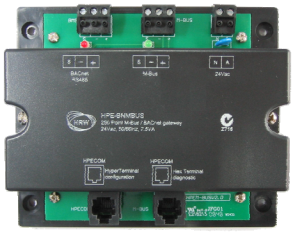

HPE-BNP1BUS – P1 FLN Gateway to BACnet MS/TP

FW4.01, from Feb. 2012

250 point integration of P1 FLN conforming devices in to BACnet MS/TP networks. Up to 32 P1 devices may be connected to the gateway for read/write access of up to 250 data-points

Typical Applications

BACnet MS/TP network integration of P1 devices:

- System 600, APOGEE Insight
- TEC, ATEC, SCU, DPU, DLM
- MEC Point Expansion units
- HRW HP…P1 devices

Feature Summary

- FIND function for initial network device/application identification
- Diagnostic function for comms verification and trouble-shooting
- Continuous poll for point status changes
- User set period for complete point status update
- Scaling table for known and customised sensor types

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Operation Overview

The gateway comprises two sections; the BACnet MS/TP device and the P1 network reading data base.

BACnet Device

The gateway is BTL listed, conforming to the BACnet standard's requirements for device & object discovery and network communication initiations and responses.

During commissioning the following should be configured:

- Node # (local network unique number)
- Device Instance (system-wide unique number)
- MS/TP network baud rate
- Maximum Master (MM), set to the highest node number existing on the network, for limiting network traffic to only those devices that exist on the network
- 250 AV objects relating to the P1 network devices' data points being read, AV4…AV253

P1 Network Gateway

250 device data points may be configured, from up to 32 P1 devices. Each data point constitutes a BACnet object (AV).

It is important to have the P1 device manufacturer's manual available to assist with P1 point address and type scaling.

Each point of the gateway data base consists of:

1. Device addresses
2. Point numbers within the device addresses
3. Sensor type relating to each point (as defined in the scaling table)
4. A point type; LDI, LDO, LAI, LAO represented as a number, 1…4 respectively

BACnet Priority Array

The BACnet protocol utilises a Priority Array for each object to enable various network devices to take control of a device's object based on the level of need. The priorities are in the range 1 (high priority) to 16 (Auto operation).

In respect of this device:

- The point database objects are NULL priority, signified by '17' when viewing the points in engineering Terminal mode
- Manually overriding a point value via terminal mode invokes priority level 9
- Release of a manual results in an object reverting to NULL or next lowest and still valid priority level if it has been commanded from another device in the system (such as the BMS)
- For normal reading of the P1 network points should always be at NULL priority

Terminal Mode

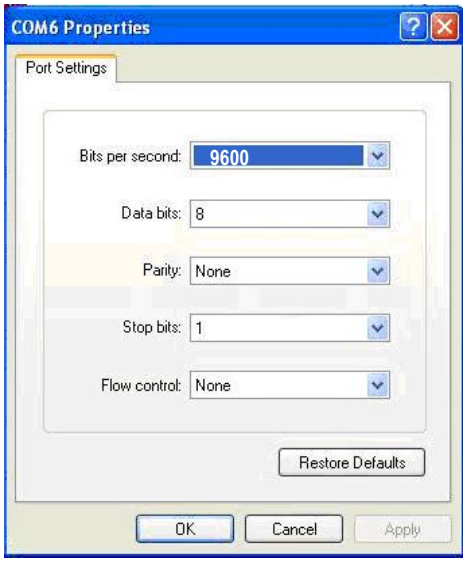
An HPECOM (serial comm. port) or HPECOMU (USB) data cable is used for terminal mode between the gateway and a PC running a terminal program. HyperTerminal or Indigo Terminal Emulator from Shade Blue are recommended. A USB port <> Serial comm port (DB9) converter may be required for HPECOM if the PC being used does not include a Com 1 serial port.

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

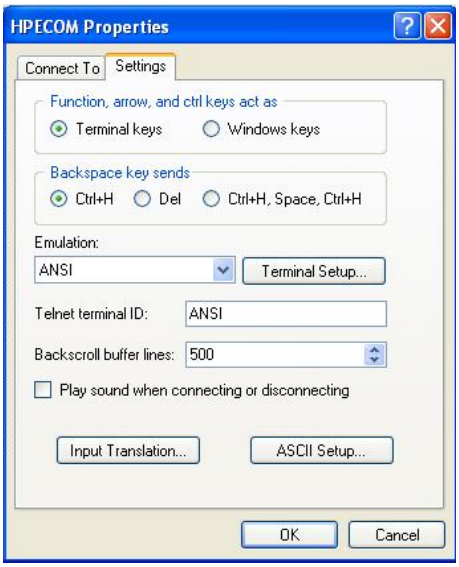
HyperTerminal Settings

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

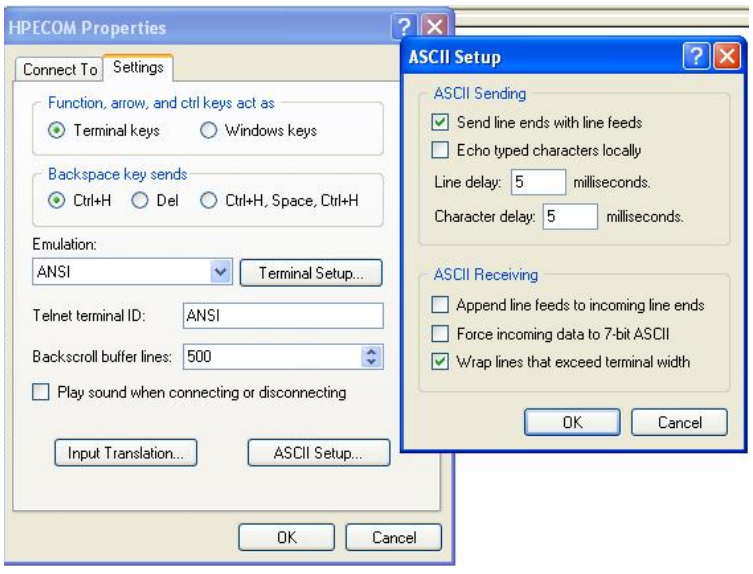
'Connect to' Comm Configuration:



'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.

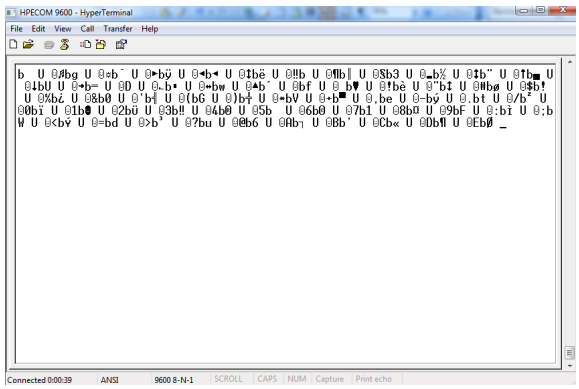
Saving HyperTerminal Settings

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

When HyperTerminal is running and the HPECOM cable is connected to the device the initial terminal screen will be receiving an ASCII character dump which is the BACnet transmission from the device. The ASCII dump will appear differently with different device address setting and if HyperTerminal baud rate is different to the baud rate set in the device. Below is an illustration of how the ASCII dump will look for a device at default settings; address 98 and 9600 baud.



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. At this point the BACnet activity on the network will be halted and the device will display the default user screen.

BACnet Configration Commands

Function	Enter	Result	Options / *Comments*
Start communication	TTTTT(TTT…)	Break in to Terminal mode	*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.*
Set node address (MAC)	1000=1…127 (master) 1000=128…255 (slave)	Network node number is assigned	*Example: 1000=25* *1…127 the device will be a 'token passing master'* *128… 255 the device will become a network slave after power reset*
Set system Device Instance	DI=0…4194303	Unique Device Instance is assigned	*Example: DI=401025 (building 4, network 1, node 25)*
Set BACnet baud rate	1001=…	Network comms speed is set	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!***
Set Maximum Master address	MM=1…127	Highest Master device address on the network is registered	*Next address searching limited to MM address*
Set Sys. Vendor ID (**S**ys**V**id)	SV=0…255	System vendor specific features may be available	*SV=0 applies generic BACnet operation. If an entered ID is not implemented then the generic operation will be applied*
Zero the Reset counters	1=0	All Reset counters are zeroed	*Factory diag. In order as displayed:* *Rx timeout, Tx timeout, Hardware reset*
Zero the BACnet comms error counter	2=0	BACnet comms error counter is reset	*Example: 2=0*
Zero the M-Bus comms error counter	3=0	M-Bus comms error counter is reset	*Example: 3=0*
Write values as default	W	Changes written.	***Always do this after making changes that you wish to be permanent***
Exit communication	X	Communication with HyperTerminal no longer active	*Auto X after 240sec without key entry.* ***After eXit unplug the HPECOM cable to allow network communication to take place***

P1 Configuration Commands

Function	Enter	Result	Options / *Comments*
Start communication	TTTTT(TTT…)	Break in to Terminal mode	*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.*
Set P1 FLN baud rate	1002=…	Network comms speed is set	2400, **4800**, 9600, 19200, 38400, 57600, 76800 *Example: 1002=9600* *Note that P1 devices are typically fixed at 4800 baud*
Set Timed Scan period	TS=1…65,000	Force complete all-point status read every set period in minutes	*Example: TS=10 (default)* *(Normal continuous reading still occurs, reading-in changes only)*
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	*Data base lines may also be manually entered, one by one*
Delete current point data base	DE followed by 10000=1	Any configuration of AV4…AV253 is deleted	*Download of a text file with new data base will delete an old existing data base as a matter of course*
Priority Release all points to NULL	R	All points are Released to NULL priority	*17 will be displayed at the extreme right of each data point configuration line to signify NULL priority*
Priority Release individual point to NULL	R=4…253	Specified point is Released to NULL priority	*17 will be displayed at the extreme right of the target data point configuration line to signify NULL priority*
Enable P1 subnet communication	E	Toggles Enabled/Disabled of M-Bus Subnet communication	*Default Disabled to allow easy configuration when no M-Bus devices are connected.* ***Always 'Enable' when M-Bus devices are connected and points are configured!***
Find	F	Identify P1 device addresses & associated application #	*Recommend to take screen print or Capture Text record as this information is not stored*
Scroll page display	P=1…10	Scroll to specific page if more data-points are present than can be displayed on one screen	*Example: P=2* *The second page of database settings are displayed*
Set point Default state in event of network error	DF=0…1	**DF=1** last valid read value will be held after P1 device/point non-responsive **DF=0** value will go to 0/OFF if P1 device/point non-responsive for more than three read attempts	*Factory default setting is DF=1*
Diagnostic display	D	Point by point response codes are displayed each time ENTER is pressed	*For data stream analysis between the HPE and the P1 devices. Create text capture file for easy analysis of the received data stream*
Write values as default	W	Changes written.	***Always do this after making changes that you wish to be permanent***
Exit communication	X	Communication with HyperTerminal no longer active	*Auto X after 240sec without key entry.* ***After eXit unplug the HPECOM cable to allow network communication to take place***

P1 Integration

Enter **E** to enable the P1 FLN port communication and enter **W** to write the enabled state so that it will still be enabled after any power failure.

Note: To disable the port for any reason, enter E again to toggle from enabled to disabled state.

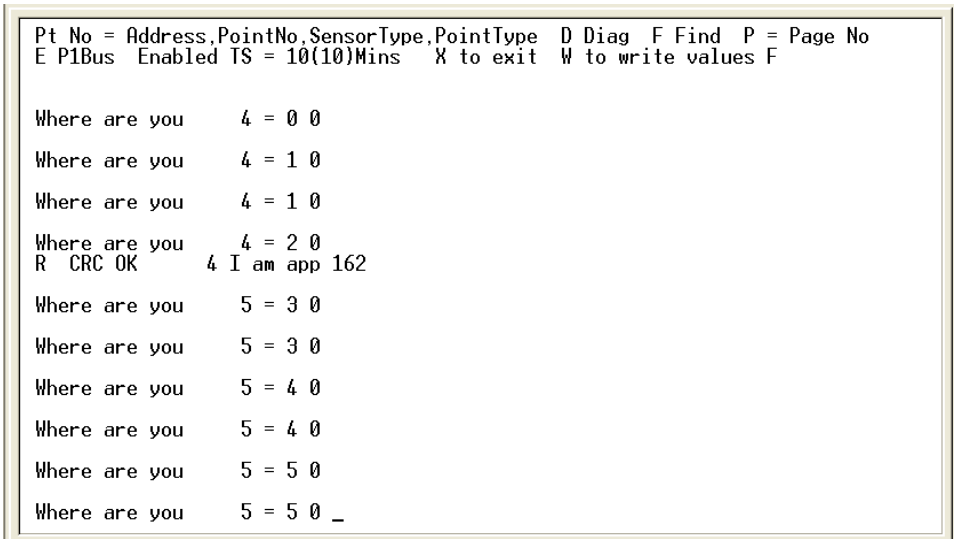
Find

The gateway Find function enables identification of existing devices on the network, returning their individual network node addresses and the number of the application running in the device. In combination with the P1 devices' application manual, the application number information helps to decide which points are available in each P1 device, simplifying the creation of the point database of the gateway.

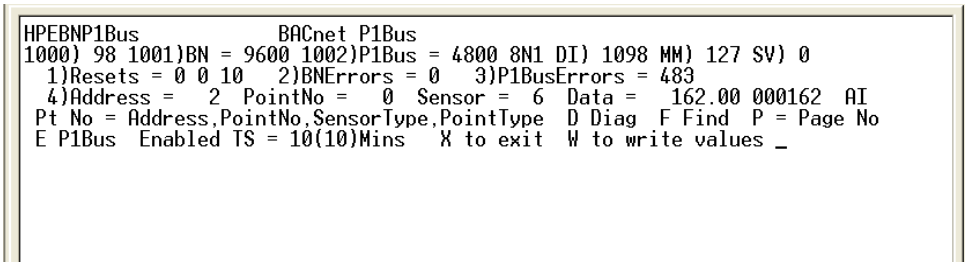
Enter **F** to start the Find function.

The Find function will automatically poll each possible P1 address to find how many devices are on an existing network. Each address is polled twice in the event a device does not respond on it's first polling. Once devices are identified they will be displayed sequentially in the point database list for cataloguing by the engineer. Each devices' active Application # is also identified and displayed.

Below we see P1 address 2 has responded and it's application is #162.



Consequently it is temporarily displayed under the HPE-BNP1BUS point 4 listing, including the application number.



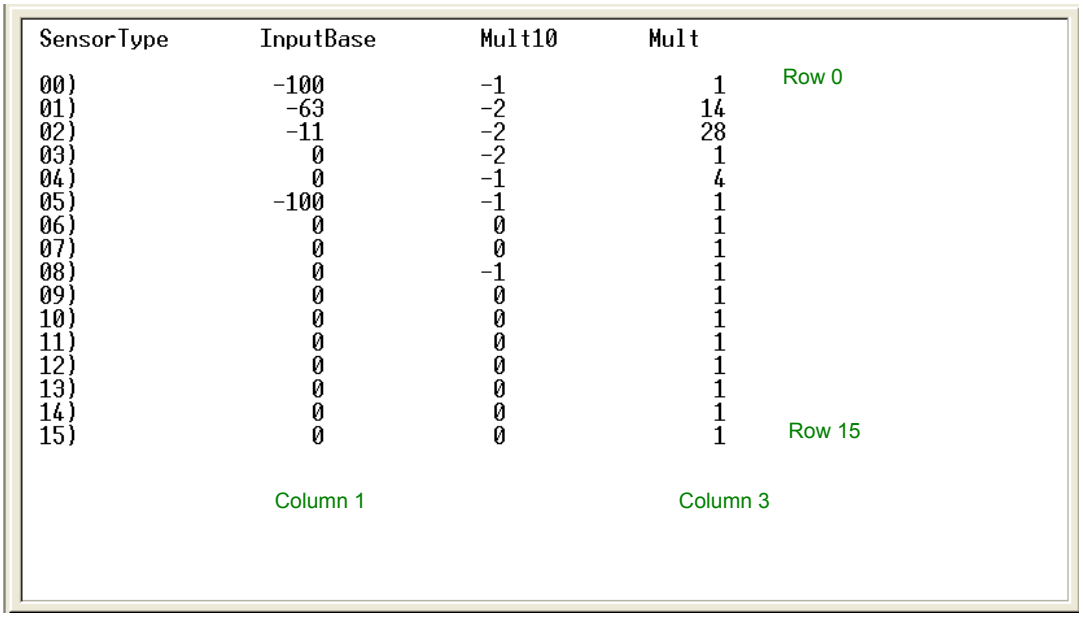
Any other discovered devices would be listed sequentially, from point 5 onwards as temporary holding points.

Sensor Type (Scaling) Table

The user configurable Sensor Type table allows up to 16 different sensor scalings to be configured prior to defining the point data base. The table elements are as follows:

- Mult1 (units multiplier)
- Mult10 (10's multiplier)
- InputBase (intercept)

By entering **S** the scaling table is revealed. Customisation can be made directly over HyperTerminal or by download of a configuration file taken from the address calculator tool.



While displaying the table, using a row/column address matrix, each value in the table may be customized.

For instance, to change Type 1 (row 1) so that it is applicable for °F instead of °C then:

1) Slope of 0.25
    a. Units multiplier = 25 therefore enter 13=25 (row#column#=25)
    b. Shift decimal place left two places = -2 therefore enter 12=-2

2) Intercept of -48
    a. Input Base = Intercept / Slope = -48/.25 = -192 therefore enter 11=-192

Standard Sensor Types

A number of standard Sensor Types are preconfigured reflecting known TEC and HRW device input/output parameters.

P1 Sensor types	Programming Value	Description
Type 0 - HRW	0	HPE/HPC = -10…92°C * (0.1/-10)
Type 1 - TEC	1	Slope 0.14 / intercept -8.889
Type 2 - TEC	2	Slope 0.28 / intercept -3.056
Type 3 - TEC	3	Slope 0.01 / intercept 0
Type 4 - TEC	4	Slope 0.4 / intercept 0
Type 5 - HRW	5	HPE/HPC = -10…92°C * (0.1/-10)
Type 6 - HRW	6	HPE/HPC = Pulse counter (1/0)
Type 7 - HRW	7	HPE/HPC = Digital (1/0)
Type 8 - HRW	8	HPE/HPC = 0…100% (0.1/0)
Type 9 - HRW	9	Seconds (1/0)
Type 10 - HRW	10	Slope 1 / intercept 0
Type 11 - HRW	11	Slope 1 / intercept 0
Type 12 - HRW	12	Slope 1 / intercept 0
Type 13 - HRW	13	Slope 1 / intercept 0
Type 14 - HRW	14	Digital Normally Closed (1/0)
Type 15 - HRW	15	Digital Toggle (1/0)

Point Type

Point Type programming value defines the P1 point in the gateway so that the gateway knows what BACnet object type should be used when making the point data available on the BACnet MSTP network.

P1 Point Type	Description	Gateway Point Type	Gateway Tag	BACnet Object Type
LDI	Digital Input	1	DI	BV
LDO	Digital Output	2	DO	BV
LAI	Analogue Input	3	AI	AV
LAO	Analogue Output	4	AO	AV
LPACI	Pulse Accumulator	3	AI	AV

Data Point Configuration

Once it is known which points are required from each device the 250 point data base, points 4…253, can be created. The elements which make up each point are as follows:

- Device address
- Point number
- Sensor Type, which defines point slope & intercept parameters
- Point Type, which defines whether a point is Digital or Analogue, Input or output (BV or AV)

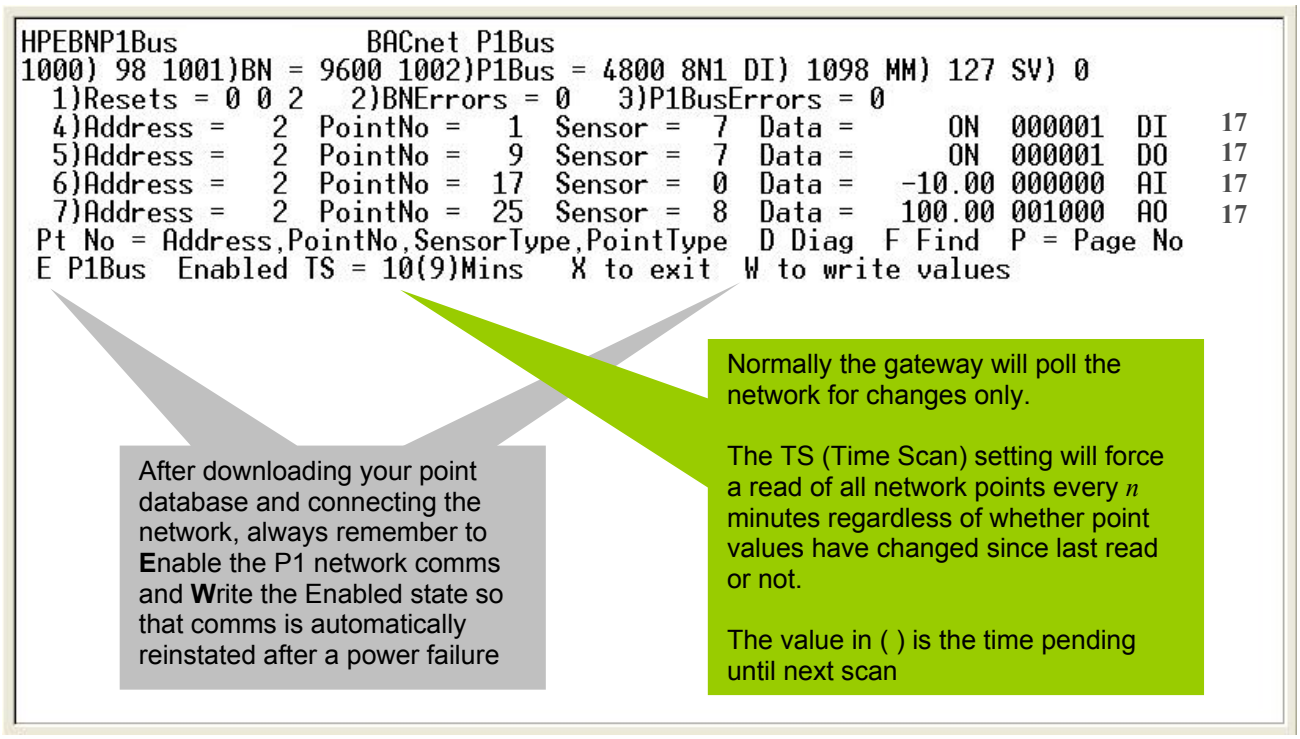
Points are entered in to the HPE-BNP1BUS in the following structure:

<Point #>=<P1 Node #>,<Node Point #>,<P1 Sensor Type>,<Point Type>

In the following HyperTerminal screen print we see four points from an HPE8884P1, device address 2:

- Point 1, a digital input (sensor type 7, point type 1)
- Point 9, a digital output (sensor type 7, point type 2)
- Point 17, an analogue input (sensor type 0, point type 3)
- Point 25, an analogue output (sensor type 8, point type 4)

All points are Null priority by default (indicted by value 17 on the right side of the display). To command from the BACnet BMS then commands must be sent with a priority of 16 or higher



Data Base Mapping Tool

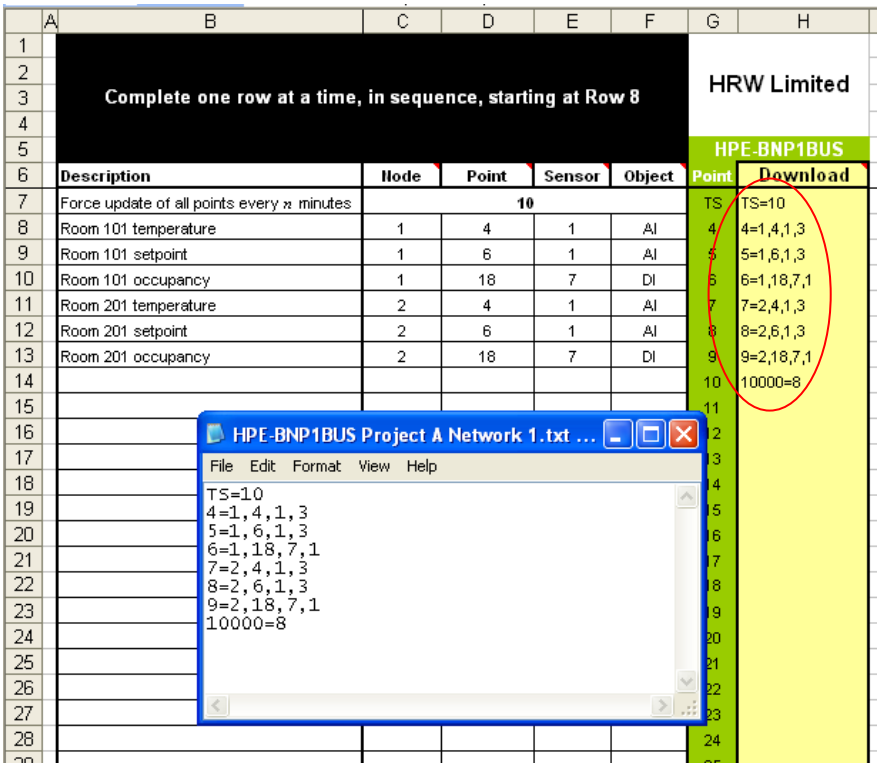
Although all configuration can be typed directly in to the gateway via the terminal program, by email request or by download from www.hrw.hk, Resources/Tools, you may use our mapping Tool for creation of a table of data base settings which can be downloaded to the gateway as a text file (*.txt).

Point Configuration

In the example below two P1 devices are configured each with three input points to be read.

Complete one row at a time, in sequence, starting at Row 8					HRW Limited	
					HPE-BNP1BUS	
Description	**Node**	**Point**	**Sensor**	**Object**	**Point**	**Download**
Force update of all points every *n* minutes		**10**			TS	TS=10
Room 101 temperature	1	4	1	AI	4	4=1,4,1,3
Room 101 setpoint	1	6	1	AI	5	5=1,6,1,3
Room 101 occupancy	1	18	7	DI	6	6=1,18,7,1
Room 201 temperature	2	4	1	AI	7	7=2,4,1,3
Room 201 setpoint	2	6	1	AI	8	8=2,6,1,3
Room 201 occupancy	2	18	7	DI	9	9=2,18,7,1
					10	10000=8

Once the information is properly entered in the tool the resultant point configuration data, in the **Download** column, may be copied to Notepad for saving as a text file and download to the gateway.



The last row of the download data, 10000=nnn, is a line count for a validity check as part of the download process. 10000=nnn is not required if manually entering the data configuration lines.

Scaling Table Configuration

By making changes to the Scaling table a Download table is created containing only the changes from factory default. Below we see the standard setting examples.

		Sensor Scaling					Sensor Type Custom Download
			Set HPE Slope Setting		Enter for Reference		
Description	Type	Base	10's Multi	1's Multi	Slope	Intercept	
HRW -10...92°C	0	-100	-1	1	0.1	-10	
TEC Primary Sensor (RTS)	1	-63	-2	14	0.14	-8.889	
TEC Secondary Sensor	2	-11	-2	28	0.28	-3.056	
TEC Flow Coefficent	3	0	-2	1	0.01	0	
TEC 0...100% Analogue	4	0	-1	4	0.4	0	
HRW -10...92°C	5	-100	-1	1	0.1	-10	
HRW Pulse Counter	6	0	0	1	1	0	
HRW Digital	7	0	0	1	1	0	
HRW %	8	0	-1	1	0.1	0	
	9	0	0	1	1	0	
	10	0	0	1	1	0	
	11	0	0	1	1	0	
	12	0	0	1	1	0	
	13	0	0	1	1	0	
	14	0	0	1	1	0	
	15	0	0	1	1	0	

By changing Type 1 settings from those for °C to those for °F we see the changes required for download will appear in the Download column. This download data is then copied to a text file for download over HyperTerminal using the same process as used for the point database download.

		Sensor Scaling					Sensor Type Custom Download
			Set HPE Slope Setting		Enter Reference		
Description	Type	Base	10's Multi	1's Multi	Slope	Intercept	
HRW -10...92°C	0	-100	-1	1	0.1	-10	S11=-192
TEC Primary Sensor (RTS)	1	-192	-2	25	0.25	-48	S13=25
TEC Secondary Sensor	2	-11	-2	28	0.28	-3.056	10000=3
TEC Flow Coefficent	3	0	-2	1	0.01	0	
TEC 0...100% Analogue	4	0	-1	4	0.4	0	
HRW -10...92°C	5	-100	-1	1	0.1	-10	
HRW Pulse Counter	6	0	0	1	1	0	
HRW Digital	7	0	0	1	1	0	
HRW %	8	0	-1	1	0.1	0	

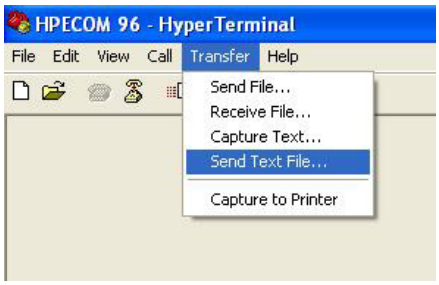
The reference Slope and Intercept values are taken from the P1 device documentation. Entering these two values automatically calculates the 'Base' value required by the HPE-BNP1BUS.

The '10's Multiplier' and '1's Multiplier' values must be manually entered in reference to the P1 device's documented slope value. In this case, 25 (1's Multi = 25) with decimal shifted two places to the left (10's Multi = -2) = the actual required slope of 0.25 (25*.01=0.25)

Download Text File

While in Terminal mode 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.

Note: To delete all existing point data without downloading a new text file enter **DE** then enter **10000=1**

Scan P1 FLN Network

In terminal mode any scanning of the P1 network will only occur after pressing Enter as a separate action to any other settings. After exit from terminal mode the scanning will occur automatically.

After pressing Enter, wait for the display to refresh with read values (this may take some time if the network contains many devices and data points).

Diagnostic Display

For trouble shooting the Diagnostic function allows a clear view of the P1 network data activity.

Enter **D** to activate the Diag function. Now, each time you force a scan with Enter you will see the full request and reply including checksum detail or error messages if applicable.

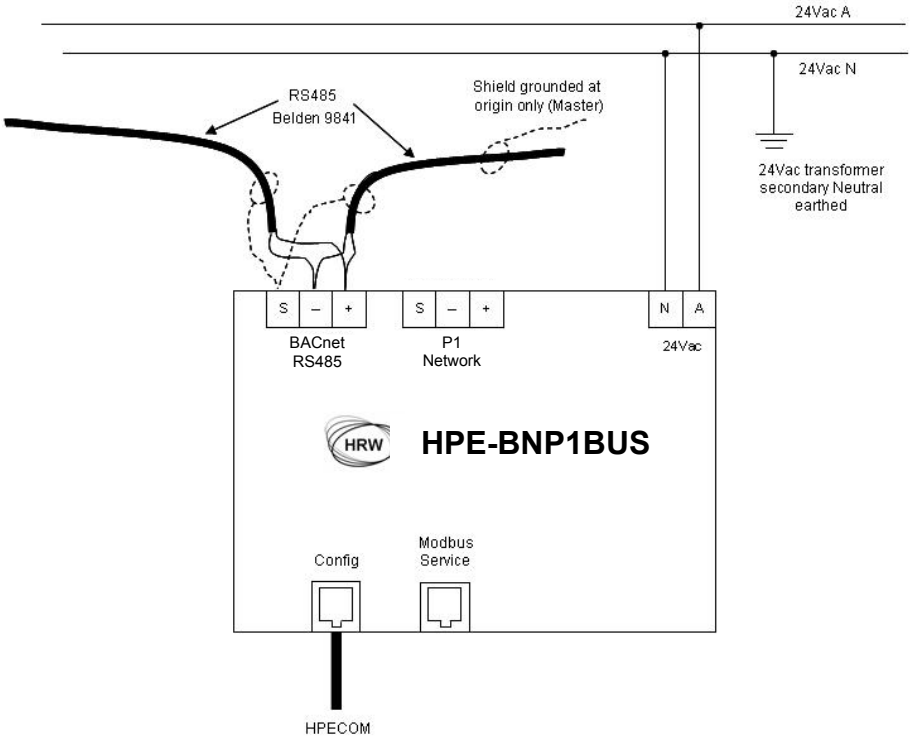
When a valid node/point change is communicated the point data value(s) will be displayed.

Via the HyperTerminal menus Transfer / Capture text option you can save this communication data for later analysis; create a capture file, press Enter to force a scan, then stop the capture. Open the resultant text file with Word to view a formatted record of the communication for analysis.

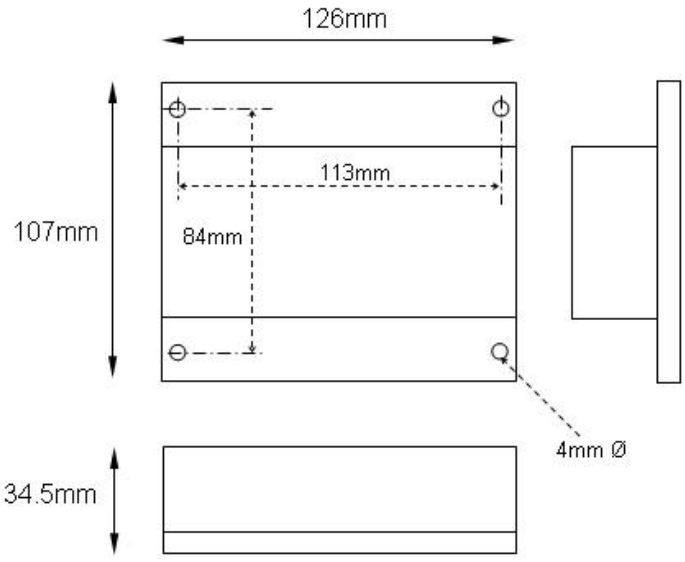
Installation & Commissioning

- This is an RS485 network device designed for mounting in an 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

BACnet MS/TP 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	2400, 4800, 9600, 19200, 38400, 57600, 76800 baud
RS485 Network Capacity	256 nodes over max. 1.2km without repeater
P1 FLN Comms Speed	2400, 4800*, 9600, 19200, 38400, 57600, 76800 baud (*typical)
P1 network Capacity	32 devices
Power Supply	24Vac, 50/60 Hz, max. 2.5VA
Conformity & approvals	
Operating Temperature Range	0…50ºC (32…122ºF)
Storage Temperature Range	-5…75ºC (-40…167ºF)
Humidity Range	10…95%rH (non-condensing)
Dimensions	126mm (W) x 107mm (H) x 34.5mm (D)

Ordering Information

HPE-BNP1BUS

Description: 250 point gateway – BACnet MS/TP integration of P1 FLN devices - for control panel mounting
Standard package: 40 units per carton

Accessories

HDA0002	DIN rail adapter brackets, factory fitted
HPECOM	Configuration cable (DB9 <> RJ11)
HPECOMU	Configuration cable (USB <> RJ11)
U232-P9	RS232 (DB9) <> USB adapter cable

Other HP_BN Series Devices

HPC0662BN	Universal Controller, 12 Point, BACnet MS/TP, 24Vac
HPC8884BN	Universal Controller, 28 Point, BACnet MS/TP, 24Vac
HPD0440BNMR	Network HMI / Universal Ctrl / Scheduler / Modbus RTU gateway 8 Point, BACnet MS/TP, 24Vac
HPD0460BN	Network HMI, 12 Point, BACnet MS/TP, 24Vac
HPD0460BNC	Network HMI / Universal Controller, 10 Point, BACnet MS/TP, 24Vac
HPD0460BNCT	Network HMI / Universal Ctrl / Scheduler, 10 Point, BACnet MS/TP, 24Vac
HPD0460BNT	Network HMI / Scheduler, 10 Point, BACnet MS/TP, 24Vac
HPE8884BN	I/O expansion, 28 Point, BACnet MS/TP, 24Vac
HPV0662BN	VAV / Universal Controller, 13 Point, BACnet MS/TP, 24Vac
HPE-BNMBUS	BACnet gateway for M-Bus devices (EN1434), 250 point, 24Vac
HPE-BNMOD	BACnet gateway for Modbus devices, 250 point, 24Vac

Notes: