



HPE-MRBN – BACnet MS/TP Gateway to Modbus RTU 485

FW4.01

Integration of BACnet MS/TP conforming devices in to Modbus RTU based systems. Up to 247 BACnet MS/TP devices may be connected to the gateway for read access of up to 250 BACnet data objects

Typical Applications

Modbus RTU 485 network integration of BACnet MS/TP devices:

- HVAC Controllers
- PMAC770 electricity meters (c/w BACnet module)
- Sontex SC531 chilled/hot water energy integrators (c/w BACnet module)
- Belimo energy Valves *

** Belimo energy valves should have dedicated gateway, with System Vendor ID# 423 (SV=423) set in the gateway. Other BACnet devices may share a gateway, with default SV=0 setting.*

Feature Summary

- Modbus RTU RS485 slave port (BMS port)
- BACnet MS/TP master-slave/token-passing (Sub-bus port)
- User customised BACnet object data based
- Modbus Long Integer and IEEE Floating Point register address ranges
- Smart-polling of BACnet objects (only actively polled when active on the Modbus BMS side)



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Operation Overview

The gateway comprises two sections; the Modbus RTU device and the BACnet MS/TP network reading data base.

Modbus Slave Device

Important for testing with Modscan or other similar test applications:

- Gateway Modbus points 1, 2 & 3 are Short Integers (16 bit). These diagnostic-counter points should not be included in your testing process
- When testing with Modscan, set up for 32 bit registers (Long Integer or IEEE Float32) and start your test routine from point 4 or higher

During commissioning the following should be configured:

- Node # (local network address)
- RS485 network baud rate
- 250 registers relating to the BACnet network devices' data objects being read

Long Integer

- Registers 4, 6, 8... 502
- Modicon Register Addresses, using F03/Holding Register as example, 40005, 40007, 40009... 40503

IEEE Floating Point

- Registers 1004, 1006, 1008... 1502
- Modicon Register Addresses using, F03/Holding Register as example, 41005, 41007, 41009... 41503

Write & Relinquish

The gateway operates on the BACnet side with Null priority by default. To facilitate some level of BACnet priority control we implement a command level address range 2004...2502 to avoid other BACnet devices overriding the BMS.

Example for point 4:

- If you wish to lock in the BMS write value such as a setpoint then send a value of 1 to register 2004 (2004=1)
- To relinquish back to Null send a value of 17 to register 2004 (2004=17)
- We recommend that the connected BACnet devices have all objects in the relinquished state



BACnet Network Gateway

250 BACnet Objects may be configured, from up to 247 BACnet MS/TP devices.

It is important to have the BACnet device manufacturer's manual available to assist with BACnet Object settings.

The gateway data base consists of 250 Modbus registers, each configured with a target BACnet object's data:

1. BACnet device address where the object resides (MS/TP Node address / MAC)
2. Object type (BI, BV, BO, AI, AV, AO, MI, MV, MO)
3. Object Instance (object number)

Separately the BACnet network baud rate and Maximum Master value must be set. The gateway is generally set as being Device Instance 0.

Terminal Mode

An HPECOMU (USB) data cable is used for terminal mode between the gateway and a PC running a terminal program. HyperTerminal or Indigo Terminal Emulator from Shade Blue are recommended.

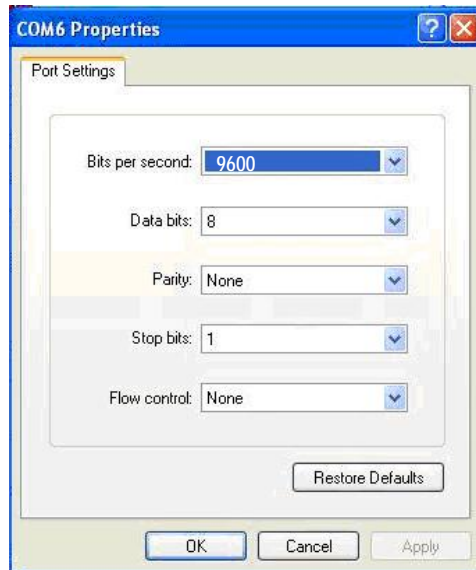
The USB driver for the HPECOMU may be found on our web site.

