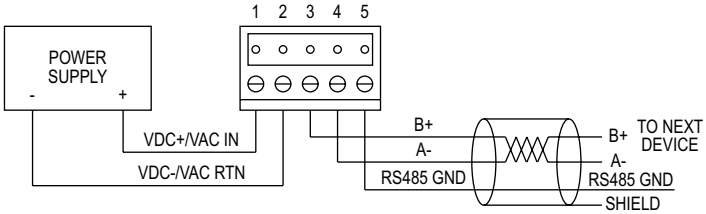
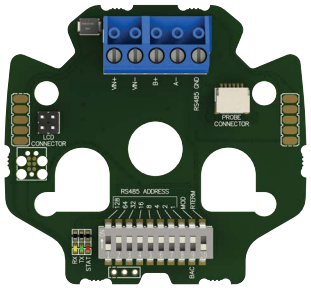


Figure 1: RHPX digital wiring diagram

Note: Power and RS485 outputs are electrically isolated. The B(+) and A(-) connections must be terminated at both ends with a 120 ohm resistor. If the RHPX is an end device, it's onboard 120 ohm resistor may be used. See DIP switch settings to enable the termination resistor.

DIP switch settings
The RHPX has on board DIP switches to set the network address, type of network (BACnet or Modbus®) and enablement of the 120 ohm termination resistor. Below are the DIP switch settings definitions.



Communication Protocol Configuration
The following sections describe configurations that pertain to the BACnet and Modbus® protocol.

Setting Protocol Address
Use the DIP switches to set the protocol address that the control system will use to recognize the transmitter. Use the below table to identify how to set the protocol address. The white rectangle indicates the switch position.

DIP SWITCH SETTINGS			
SW#	**On**	**Off**	**Value**
1	ADDR BIT7=1	ADDR BIT7=0	128
2	ADDR BIT6=1	ADDR BIT6=0	64
3	ADDR BIT5=1	ADDR BIT5=0	32
4	ADDR BIT4=1	ADDR BIT4=0	16
5	ADDR BIT3=1	ADDR BIT3=0	8
6	ADDR BIT2=1	ADDR BIT2=0	4
7	ADDR BIT1=1	ADDR BIT1=0	2
8	ADDR BIT0=1	ADDR BIT0=0	1
9	MODBUS	BACNET	
10	120 Ω CONNECTED	120 Ω NOT CONNECTED	

Example: Address 116 (64+32+16+4), BACnet, 120 Ω connected

Default DIP switch setting: OFF-ON-ON-ON-ON-ON-ON-ON-ON-ON unit address 127, Modbus®, 120 Ω not connected

Note: Modbus® addresses must be between 001-247. BACnet addresses must be between 000-127.

SUPPORTED BAUD RATES					
	Mode	**Baud Rates**	**Data Size**	**Parity**	**Stop Bits**
Modbus®	RTU	9600 19200 38400 57600 76800 115200	8	Even Odd None	1, 2
BACnet	MS/TP	9600 19200 38400 57600 76800 115200	8	None	1

Intelligent Serial Configuration
The Intelligent Serial Configuration feature enables the device to determine the baud rate, parity, and stop bits automatically from Modbus® or BACnet serial traffic.
To perform Intelligent Serial Configuration:
1. Remove power from the transmitter.
2. Use the DIP switches to set a valid protocol address.
3. Reapply power.
   The red LED will blink steadily when the transmitter begins monitoring for serial traffic.
4. (Optional) If setting up a transmitter offline or away from the main network, you must send read requests to the unit manually.

The configuration process is complete after the device has successfully received and processed a request. The red LED will also stop blinking. If a change to the system requires an updated serial configuration, cycle power to the transmitter to reconfigure.

Modbus® PROTOCOL REFERENCE
The following sections explain transmitter functions in systems employing Modbus® communications protocol. The string data type is read as a stream.

