

#### Introduction

The duct RH/T network sensor uses a highly accurate and reliable Thermoset Polymer based capacitance humidity sensor and curve-matched NTC thermistor temperature sensor together with state-of-the-art digital linearization and temperature compensated circuitry to monitor humidity and temperature levels in a duct and transmit values via BACnet® communication to a building automation system. The sensors are encapsulated in a 60 micron HDPE filter at the end of a 230 mm (9") S/S probe and a compact enclosure.

#### Before Installation

Read these instructions carefully before installing and commissioning the RH/T sensor. Failure to follow these instructions may result in product damage. Do not use in an explosive or hazardous environment, with combustible or flammable gases, as a safety or emergency stop device or in any other application where failure of the product could result in personal injury. **Take electrostatic discharge precautions during installation and do not exceed the device ratings.**

#### Mounting

The RH/T sensor installs directly into any air duct with a minimum width/diameter of 25.5 cm (10"). Select a suitable installation area in the middle of the duct wall. To achieve the best reading, do not place in an area where air stratification may be present. **Mount the sensor at least 1.5 m (5') in either direction from elbows, dampers, filters or other duct restrictions. Avoid areas where the transmitter is exposed to vibrations or rapid temperature changes.**

Once a suitable spot is selected, drill a 15 -20 mm (0.6" - .75") hole for the probe.

Slide the probe in the drilled hole until the enclosure is flush against the duct. The airflow direction is not important. Secure the enclosure to the duct with (2) #10 x 1" (25 mm) self tapping screws (Not provided). Tighten screws until the enclosure is tight against the duct and there is no movement of the enclosure as shown in Figure 1.

A foam gasket is provided on the back of the enclosure that provides a tight seal against any air leaks.

Using a Phillips screwdriver, remove the (2) cover screws, as shown in Figure 2. Remove cover and set aside with screws for re-installing after wiring and set up.

Two 21 mm (0.8125") holes are provided for connection of either 12.77mm (0.5") EMT or a cable gland style connector as shown in Figure 3. Insert the EMT or cable gland connector through the hole and securely fasten using a locknut. If only one connection hole is required, use the included hole plug to cap off the unused one as shown in Figure 4.

**Special care must be taken not to damage any internal components during installation.**

Make wire connections as per the "Wiring" illustrations on Page 2.

Once wiring and set up are complete, re-install cover and tighten the (2) screws using a Phillips screwdriver.

Figure 1

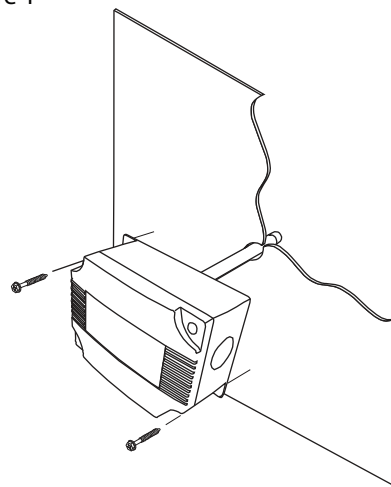


Figure 2

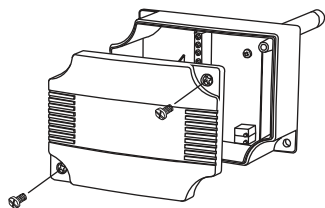


Figure 3

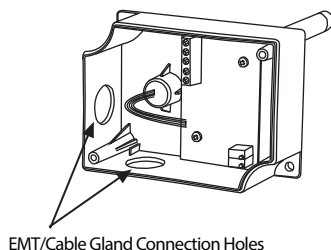
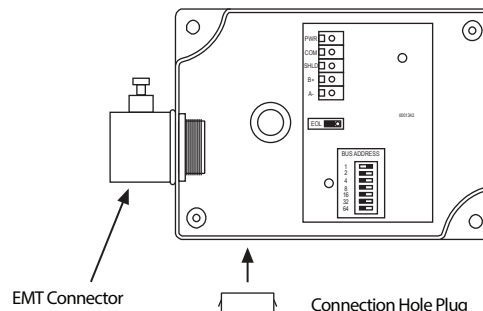


Figure 4



## Wiring

Deactivate the 24 Vac/dc power supply until all connections are made to the device to prevent electrical shock or equipment damage. Follow proper electrostatic discharge (ESD) handling procedures when installing the device or equipment damage may occur. Use 22 AWG shielded wiring for all connections and do not locate the device wires in the same conduit with wiring used to supply inductive loads such as motors. Make all connections in accordance with national and local codes.