The following settings reflect HyperTerminal. Please contact us if you require assistance setting up Indigo.

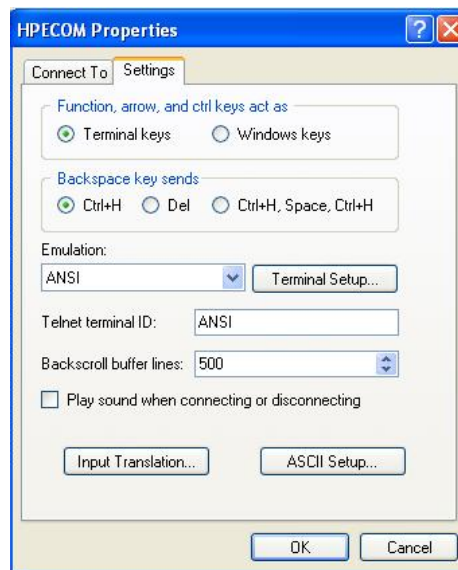
HyperTerminal Settings

For successful communication between HyperTerminal and the device, initial Properties setup of HyperTerminal should be as per the screen prints below.

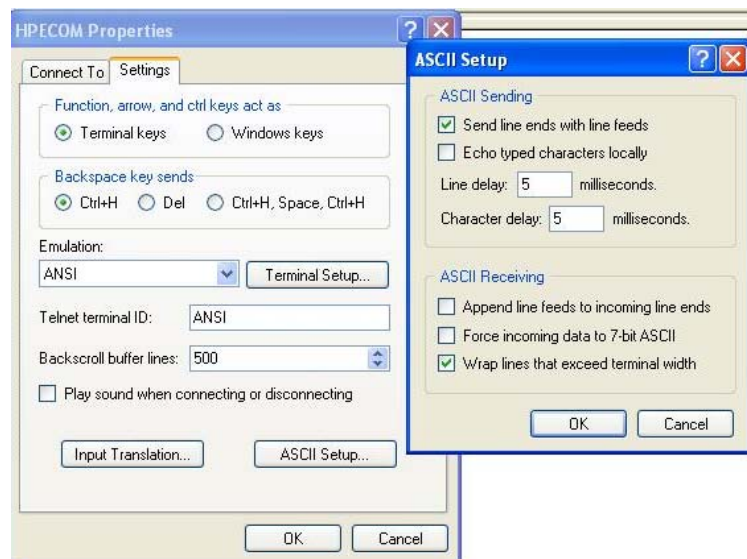
'Connect to' Comm Configuration:



'Settings' General:



'Settings' ASCII Setup:



Additional Settings

Some PC platforms may need keyboard response adjustment for initial Terminal Mode success. These settings may be done via the PC Control Panel >> Keyboard Settings:

- Fastest Repeat rate
- Shortest Delay time
- Fastest Cursor Blink rate

Connecting at 76800 Baud Rate

Because HyperTerminal does not support 76800 baud then after setting to 76800 the device baud rate will remain at 9600 baud for HyperTerminal communication and switch to 76800 after Writing the new baud rate and eXiting terminal mode.

To allow later terminal communication a device set with 76800 baud will operate at 9600 baud for the first 5 seconds after a power-up. If no attempt to connect the terminal at 9600 baud is made within 5 seconds of a power-up then the device will automatically switch to 76800 for normal network operation.

Saving HyperTerminal Settings

For ease of connection it is recommended to save the HyperTerminal setup for each baud rate you may wish to use with an easily recognised configuration name. For example:

- HPECOM 24 (2400)
- HPECOM 48 (4800)
- HPECOM 96 (9600)
- HPECOM 19.2 (19200)
- HPECOM 38.4 (38400)
- HPECOM 57.6 (57600)

Break in to Terminal Mode

To break in to terminal mode set Caps Lock on and hold the 'T' character key continuously (TTTTTTT...). After five (5) T's have been sent to the device it will switch to terminal mode.



Modbus Configuration Commands

Function	Enter	Result	Options / Comments
Start communication	TTTTT(TTT...)	Break in to Terminal mode	<i>With the Caps Lock on, hold the T key down until the screen updates with HPE data. It is not necessary to press the enter key to start communication.</i>
Set node address	1000=1...98, 100...247	Network node number is assigned	<i>Example: 1000=1 Node address 99 is not allowed</i>
Set RS485 network baud rate	1001=...	Network comms speed is set	<i>2400, 4800, 9600, 19200, 38400, 57600, 76800 Example: 1001=38400 After changing comm. speed it will be necessary to reconnect with HyperTerminal at the new comm. speed to save (write) the change!</i>
Zero the Reset counters	1=0	All Reset counters are zeroed	<i>Factory diag. In order as displayed: Rx timeout, Tx timeout, Hardware reset</i>
Zero the BACnet comms error counter	2=0	BACnet comms error counter is reset	<i>Example: 2=0</i>
Zero the M-Bus comms error counter	3=0	M-Bus comms error counter is reset	<i>Example: 3=0</i>
Write values as default	W	Changes written.	<i>Always do this after making changes that you wish to be permanent</i>
Exit communication	X	Communication with HyperTerminal no longer active	<i>Auto X after 240sec without key entry. After eXit unplug the HPECOM cable to allow network communication to take place</i>



BACnet Configuration Commands

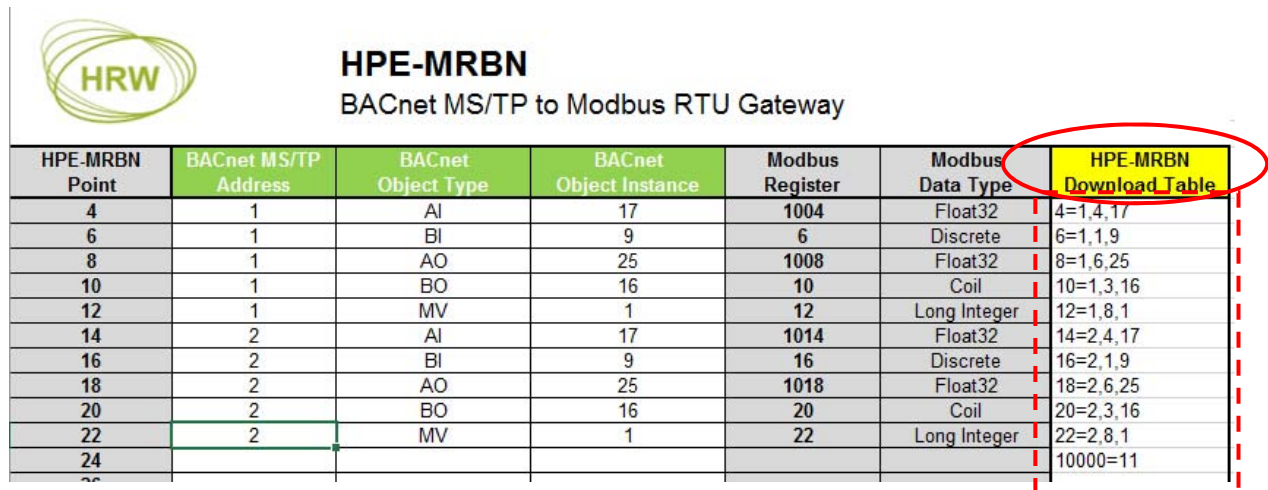
Function	Enter	Result	Options / Comments
Start communication	TTTTT(TTT...)	Break in to Terminal mode	<i>With the Caps Lock on, hold the T key down until the screen updates with HPE data. It is not necessary to press the enter key to start communication.</i>
Set BACnet baud rate	1002=...	Network comms speed is set	9600, 19200, 38400, 57600, 76800 <i>Example: 1002=19200</i>
Set BACnet address	1003=0	Set the gateway's BACnet MS/TP address	<i>Typically addr 0, as the gateway is considered to be the MS/TP network router</i>
Set BACnet Device Instance	DI=1...4194303	Set the gateway's BACnet unique address	<i>Can be left at default as a wider BACnet based system does not exist if this gateway is being employed</i>
Set Maximum Master	MM=1...127	Set the highest numbered BACnet device's address	<i>This setting acts to limit address polling only up to the MM value, for network efficiency</i>
Prepare for point data base text file download	DE	'Ready' will be displayed at which time the relevant text file should located and sent to the gateway	<i>Data base lines may also be manually entered, one by one</i>
Delete current point data base	DE followed by 10000=1	Any configuration of point 4...502 is deleted	<i>Download of a text file with new data base will delete an old existing data base as a matter of course</i>
Enable BACnet subnet communication	E	Toggles Enabled/Disabled of M-Bus Subnet communication	<i>Default Disabled to allow easy configuration when no devices are connected. Always 'Enable' when devices are connected and points are configured!</i>
Scroll page display	P=1...10	Scroll to specific page if more data-points are present than can be displayed on one screen	<i>Example: P=2 The second page of database settings are displayed</i>
Diagnostic display	D	Point by point response codes are displayed each time ENTER is pressed	<i>For data stream analysis between the HPE and the BACnet devices. Create text capture file for easy analysis of the received data stream</i>
Release manualled points	R	Enter R to release all manualled points. Enter R=n(nn) to release specific individual points	<i>n(nn) represents a specific point number in the range 4...502</i>
Write values as default	W	Changes written.	<i>Always do this after making changes that you wish to be permanent</i>
Exit communication	X	Communication with HyperTerminal no longer active	<i>Auto X after 240sec without key entry. After eXit unplug the HPECOM cable to allow network communication to take place</i>