Functions
The RHPX Comms supports the following Modbus® functions:

Function Name	Function Code
Read holding registers	03
Read input registers	04
Write single register	06
Write multiple registers	16

Supported Modbus® communication protocol functions

The string data type is read as a stream of ASCII characters, with the first character sent in the MSB of the first register, and the second character sent in the LSB of the first register and so on. If the string is shorter than the allotted size, the remaining bytes are zero-padded.

INPUT REGISTERS			
Register Number	**Description**	**Data Type**	**Range**
0001-0002	Relative Humidity (%RH)	32bit float	-
0003-0004	Dew Point (°F)	32bit float	-
0005-0006	Dew Point(°C)	32bit float	-
0007-0008	Enthalpy (BTU/lb)	32bit float	-
0009-0010	Enthalpy (kJ/kg)	32bit float	-
0011-0012	Absolute Humidity (g/m^3)	32bit float	-
0013-0014	Absolute Humidity (lb/ million ft^3)	32bit float	-
0015-0016	Temperature (°F)	32bit float	-
0017-0018	Temperature (°C)	32bit float	-
0019-0020	Error Flags	32bit integer	See Table Below
8001-8016	Model Number	String(32)	"RHPX-XXX"
8017-8020	Serial Number	String(8)	"XXXXX"
8021-8028	Firmware Version	String(16)	"X.X.XR"
8029-8032	Date Code	String(8)	"XXXXXX"
Note: Register address is 1 less than register number			

ERROR FLAGS	
Bit Possition	**Description**
0	Invalid Address
1	Sensor Range Exceeded
2	Sensor Error
3	No Sensor
4	User Settings Invalid
5	Factory Settings Invalid
6	External Memory Failure
7	Internal Memory Failure

HOLDING REGISTERS			
Register Number	**Description**	**Data Type**	**Range**
0001-0002	Humidity Offset (%RH)	32bit float	-3.5 % to 3.5 % RH
0003-0004	Temperature Offset (°F)	32bit float	-5.0 °F to 5.0 °F
0005	Humidity Display Unit	16bit integer	0=Dew Point (°F) 1=Dew Point (°C) 2=Relative Humidity (%RH) 3=Enthalpy (BTU/lb) 4=Enthalpy (lb/ million ft^3) 5=Absolute Humidity (kJ/kg) 6=Absolute Humidity (g/m^3)
0006	Temperature Display Unit	16bit integer	0 = °F, 1 = °C
0007-0023	Device Name	String(32)	"RHPX"
Note: Register address is 1 less than register number			

Multi-address support Multi-Address support allows a register to be read or written to using different byte orientations as specified by the address range. For example, input register 0003 can also be read at 2003, 4003 and 6003 with different byte orientations as listed in the table below. Registers that do not have multi-address support are only available in Big-Endian byte orientation (Modbus® Communication Protocol standard).

		Float/32-bit Values				16-bit Values	
	Address	Register 1		Register 2		Register 1	
Byte Order	Range	MSB			LSB	MSB	LSB
Big-Endian	1-2000	A	B	C	D	A	B
Byte swap	2001-4000	B	A	D	C	B	A
Word swap	4001-6000	C	D	A	B	A	B
Little-Endian	6001-8000	D	C	B	A	B	A

BACnet PROTOCOL REFERENCE
The following sections explain the transmitter functions in systems employing a BACnet protocol.

BACnet services
The RHPX Comms supports the following BACnet BIBB services and functions:

Device Communications Control-B (DM-DCC-B): Optional time duration in minutes
Reinitialize Device (DM-RD-B): COLDSTART and WARMSTART

The password required to execute these functions is: **Dwyer**

Objects
This device supports the following objects:

Object Type	Identifier	Name
Device	607XXX*	RHPX 607XXX
Analog Input	AI1 AI2 AI3 AI4 AI5 AI6 AI7 AI8 AI9	Relative Humidity Dew Point degrees C Dew Point degrees F Enthalpy kJ/kg Enthalpy BTU/lb Absolute Humidity g/m^3 Absolute Humidity lb/MMCF Temperature degrees C Temperature degrees F
Analog Value	AV1 AV2	Humidity Offset %RH Temperature Offset deg F
Multi-State Value	MSV1 MSV2	Temperature Display Unit` Humidity Display Measurement
Network Port	NP1	MS/TP
*XXX is replaced by the address value set by the address DIP switches		

Accessing Measurements
The analog input AI1 transmits the relative humidity measurement.
The two analog inputs AI2-AI3 transmit the dew point calculation in the desired engineering units.
The two analog inputs AI4-AI5 transmit the enthalpy calculation in the desired engineering units.
The two analog inputs AI6-AI7 transmit the absolute humidity measurement in the desired engineering units.
The two analog inputs AI8-AI9 transmit the temperature measurement in the desired engineering units.

Analog value object AV1 allows the relative humidity value to offset by up to ±3.5%.
Analog value object AV2 allows the temperature value to be offset by up to ±5°F.

I. BACnet DEVICE OBJECTS

Property	Default Values	User Writable	Data Type
Object Identifier	DEV607XXX	Yes	Object Identifier
Object Name	"RHPX 607xxx"	Yes	Character String(32)
Object Type	Device	No	Object Type
System Status	Operational	No	Device Status
Vendor Name	"Dwyer Instruments, LLC"	No	Character String
Vendor Identifier	607	No	Unsigned
Model Name	"RHPX-XXXXX-XX	No	Character String
Firmware Version	"x.x"	No	Character String
Application Software Version	"x.x.x"	No	Character String
Location	""	Yes	Character String(32)
Description	Humidity/Temperature Transmitter"	Yes	Character String(32)
Protocol Version	1	No	Unsigned
Protocol Revision	22	No	Unsigned
Protocol Services	See BACnet Services	No	Protocol Services Supported
Supported Object Types	See Object Table	No	Object Types Supported
Object List	See Object Table	No	BACnetArray of Object Types
Maximum APDU Length	480	No	Unsigned
Segmentation Supported	No Segmentation	No	Segmentation
APDU Timeout	0	No	Unsigned
Number of APDU Retries	0	No	Unsigned
Max Master	127	Yes	Unsigned8
Max Info Frames	1	Yes	Unsigned8
Device Address Binding	{ }	No	Address Binding
Database Revision	0	No	Unsigned
Serial Number	"xxxxxx"	No	Character String

II. BACnet ANALOG INPUT OBJECTS

Property	Default Values	User Writable	Data Type
Object Identifier	AI1	No	Object Identifier
Object Name	"Relative Humidity"	No	Character String
Object Type	Analog Input	No	Object Type
Present Value	**current reading**	No	Real
Status Flags	{0,0,0,0}	No	Status Flags
Event State	Normal	No	Event State
Reliability	No Fault Detected	No	Reliability
Out Of Service	FALSE	Yes	Boolean
Units	percent-relative-humidity	No	Engineering Units

Property	Default Values	User Writable	Data Type
Object Identifier	AI2	No	Object Identifier
Object Name	"Dew Point degrees C"	No	Character String
Object Type	Analog Input	No	Object Type
Present Value	**current reading**	No	Real
Status Flags	{0,0,0,0}	No	Status Flags
Event State	Normal	No	Event State
Reliability	No Fault Detected	No	Reliability
Out Of Service	FALSE	Yes	Boolean
Units	degrees-celsius	No	Engineering Units

Property	Default Values	User Writable	Data Type
Object Identifier	AI3	No	Object Identifier
Object Name	"Dew Point degrees F"	No	Character String
Object Type	Analog Input	No	Object Type
Present Value	**current reading**	No	Real
Status Flags	{0,0,0,0}	No	Status Flags
Event State	Normal	No	Event State
Reliability	No Fault Detected	No	Reliability
Out Of Service	FALSE	Yes	Boolean
Units	degrees-fahrenheit	No	Engineering Units

Property	Default Values	User Writable	Data Type
Object Identifier	AI4	No	Object Identifier
Object Name	"Enthalpy kJ/kg"	No	Character String
Object Type	Analog Input	No	Object Type
Present Value	**current reading**	No	Real
Status Flags	{0,0,0,0}	No	Status Flags
Event State	Normal	No	Event State
Reliability	No Fault Detected	No	Reliability
Out Of Service	FALSE	Yes	Boolean
Units	kilojoules-per-kilogram	No	Engineering Units

Property	Default Values	User Writable	Data Type
Object Identifier	AI4	No	Object Identifier
Object Name	"Enthalpy kJ/kg"	No	Character String
Object Type	Analog Input	No	Object Type
Present Value	**current reading**	No	Real
Status Flags	{0,0,0,0}	No	Status Flags
Event State	Normal	No	Event State
Reliability	No Fault Detected	No	Reliability
Out Of Service	FALSE	Yes	Boolean
Units	kilojoules-per-kilogram	No	Engineering Units

Property	Default Values	User Writable	Data Type
Object Identifier	AI5	No	Object Identifier
Object Name	"Enthalpy BTU/lb"	No	Character String
Object Type	Analog Input	No	Object Type
Present Value	**current reading**	No	Real
Status Flags	{0,0,0,0}	No	Status Flags
Event State	Normal	No	Event State
Reliability	No Fault Detected	No	Reliability
Out Of Service	FALSE	Yes	Boolean
Units	btus-per-pound	No	Engineering Units

Property	Default Values	User Writable	Data Type
Object Identifier	AI6	No	Object Identifier
Object Name	"Absolute Humidity g/m^3"	No	Character String
Object Type	Analog Input	No	Object Type
Present Value	**current reading**	No	Real
Status Flags	{0,0,0,0}	No	Status Flags
Event State	Normal	No	Event State
Reliability	No Fault Detected	No	Reliability
Out Of Service	FALSE	Yes	Boolean
Units	grams-per-cubic-meter	No	Engineering Units

Property	Default Values	User Writable	Data Type
Object Identifier	AI7	No	Object Identifier
Object Name	"Absolute Humidity lb/MMCF"	No	Character String
Object Type	Analog Input	No	Object Type
Present Value	**current reading**	No	Real
Status Flags	{0,0,0,0}	No	Status Flags
Event State	Normal	No	Event State
Reliability	No Fault Detected	No	Reliability
Out Of Service	FALSE	Yes	Boolean
Units	532*	No	Engineering Units
*Vendor specific unit: Million Cubic Feet			

Property	Default Values	User Writable	Data Type
Object Identifier	AI8	No	Object Identifier
Object Name	"Temperature degrees C"	No	Character String
Object Type	Analog Input	No	Object Type
Present Value	**current reading**	No	Real
Status Flags	{0,0,0,0}	No	Status Flags
Event State	Normal	No	Event State
Reliability	No Fault Detected	No	Reliability
Out Of Service	FALSE	Yes	Boolean
Units	degrees-celsius	No	Engineering Units

Property	Default Values	User Writable	Data Type
Object Identifier	AI9	No	Object Identifier
Object Name	"Temperature degrees F"	No	Character String
Object Type	Analog Input	No	Object Type
Present Value	**current reading**	No	Real
Status Flags	{0,0,0,0}	No	Status Flags
Event State	Normal	No	Event State
Reliability	No Fault Detected	No	Reliability
Out Of Service	FALSE	Yes	Boolean
Units	degrees-fahrenheit	No	Engineering Units

III. BACnet ANALOG VALUE OBJECTS

Property	Default Values	User Writable	Data Type
Object Identifier	AV1	No	Object Identifier
Object Name	"Humidity Offset %RH"	No	Character String
Object Type	Analog Value	No	Object Type
Present Value	0	Yes	Real
Max Present Value	3.5	No	Real
Min Present Value	-3.5	No	Real
Status Flags	{0,0,0,0}	No	Status Flags
Event State	Normal	No	Event State
Reliability	No Fault Detected	No	Reliability
Out Of Service	FALSE	Yes	Boolean
Units	percent-relative-humidity	No	Engineering Units

Property	Default Values	User Writable	Data Type
Object Identifier	AV2	No	Object Identifier
Object Name	"Temperature Offset deg F"	No	Character String
Object Type	Analog Value	No	Object Type
Present Value	0	Yes	Real
Max Present Value	-5	No	Real
Min Present Value	5	No	Real
Status Flags	{0,0,0,0}	No	Status Flags
Event State	Normal	No	Event State
Reliability	No Fault Detected	No	Reliability
Out Of Service	FALSE	Yes	Boolean
Units	degrees-fahrenheit	No	Engineering Units

IV. BACnet MULTI-STATE VALUE OBJECTS

Property	Default Values	User Writable	Data Type
Object Identifier	MSV1	No	Object Identifier
Object Name	"Temperature Display Unit"	No	Character String
Object Type	Multi-State Value	No	Object Type
Present Value	1	Yes	Real
Status Flags	{0,0,0,0}	No	Status Flags
Event State	Normal	No	Event State
Reliability	No Fault Detected	No	Reliability
Out Of Service	FALSE	Yes	Boolean
Number Of State	2	No	Unsigned
State Text	""Degrees Fahrenheit", "Degrees Celsius"	No	BACnetArray of CharacterString

Property	Default Values	User Writable	Data Type
Object Identifier	MSV2	No	Object Identifier
Object Name	"Humidity Display Measurement"	No	Character String
Object Type	Multi-State Value	No	Object Type
Present Value	3	Yes	Real
Status Flags	{0,0,0,0}	No	Status Flags
Event State	Normal	No	Event State
Reliability	No Fault Detected	No	Reliability
Out Of Service	FALSE	Yes	Boolean
Number Of State	7	No	Unsigned
State Text	"Due Point (degrees F)", "Due Point (degrees C)", "Relative Humidity (%RH)", "Enthalpy (BTU/lb)", "Absolute Humidity (lb/MMCF)", "Enthalpy (kJ/kg)", "Absolute Humidity (g/m^3)"	No	BACnetArray of CharacterString

V. BACnet NETWORK PORT OBJECTS

Property	Default Values	User Writable	Data Type
Object Identifier	NP1	No	Object Identifier
Object Name	"MS/TP"	No	Character String
Object Type	Network Port	No	Object Type
Status Flags	{0,0,0,0}	No	Status Flags
Event State	Normal	No	Event State
Reliability	No Fault Detected	No	Reliability
Out Of Service	FALSE	Yes	Boolean
Network Type	MSTP	No	Network Type
Protocol Level	BACnetApp	No	Protocol Level
Network Number	0	No	Unsigned16
Network Number Quality	Unknown	No	Network Number Quality
Changes Pending	FALSE	No	Boolean
MAC Address	127	No	Octet String
APDU Length	480	No	Unsigned
Link Speed	**current baud rate**	No	Real
Link Speeds	{9600,19200,38400,57600,76800,115200}	No	BACnetArray of Real
Link Speed Autonegotiate	TRUE	No	Boolean
Max Master	127	Yes	Unsigned8
Max Info Frames	1	Yes	Unsigned8

MAINTENANCE/REPAIR

Upon final installation of the Series RHPX, no routine maintenance is required. The Series RHPX is not field serviceable and is not possible to repair the unit. Field repair should not be attempted and may void warranty.

Do not dispose of as unsorted domestic or municipal waste. Consult retailer or local authorities for recycling information.

WARRANTY/RETURN

Refer to "Terms and Conditions of Sale" in our catalog and on our website. Contact customer service to receive a Return Materials Authorization (RMA) number before shipping the product back for repair. Be sure to include a brief description of the problem plus any additional application notes.

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