Connect the 24 Vac/dc power supply to the terminals labeled PWR (power) and COM (common) as shown in Figure 6. This device has a half-wave type power supply so use caution when wiring multiple devices so that the circuit ground point is the same on all devices and the controller. Use caution if 24 Vac power is used and one side of the transformer is earth-grounded. In general, the transformer should NOT be connected to earth ground when using devices with RS-485 network connections. The device is reverse voltage protected and will not operate if connected backwards.

Connect the RS-485 network with twisted shielded pair to the terminals marked A-, B+ and SHLD (shield) as shown in Figure 6. The positive wire connects to B(+) and the negative wire connects to A(-) and the cable shield must be connected to the SHLD terminal on each device. If the device is installed at either end of the network, an end-of-line (EOL) termination resistor (121 ohm) should be installed in parallel to the A(-) and B(+) terminals. This device includes a network termination jumper and will connect the resistor correctly on the pcb. Simply move the pcb jumper to the EOL position and no external resistor is required as shown in Figure 7. The ground wire of the shielded pair should be connected to earth ground at the end of the network and the master is not grounded. Do not run bus wiring in the same conduit as line voltage wiring.

A network segment is a single shielded wire loop run between several devices (nodes) in a daisy chain configuration. The total segment length should be less than 4000 feet (1220 meters) and the maximum number of nodes on one segment is 127. Nodes are any device connected to the loop and include controllers, repeaters and sensors such as the RH/T Sensor but does not include the EOL terminators. To install more devices, or to increase the network length, repeaters will be required for proper communication. The maximum daisy chain length (segment) depends on transmission speed (baud rate), wire size and number of nodes. If communication is slow or unreliable, it may be necessary to wire two daisy chains to the controller with a repeater for each segment.

Figure 5

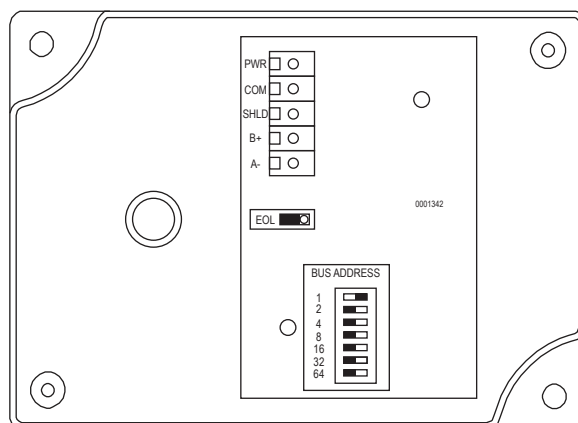


Figure 6

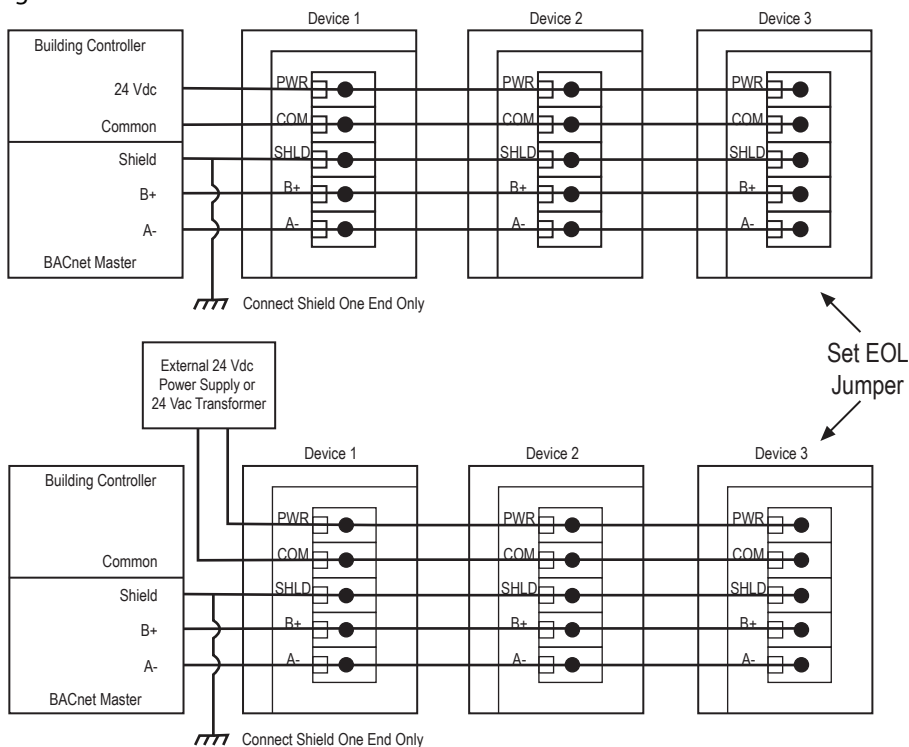
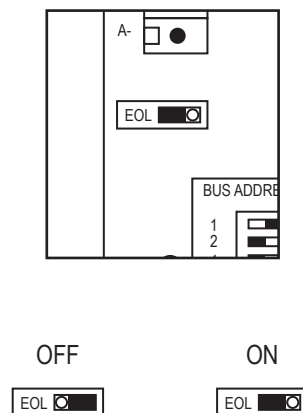


Figure 7



## Network Communication

The device parameters must be set before connection to the network and will ensure that each device has a unique MAC address and Device Instance for startup. On startup, the MAC address is appended to the Device Object : Vendor Identifier to create the unique Device Instance (Device Object : Object Identifier). Once connected to a network, the Device Object : Object Identifier can be written to any unique value via BACnet and then the MAC address will no longer be appended to the value. All parameters are saved in memory. The DIP switch is used to set the BACnet address (0-127). Slide the appropriate DIP switch(s) to the "ON" position as shown in Figure 8.

Note that the BACnet network baud rate may be 9600, 19200, 38400, 57600, 76800 or 115200 and is auto-detected on startup.

The RH/T Sensor operates as a slave. It will not communicate unless a master is connected to the network and sends a request for information, then the slave will answer. If the device does not communicate properly, first check that the communication wires are not reversed. Then check that the slave address has a unique setting for the network segment it is connected to. Ensure the device object name and object identifier are unique on the entire BACnet network, not just on the MS/TP sub-net. Both of these properties are writable.

Ensure the application software is not set to poll the devices too frequently. For example, if the software is polling the devices every 500 mS, the network could be heavily congested with the network traffic and may not operate reliably. A slower polling rate such as 5 to 10 seconds will usually produce better results on a typical network segment.

Use care when setting the MS/TP MAC address and the device object Max\_Master property since both can have a significant effect on the network efficiency. Some MAC address and Max\_Master combinations will operate more efficiently than others. MAC addresses should be selected sequentially, starting at the lowest possible value. For example, on a five node segment, the MAC addresses should be set to 1, 2, 3, 4 and 5. In this case, if the Max\_Master property value is left at the 127 default, then there will be a lot of wasted time on the network polling for masters that are not present. In this example, the five RH/T nodes should be set such that Max\_Master is equal to 5. The Max\_Master value initially defaults to 127 so that any master can be found when the device first starts.

Figure 8

DIP Switch Position							BACnet Address
64	32	16	8	4	2	1	
OFF	OFF	OFF	OFF	OFF	OFF	OFF	0
OFF	OFF	OFF	OFF	OFF	OFF	ON	1
OFF	OFF	OFF	OFF	OFF	ON	OFF	2
OFF	OFF	OFF	OFF	OFF	ON	ON	3
↓	↓	↓	↓	↓	↓	↓	↓
ON	ON	ON	ON	ON	ON	OFF	126
ON	ON	ON	ON	ON	ON	ON	127

BUS ADDRESS	
1	<input type="checkbox"/>
2	<input type="checkbox"/>
4	<input type="checkbox"/>
8	<input type="checkbox"/>
16	<input type="checkbox"/>
32	<input type="checkbox"/>
64	<input type="checkbox"/>

OFF	ON
<input type="checkbox"/>	<input type="checkbox"/>

## BACnet Protocol

The device has several BACnet objects to identify the device, read current values, configure the device and calibrate the sensors. There are four standard supported BACnet object types as shown in Figure 9.

Figure 9

Object Type	Dynamically Creatable	Dynamically Deletable	Object Identifier	Object Name
Device	No	No	381001	RHT 001
Analog Input	No	No	AI 1 AI 2	Temperature Relative Humidity
Analog Value	No	No	AV 1 AV 2	Temperature Offset RH Offset
Binary Value	No	No	BV 1	Temperature Units

The BACnet Device object allows configuration of the device. Device object properties are shown in Figure 10.

Figure 10

Property	Default Value	Property Data Type	Access
Object Identifier	381001	BACnetObjectIdentifier(numeric)	Read/Write
Object Name	RHT 001	CharacterString (32)	Read/Write
Object Type	DEVICE (8)	BACnetObjectType	Read
System Status	OPERATIONAL (0)	BACnetDeviceStatus	Read
Vendor Name	Greystone Energy Systems	CharacterString	Read
Vendor Identifier	381	Unsigned16	Read
Model Name	RHT	CharacterString	Read
Firmware Revision	1.2	CharacterString	Read
Application Software Version	V1.0	CharacterString	Read
Location	150 English Drive, Moncton, NB	CharacterString (32)	Read/Write
Description	Greystone RH/T Sensor	CharacterString (32)	Read/Write
Protocol Version	1	Unsigned	Read
Protocol Revision	14	Unsigned	Read
Protocol Services Supported	See description below	BACnetServicesSupported	Read
Protocol Object Types Supported	See description below	BACnetObjectTypesSupported	Read
Object List	See description below	BACnetArray	Read
Max APDU Length Accepted	50, B'0000'	Unsigned	Read
Segmentation Supported	NO_SEGMENTATION (3)	BACnetSegmentation	Read
APDU Timeout	6,000	Unsigned	Read/Write
Number of APDU Retries	3	Unsigned	Read/Write
Max Master	127	Unsigned	Read/Write
Max Info Frames	1	Unsigned	Read
Device Address Binding	empty	BACnetAddressBinding	Read
Database Revision	0	Unsigned	Read
Property List		BACnetArray	Read

**Object Identifier** Initial default number is 381001, where 381 is the vendor ID and 001 is the default network MAC address. When the MAC address is initially changed the value is updated and saved. For example, if the MAC address is set to 50 via the DIP Switch for startup, then the device instance will be set to 381050. This property is also writable via BACnet. If the Device: Object\_Identifier is written to via BACnet then the MAC address is no longer appended to the vendor ID to create this value.

**Object Name** Initial string is "RHT 001" where RHT is the device model name and 001 is the default network address. Can be written with a new string of maximum length of 32 characters and the value is saved. The "001" is the MAC address as set by the DIP Switch and is automatically changed if the MAC address is changed. Once written to via BACnet, the MAC address no longer gets appended to the value.

**Protocol Services Supported** readProperty, writeProperty, deviceCommunicationControl, who-Has, who-Is  
Binary bit string = {00000000 00001001 01000000 00000000 01100000 0}

**Protocol Object Types Supported** Analog\_Input, Analog\_Value, Binary\_Value, Device  
Binary bit string = {10100100 10000000 00000000 00000000 00000000 00000000 00000000}

**Object List** ((Device, Instance 1), (Analog Input, Instance 1), (Analog Input, Instance 2), (Analog Value, Instance 1), (Analog Value, Instance 2), (Binary Value, Instance 1))

**APDU Timeout** Value is 6,000. Can be modified from 1 to 10,000.

**Number Of APDU Retries** Value is 3. Can be modified from 1 to 10.

**Max Master** Value is 127. Value is saved. Can be modified from 1 to 127.

**Database Revision** Value is 0 to 255.

The analog input BACnet objects allow reading of sensor values. Analog input object properties are shown in Figure 11.

Figure 11

**Analog Input Object  
Temperature**

(Present Value is current temperature sensor reading in °F or °C, resolution is 0.1°)  
(The temperature units default to °C but can be changed to °F using BV1)

Property	Default Value	Property Data Type	Access
Object Identifier	AI1 (Analog Input 1)	BACnetObjectIdentifier	Read
Object Name	Temperature	CharacterString (32)	Read
Object Type	ANALOG_INPUT (0)	BACnetObjectType	Read
Present Value	current reading	Real	Read
Description	Temperature	CharacterString (32)	Read
Device Type	Temperature Sensor	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000)	BACnetStatusFlags	Read
Event State	NOR_MAL (0)	BACnetEventState	Read
Reliability	NO_FAULT_DETECTED (0)	BACnetReliability	Read
Out of Service	FALSE (0)	Boolean	Read
Units	degreesFahrenheit (64) or degreesCelsius (62)	BACnetEngineeringUnits	Read
Property List		BACnetArray	Read

**Analog Input Object  
Relative Humidity**

(Present Value is current RH sensor reading in %RH, resolution is 0.1%)

Property	Default Value	Property Data Type	Access
Object Identifier	AI2 (Analog Input 2)	BACnetObjectIdentifier	Read
Object Name	Relative Humidity	CharacterString (32)	Read
Object Type	ANALOG_INPUT (0)	BACnetObjectType	Read
Present Value	current reading	Real	Read
Description	Relative Humidity	CharacterString (32)	Read
Device Type	RH Sensor	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000)	BACnetStatusFlags	Read
Event State	NORMAL (0)	BACnetEventState	Read
Reliability	NO_FAULT_DETECTED (0)	BACnetReliability	Read
Out of Service	FALSE (0)	Boolean	Read
Units	Percent relative humidity (29)	BACnetEngineeringUnits	Read
Property List		BACnetArray	Read

The analog value BACnet objects allow sensor offset calibration. Analog value object properties are shown Figure 12.

Figure 12

**Analog Value Object Temperature Offset** (Present Value defaults to 0 for no offset. Can be set from -10 to +10 Δ°F or -5.0 to +5.0 Δ°C)  
(Units depend on the device units, either °C or °F), (°C resolution = 0.5, °F resolution = 1)

Property	Default Value	Property Data Type	Access
Object Identifier	AV1 (Analog Value 1)	BACnetObjectIdentifier	Read
Object Name	Temperature Offset	CharacterString (32)	Read
Object Type	ANALOG_VALUE (2)	BACnetObjectType	Read
Present Value	0	Real	Read / Write
Description	Temperature Offset	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000)	BACnetStatusFlags	Read
Event State	NORMAL (0)	BACnetEventState	Read
Out of Service	FALSE (0)	Boolean	Read
Units	delta-degreesFahrenheit (120) or Δ°C (121)	BACnetEngineeringUnits	Read
Property List		BACnetArray	Read

**Analog Value Object RH Offset** (Present Value defaults to 0 for no offset. Can be set from -10 to +10 %RH, resolution = 1)

Property	Default Value	Property Data Type	Access
Object Identifier	AV2 (Analog Value 2)	BACnetObjectIdentifier	Read
Object Name	RH Offset	CharacterString (32)	Read
Object Type	ANALOG_VALUE (2)	BACnetObjectType	Read
Present Value	0	Real	Read / Write
Description	RH Offset	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000)	BACnetStatusFlags	Read
Event State	NORMAL (0)	BACnetEventState	Read
Out of Service	FALSE (0)	Boolean	Read
Units	percentrelative-humidity (29)	BACnetEngineeringUnits	Read
Property List		BACnetArray	Read

The binary value BACnet object allows configuration of the device. Binary value object properties are shown in Figure 13.

Figure 13

**Binary Value Object Temperature Units** (Present Value defaults to 0 (INACTIVE) for Celsius. Can be set to 1 (ACTIVE) for Fahrenheit)

Property	Default Value	Property Data Type	Access
Object Identifier	BV1 (Binary Value 1)	BACnetObjectIdentifier	Read
Object Name	Temperature Units	CharacterString (32)	Read
Object Type	BINARY_VALUE (5)	BACnetObjectType	Read
Present Value	INACTIVE (0)	BACnetBinaryPV	Read / Write
Description	Celsius (0) or Fahrenheit (1)	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000)	BACnetStatusFlags	Read
Event State	NORMAL (0)	BACnetEventState	Read
Reliability	NO_FAULT_DETECTED (0)	BACnetReliability	Read
Out of Service	FALSE (0)	Boolean	Read
Property List		BACnetArray	Read

## General Specifications

Power Supply .....	24 Vac/dc $\pm 10\%$ (non-isolated half-wave rectified)
Consumption .....	25 mA max @ 24 Vdc
Protection Circuitry .....	Reverse voltage protected, overvoltage protected
Operating Conditions .....	-40 - 122 °F (-40 - 50 °C), 0-95 %RH non-condensing
Wiring Connections .....	Screw terminal block (14 to 22 AWG)
Enclosure .....	ABS, UL94-V0, IP61 (NEMA 2)
Dimensions .....	114 x 84 x 53 mm (4.5" w x 3.3" h x 2.1" d)
Sensing Probe .....	230 mm (9") long x 12.7 mm (1/2") diameter stainless steel with porous filter

## RH

Sensor .....	Thermoset polymer based capacitive
Accuracy .....	$\pm 2\%$ RH
Range .....	0-100 %RH
Resolution .....	0.1 %RH
Hysteresis .....	$\pm 1.5\%$ RH
Response Time .....	15 seconds typical
Stability .....	$\pm 1.2\%$ RH typical @ 50 %RH in 5 years

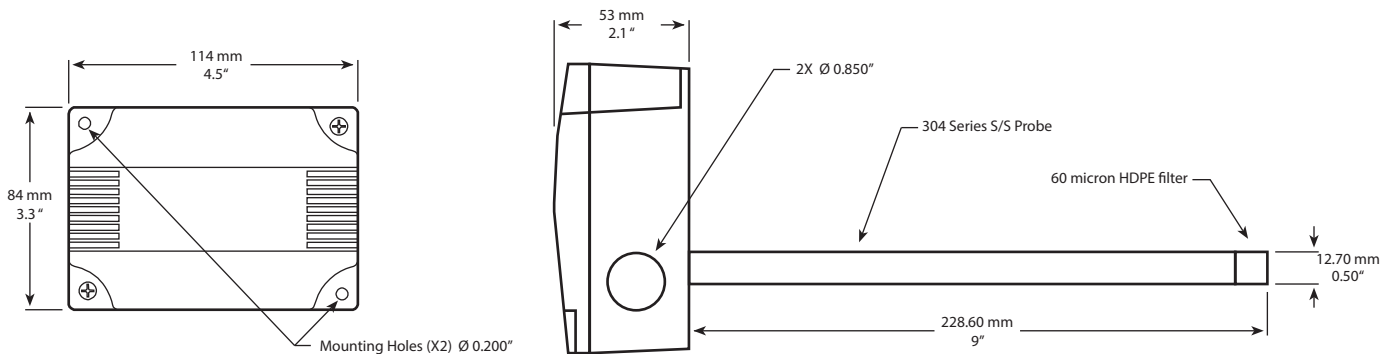
## Temperature

Sensor .....	20K $\Omega$ NTC thermistor
Accuracy .....	$\pm 0.4\text{ }^{\circ}\text{F}$ ( $\pm 0.2\text{ }^{\circ}\text{C}$ ) curve matched
Range .....	-40 - 122 °F (-40 - 50 °C)
Resolution .....	0.1 °F / °C

## Interface

Hardware .....	2-wire RS-485
Software .....	Native BACnet MS/TP protocol
Baud Rate .....	9600, 19200, 38400, 57600, 76800 or 115200 auto-detect
Network Address Range .....	Locally set to 0-127

## Dimensions:





## BACnet Protocol Implementation Conformance Statement (PICS)

**Date :** January 18, 2016  
**Vendor Name :** Greystone Energy Systems Inc.  
**Product Name :** RH/T Sensor  
**Product Model Number :** NTDABAC  
**Application Software Version :** 1.0  
**Firmware Revision :** 1.2  
**BACnet Protocol Revision :** 14

**Product Description :** The Greystone RH/T Sensor is a smart sensor with native BACnet MS/TP protocol for network communication. It measures Relative Humidity and Temperature levels and reports the values back to a building automation system (BAS). The device is configured for duct applications.

**BACnet Standardized Device Profile (Annex L) :** BACnet Application Specific Controller (B -ASC)

**BACnet Interoperability Building Blocks Supported (Annex K) :** DS-RP -B, DS -WP -B,  
DM -DDB -B, DM -DOB -B  
DM -DCC -B

**Segmentation Capability :** Not supported

**Standard Object Types Supported :**

Object Type	Dynamically Creatable	Dynamically Deletable	Optional Properties Supported	Writable Properties
Device	No	No	Location, Description, Max_Master, Max_Info_Frames	Object_Identifier, Object_Name, Location, Description, APDU_Timeout, Max_Master, Number_Of_APDU_Retries
Analog Input	No	No	Description, Reliability, Device_Type	
Analog Value	No	No	Description	Present_Value
Binary Value	No	No	Description, Reliability	Present_Value

**Data Link Layer Options :** MS/TP master (Clause 9), baud rates : 9600, 19200, 38400, 57600, 76800, 115200

**Device Address Binding :** Not supported

**Networking Options :** None

**Character Set Supported:** ISO 10646 (UTF-8)

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