Data Base Mapping Tool

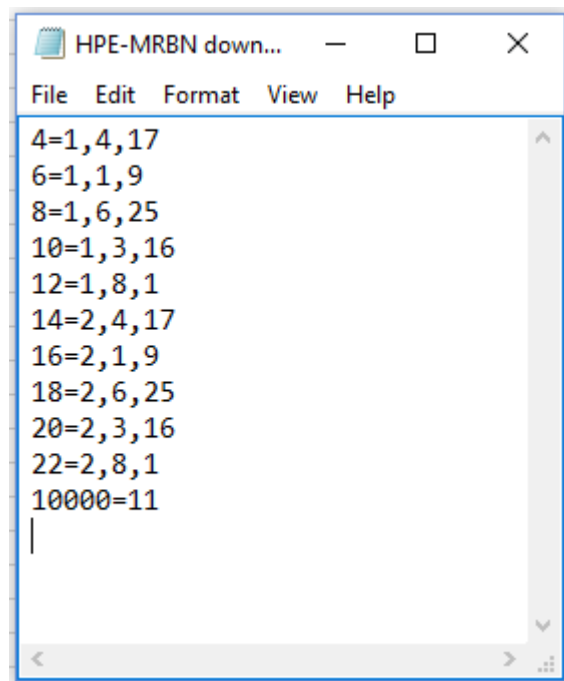
Although all configuration can be typed directly in to the gateway via the terminal program, by email request or by download from www.hrw.hk, Resources/Tools, you can use our the HPE-MRBN mapping Tool for creation of a table of data base settings which can be downloaded to the gateway as a text file (*.txt).

As well as the generic BACnet mapping tool, we also have Belimo-device-specific mapping tools available on request.

Copy the Download Table lines from the tool to Notepad text file and save for download to the gateway:



HPE-MRBN Point	BACnet MS/TP Address	BACnet Object Type	BACnet Object Instance	Modbus Register	Modbus Data Type	HPE-MRBN Download Table
4	1	AI	17	1004	Float32	4=1,4,17
6	1	BI	9	6	Discrete	6=1,1,9
8	1	AO	25	1008	Float32	8=1,6,25
10	1	BO	16	10	Coil	10=1,3,16
12	1	MV	1	12	Long Integer	12=1,8,1
14	2	AI	17	1014	Float32	14=2,4,17
16	2	BI	9	16	Discrete	16=2,1,9
18	2	AO	25	1018	Float32	18=2,6,25
20	2	BO	16	20	Coil	20=2,3,16
22	2	MV	1	22	Long Integer	22=2,8,1
24						10000=11



```

HPE-MRBN down...
File Edit Format View Help
4=1,4,17
6=1,1,9
8=1,6,25
10=1,3,16
12=1,8,1
14=2,4,17
16=2,1,9
18=2,6,25
20=2,3,16
22=2,8,1
10000=11
  
```

Terminal Operation

After entering terminal mode with TTTTTTTT you will initially see the factory default settings.

```

HPE-MRBN V4.01          Modbus BACnet
1000) 98 1001)MR = 9600 8N1 1002)BACnet = 38400 8N1 1003) 0 DI) 1098 MM) 127 SV)
0
1)Resets = 0 0 3      2)ModbusErrors = 0      3)BACnetErrors = 0
4)Address = 98 InstanceNo = 1 Data = OFF          DV 17
6)Address = 98 InstanceNo = 2 Data = OFF          DV 17
8)Address = 98 InstanceNo = 19 Data = 0 0 0       AV 17
10)Address = 98 InstanceNo = 20 Data = 0 0 0      AV 17
12)Address = 98 InstanceNo = 21 Data = 0 0 0      AV 17
14)Address = 98 InstanceNo = 22 Data = 0 0 0      AV 17

Pt No = Address,ObjectType,Instance D Diag F Find P = Page No
E BACnet Disabled X to exit W to write values
  
```

Make settings such as Modbus address & baud rate by entering the required settings. Note that after changing the Modbus baud rate the terminal mode baud rate is also changed so reconnect HyperTerminal at the newly set baud rate and then Write (W) the new setting.

Download Text File

Enter **DE**. The display will indicate that the existing data base is being blanked and now 'Ready' to receive data base text file:

While in the 'Ready' state, navigate to the text file path via the Transfer / Send Text File dialogue:



After download of the text file the display will indicate a check between lines received and lines expected (indicated by the 10000=*n* line count generated in the mapping tool configuration table).

If the lines check is correct then the new data base is loaded, otherwise the old data base will be reinstalled automatically.

```

HPE-MRBN V4.01          Modbus BACnet
1000) 1 1001)MR = 9600 8N1 1002)BACnet = 38400 8N1 1003) 0 DI) 0 MM) 2 SV) 0

1)Resets = 0 0 4      2)ModbusErrors = 0    3)BACnetErrors = 0
4)Address = 1 InstanceNo = 17 Data = 0 0 0      AI 17
6)Address = 1 InstanceNo = 9 Data = OFF          DI 17
8)Address = 1 InstanceNo = 25 Data = 0 0 0      AO 17
10)Address = 1 InstanceNo = 16 Data = OFF        DO 17
12)Address = 1 InstanceNo = 1 Data = 0 0 0      MV 17
14)Address = 2 InstanceNo = 17 Data = 0 0 0      AI 17
16)Address = 2 InstanceNo = 9 Data = OFF         DI 17
18)Address = 2 InstanceNo = 25 Data = 0 0 0      AO 17
20)Address = 2 InstanceNo = 16 Data = OFF        DO 17
22)Address = 2 InstanceNo = 1 Data = 0 0 0      MV 17

Pt No = Address,ObjectType,Instance D Diag F Find P = Page No
E BACnet Disabled X to exit W to write values

```

Enable BACnet MS/TP Port

Enter E to enable the BACnet MS/TP communication and enter W to write the enabled state so that it will still be enabled after a power failure.

Note: To disable enter E again to toggle from enabled to disabled state.

Verify BACnet Network Communication

In terminal mode any scanning of the BACnet network will only occur after the data based points are added to the Log list:

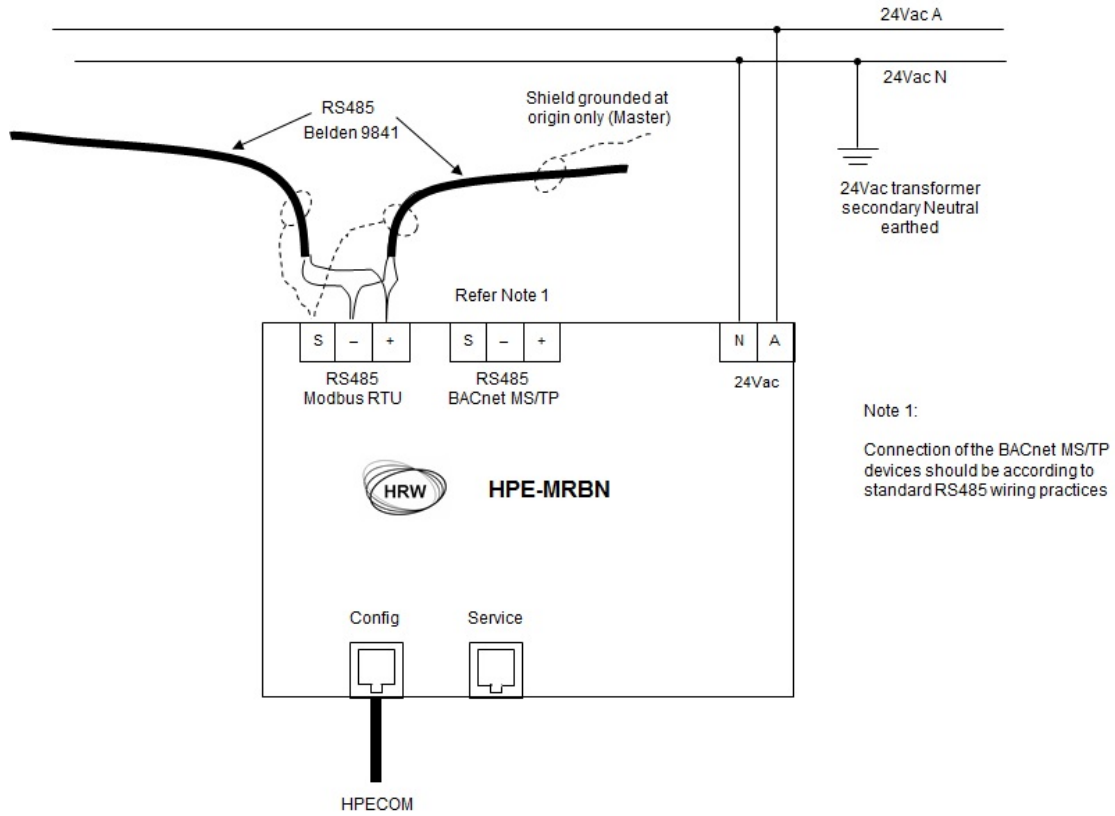
- 1) Enter L to place all points on log
- 2) Enter X to eXit terminal mode so that the gateway freely scans the BACnet network
- 3) Wait 30 seconds to ensure all points are read in
- 4) Enter TTTTTTTT to go back in to terminal mode
- 5) Enter D to invoke Diagnostic display (display of true scaled values, as opposed to raw data)

Installation & Commissioning

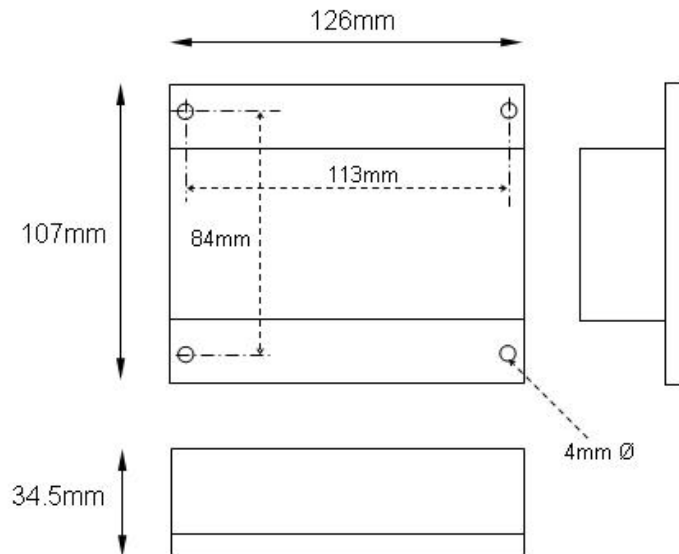
Power & RS485

- This is an RS485 network device designed for indoor use, mounted in a dry electrical panel. Ideally it should be mounted to the panel backplane in a horizontal position (RJ11 sockets on the lower side and communications ports on the upper side)
- Each 24Vac power supply transformer should have the neutral (24Vac N) connection grounded at the electrical panel earth connection to ensure the device grounding is at the same potential as the network master's grounding
- Where more than one device is connected to a common transformer ensure that the 24Vac phasing is the same to each device ('A' connects to 'A', 'N' connects to 'N' in all cases)
- If the red comms light adjacent to the RS485 terminals emits an obvious flash every time 24Vac power is applied to the device then the micro-processor may be corrupted. The micro processor should be replaced
- RS485 multi-drop cable should be used for the network connections, complete with end of line terminating resistors (120Ω). Belden 9841 or equivalent is recommended. The recommended cable is a low capacitance twisted pair with braid and foil screen
- The RS485 cables should be terminated directly at each device in a daisy-chain configuration, avoiding 'laterals' or 'spurs'
- The RS485 screen should be connected at the network master's ground terminal. The incoming and outgoing screen at each device should be continuously connected via the S terminal of the device (note that the device's S terminal has no electrical connection to the device, it merely acts as a junction terminal for the purpose of screen continuity)
- The RS485 cable should avoid cable routes that run with power cables. Where the RS485 cable must cross power cables then they should cross at 90° avoiding parallel runs beside power cables
- Prior to connection of the slave devices to the RS485 network check that no AC voltage is present. Double check the network for short circuits between the twisted pair cores and between the cores and the screen. Ensure continuity of the twisted pair cores and the screen
- Check the network master's +/- terminals for correct voltages to ground (approx. 2.5Vdc) and connect the RS485 network cable to the network master's RS485 port
- At each device assign an individual address and the baud rate specific to the network. Write the changes, eXit the terminal application and remove the HPECOM cable
- Verify network voltage at the RS485 connector (between +/- and ground) and connect to the device. Communication can be verified by flashing of the red comms LED adjacent the 3 terminal RS485 connector). Frequency of comms LED flash is baud rate dependant. At higher baud rates the LED flash may not be obvious, the LED appearing to be continuously on
- Where a network runs between buildings and zero earth potential difference between individual panel 24Vac power supplies cannot be guaranteed, we recommend that a repeater be used to provide isolation of the sections of the network having differing earth potential

Connections







Dimensions



If using HDA0002 DIN rail adapter brackets the overall depth from the gear plate to the front surface of the device is 45.5mm

Technical Data

Network Wiring	Shielded twisted pair (shield grounded) Belden 9841 low capacitance twisted pair for RS485 networks (braided + foil shield, shield continuous throughout the network and grounded at network origin)
RS485 Comms Speed	RS485 - 2400, 4800, 9600, 19200, 38400, 57600, 76800 baud
RS485 Network Capacity	247 nodes over max. 1.2km without repeater
Power Supply	24Vac, 50/60 Hz, max. 7.5VA
Conformity & approvals	   
Operating Temperature Range	0...50°C (32...122°F)
Storage Temperature Range	-5...75°C (-40...167°F)
Humidity Range	10...95%rH (non-condensing)
Dimensions	126mm (W) x 107mm (H) x 34.5mm (D)

Ordering Information

HPE-MRBN

Description:	250 point gateway – Modbus RTU 485 integration of BACnet MS/TP device, for control panel mounting
Standard package:	40 units per carton

Accessories

HDA0002	DIN rail adapter brackets, factory fitted
HPECOMU	Configuration cable (USB)

Other HP_MR Series Devices

HPC0662MR	Universal Controller, 12 Point, Modbus RTU, 24Vac
HPC8884MR	Universal Controller, 28 Point, Modbus RTU, 24Vac
HPD0440BNMR	Network HMI / Universal Ctrl / Scheduler / Modbus RTU gateway 8 Point, BACnet MS/TP, 24Vac
HPD0460MR	Network HMI, 12 Point, Modbus RTU, 24Vac
HPD0460MRC	Network HMI / Universal Controller, 10 Point, Modbus RTU, 24Vac
HPD0460MRCT	Network HMI / Universal Ctrl / Scheduler, 10 Point, Modbus RTU, 24Vac
HPD0460MRT	Network HMI / Scheduler, 10 Point, Modbus RTU, 24Vac
HPE0662MR	I/O expansion, 12 Point, Modbus RTU, 24Vac
HPE8884MR	I/O expansion, 28 Point, Modbus RTU P, 24Vac
HPV0662MR	VAV / Universal Controller, 13 Point, Modbus RTU, 24Vac
HPE-MRSMA	Modbus gateway for SMA inverter devices, 250 point, 24Vac

Also available are gateways for Modbus RTU devices in to BACnet MS/TP and P1 FLN based networks



Notes: