HPE-BNMBUS – M-Bus (EN1434-3) Gateway to BACnet MS/TP

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250 point integration of M-Bus (EN1434-3) conforming devices in to BACnet MS/TP networks. Up to 40 M-Bus devices may be connected to the gateway for read access of up to 250 M-Bus data-points

Typical Applications

BACnet MS/TP network integration of M-Bus devices:

- Hot water or chilled water energy meters (BTU meters)
- Water meters
- Electricity meters
- Pulse converters

Feature Summary

- Integrated M-Bus network driver, up to 40 M-Bus devices
- Primary or Secondary addressing
- Diagnostic function for M-Bus point DIF/VIF identification
- With or without common 'DVIF' data point assigned to each device address configuration point
- Beyond the device address point DVIF assignment, independent point configuration per-device
- M-Bus point DIF-only scan option possible (independent of point VIF value)
- Settable network scan period (for suitable battery powered meters, battery conservation)

Default M-Bus Settings

The gateway may be configured for any M-Bus device. As an initial guide (example) the factory settings include meter and point addressing for the Sontex SuperCal 531 energy integrator. Ultimately the user must configure the meter and point data base to suit the specific devices connected in the M-Bus network.

Sontex SC531 example points:

- Primary address 0
- Common DVIF for Energy (kWh, assigned to the Primary address point, point 4 / AV4)
- Volume at point 5 (AV5)
- Flow temperature at point 6 (AV6)
- Return temperature at point 7 (AV7)
- Power (kW) at point 8 (AV8)
- Flow rate (m^3/h) at point 9 (AV9)

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Operation Overview

The gateway comprises two sections; the BACnet MS/TP device and the M-Bus 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 M-Bus network devices' data points being read, AV4…AV253

M-Bus Network Gateway

250 device data points may be configured, from up to 40 M-Bus devices. Each data point constitutes a BACnet object (AV).

It is important to have the M-Bus device manufacturer's manual available to assist with M-Bus point address settings although the gateway's Diagnostic function means the available data points can be identified without the manufacturer's manual if need be. Each required data point should be configured in the order that it appears in the manufacturer's point table (or in the order that they appear in the Diagnostic response).

The gateway data base consists of:

1. One data point, the 'DVIF', which should be the first M-Bus user-required data point as it appears in the data sequence. The data returned according to the DVIF point address may be assigned to any AV that is configured as a meter addressing point
2. Starting with gateway point 4 (AV4) the first meter Primary or Secondary address point
3. Starting with point 5 (AV5) a sequential selection of required M-Bus data points related to the preceding meter address point
4. Repeat step 2 & 3 for each subsequent M-Bus device

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 M-Bus network points should always be at NULL priority

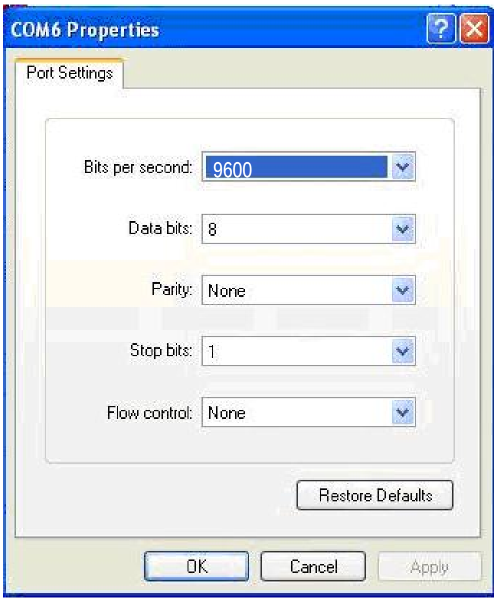
Terminal Mode

The HPECOMU serial data cable is used for terminal mode between the device and a PC running a terminal program. HyperTerminal is recommended.

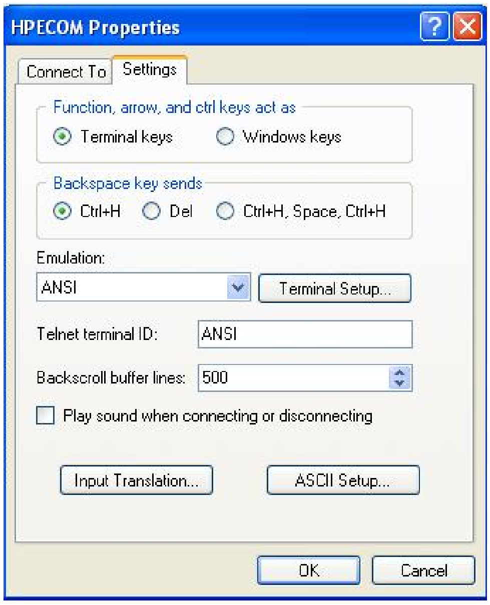
HyperTerminal Settings

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

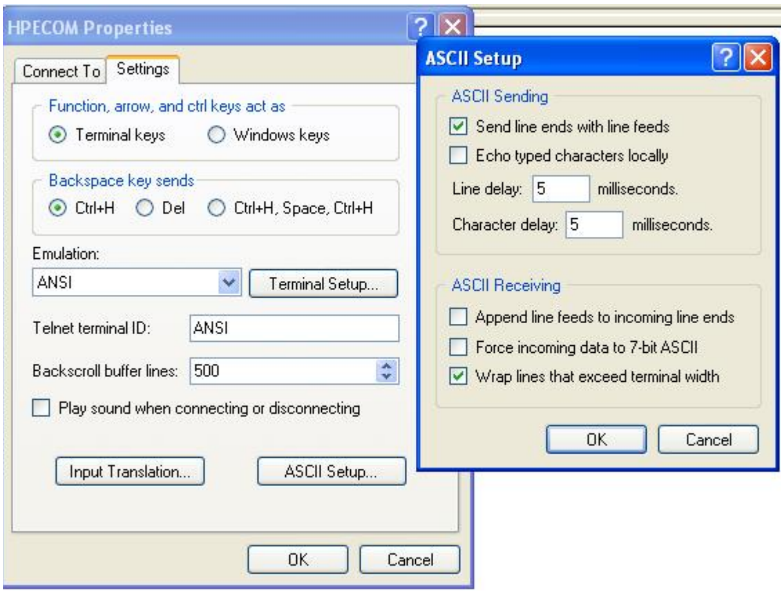
'Connect to' Comm Configuration:



'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.

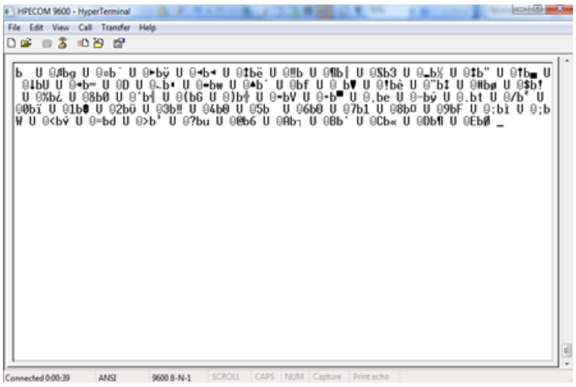
Saving HyperTerminal Settings

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…98, 100…127 (master) 1000=128…255 (slave)	Network node number is assigned	*Example: 1000=25* *1…98 or 100…127 the device will be a 'token passing master'. **Note that 99 may not be used.** 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***

M-Bus 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 M-Bus baud rate	1002=…	Network comms speed is set	**2400**, 4800, 9600 *Example: 1002=9600*
Set Timed Scan period	TS=1…65,000 (minutes)	Network will be read every set period in minutes	*Example: TS=10 (default)*
Set M-Bus comms Time Out	TO=200…60,000 (msec)	Retries to a non-responding meter will be after the set period, in milliseconds. Skip after three attempts	*Example: TO=200 (default)* *Set in 5ms increments*
Set M-Bus comms Turn-around time	TA=20…1000 (msec)	The wait time before sending new commands to a responding device, in milliseconds	*Example: TA=100 (default)* *Set in 5ms increments*
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 M-Bus 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!***
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*
Diagnostic display	D	Point by point response codes are displayed each time ENTER is pressed	*For data stream analysis between the HPE and the M-Bus 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***

M-Bus Reading Structure

Data point search

When an M-Bus device responds to a read request it will provide the data as a series of Response (RSP) pages. These may be anything from one page to many pages, depending on the number of data points available from the meter.

To make best use of the available gateway points the gateway will only extract from these pages the data points that you configure.

Because M-Bus protocol does not enable the gateway to request a specific page or data point then it is important that the points you require are configured in the gateway in the same sequence as they appear in the M-Bus device manufacturer's RSP page/table sequence, otherwise the gateway may spend unnecessary time searching for data points that have previously been passed in the RSP page sequence.

Data point address

Each data point in the device pages consists of DIF (Data Information Field) which indicates the data type (DEC, HEX, BIN, number of data bytes) and one of more VIF (Variable Information Field) which indicate information such as decimal placement.

In the gateway the DIF must be specified, as minimum criteria, to identify the data point required to be read. The VIF's (up to two) may also need to be specified additionally where an identical DIF is used for more than one data point. This need of VIF definition is particularly true where two data points have identical DIF value but it is only the subsequent of the two data points having identical DIF that you want to read.

If both points with identical DIF are required for reading then only the DIF need be defined for both because the gateway will find the first based on the DIF value and then find the next with same DIF value as it moves on to search the remaining page records.

When all required points are found the search will end and the gateway will move on to requesting the next network meter address point in it's configured point data base

Example RSP Pages

Following is the first Response page from the Sontex SuperCal 531 energy integrator (SC531)

531 rsp_1

Respond with user data RSP_UD, Variable structure response (slave to master)

		Field	Frame bytes in hex	Bytes	Coding	Fun	Sto	Tar	Dev	Value Info
Header		Start, Length	#NAME?	4	See Note 1					
Header		Control	08	1	Respond with user data, RSP_UD					
Header		Address	xx	1						
Header		Control Information	72	1	Variable structure respond (mode 0: LSByte first)					
User Data Header				0	*Coding*					
User Data Header		Identification number	xx xx xx xx	4	A, 32 bits					
User Data Header		Manufacturer ID: "SON"	EE 4D	2	C, 16 bits					
User Data Header		Generation of meter	0D	1	C, 8 bits					
User Data Header		Measured media: Heat	04	1	D, 8 bits					
User Data Header		Access number	xx	1	C, 8 bits					
User Data Header		Status	xx	1	Ds, 8 bits					
User Data Header		Signature (not used)	00 00	2	C, 16 bits					
User Data Records				0	*Coding*	*Fun*	*Sto*	*Tar*	*Dev*	*Value Info*
User Data Records	§	Detailed errors	02,FD 17,er er	5	D, 16 bits		0	0	0	Error flags, device type specific
User Data Records	§	Current error duration	34,75,xx xx xx xx	6	B, 32 bits	Err	0	0	0	Current error duration [min]
User Data Records	§	Current date & time	04,6D,xx xx xx xx		F, 32 bits		0	0	0	Time point; date & time
User Data Records	§	Energy totalizer heating	04,en en,xx xx xx xx	7	B, 32 bits		0	0	0	Energy; 0.1, 1, 10 kWh, 1, 10 MJ
User Data Records	§	Volume totalizer	04,vo vo,xx xx xx	7	B, 32 bits		0	0	0	Volume; 0.001, 0.01 m3
User Data Records	§	Energy totalizer tarif 1	84 10,en en,xx xx xx xx	8	B, 32 bits		0	1	0	Energy; 0.1, 1, 10 kWh, 1, 10 MJ
User Data Records	§	Volume totalizer tarif 1	84 10,vo vo,xx xx xx xx	8	B, 32 bits		0	1	0	Volume; 0.001, 0.01 m3
User Data Records	§	Energy totalizer tarif 2	84 20,en en,xx xx xx xx	8	B, 32 bits		0	2	0	Energy; 0.1, 1, 10 kWh, 1, 10 MJ
User Data Records	§	Volume totalizer tarif 2	84 20,vo vo,xx xx xx xx	8	B, 32 bits		0	2	0	Volume; 0.001, 0.01 m3
User Data Records	§	Identification number 1	8C 40,79,xx xx xx xx	7	A, 32 bits		0	0	1	Identification number 1, BCD
User Data Records	§	Complementary counter 1 totalizer	84 40,co co,xx xx xx xx	8	B, 32 bits		0	0	1	Counter 1 ;
User Data Records	§	Identification number 2	8C 80 40,79,xx xx xx xx	8	A, 32 bits		0	0	2	Identification number 2, BCD
User Data Records	§	Complementary counter 2 totalizer	84 80 40,co co,xx xx xx xx	9	B, 32 bits		0	0	2	Counter 2 ;
User Data Records		Identification number 3	8C C0 40,79,xx xx xx xx	8	A, 32 bits		0	0	3	Identification number 3, BCD
User Data Records		Complementary counter 3 totalizer	84 C0 40,co co,xx xx xx xx	9	B, 32 bits		0	0	3	Counter 3 ;
User Data Records		Identification number 4	8C 80 80 40,79,xx xx xx xx	9	A, 32 bits		0	0	4	Identification number 4, BCD
User Data Records		Complementary counter 4 totalizer	84 80 80 40,co co,xx xx xx xx	10	B, 32 bits		0	0	4	Counter 4 ;
User Data Records		Identification number 5	8C C0 80 40,79,xx xx xx xx	9	A, 32 bits		0	0	5	Identification number 5, BCD
User Data Records		Complementary counter 5 totalizer	84 C0 80 40,co co,xx xx xx xx	10	B, 32 bits		0	0	5	Counter 5 ;
User Data Records		Identification number 6	8C 80 C0 40,79,xx xx xx xx	9	A, 32 bits		0	0	6	Identification number 6, BCD
User Data Records		Complementary counter 6 totalizer	84 80 C0 40,co co,xx xx xx xx	10	B, 32 bits		0	0	6	Counter 6 ;
User Data Records		**USER CUSTOM M-Bus**	Depends on user requested fields	§	**can be enabled or not (but not unavailable in a radio frame)**					
User Data Records		More records in next telegram	no	1	Special function: start of manufacturer specific data					
End		Check Sum	xx	1	See Note 2					
End		Stop	16	1	**§ max. 61 bytes**					

DIF 04 (arrow to Energy totalizer heating)

DIF 04, VIF 6D (arrow to Current date & time)

DIF 04 (arrow to Volume totalizer)

531 Notes

en en

Physical unit coding of energy :

VIF Choice

03	0.001 kWh
04	0.01 kWh
05	0.1 kWh
06	1 kWh
07	10 kWh
87 77	100 kWh
0E	1 MJ
0F	10 MJ
8F 77	100 MJ
80 3D	1 Btu

These VIF choices are fixed at one only, specific to the meter size and units. Check the meter LCD to verify units and resolution to be able to select the correct VIF setting, or analyse gateway Diagnostic reading display to identify which VIF is existing

vo vo

Physical unit coding of volume :

VIF Choice

13	0.001 m3
14	0.01 m3
15	0.1 m3
16	1 m3
93 3D	1 Usgallon

Gateway Data Base Structure

Gateway Point Types

Each point (AV4…253) must be configured to access the relevant M-Bus network device and data registers within the device. The points are grouped starting with a meter address point followed by a subset of data points associated with the preceding meter addressing point.

Point configurations always end with code lettering which indicate whether the point is an addressing point, a data point, a data point extension (additional four bytes of data needed for the preceding point address) and whether the reading is periodical as opposed to continuous.

HPE-BNMBUS Point Type	End Code	Description
Meter ID No. with AV active	…M	Indicates that the point config string is defining a Meter address with the common 'DVIF' data point result assigned to the associated gateway AV
Meter ID No. AV inactive	…A	Indicates that the point config string is defining a meter Address only, without the 'DVIF' data point result assigned to the associated gateway AV
Data Point	…D	Indicates that the point config string is defining a data point with in the previous meter address location
Data Extension Point	…X	Indicates that the point config string is a data capacity extension to the previous point. Any point with more than 4 bytes of data will require an X point added for every additional 4 data bytes
Timed Scan point	…_T	When appended to M, A, D or X types above, indicates that the point will be periodically scanned according to the TS setting (recommended)

Common DVIF

To enable the meter addressing point to also act as a data gathering point there is a common global point configuration available, the DVIF, the read value of which will be applied to all gateway points (AV) that have end code M.

Gateway Point Type	Global Point	Description
Data Point common to all M points	DVIF=…	Sets the data point address to read for every point configured as a meter address point (M)

The DVIF should be the first required point as it appears in the M-Bus device's RSP pages and ideally it should be possible to define it using DIF value only. If VIF must be used to avoid reading an sequentially earlier value which is not needed but which has identical DIF, the VIF should be identical for all of the devices on the network, i.e., it should not be a value who's VIF changes from device to device due to differing data resolution in the device.

If it is not possible to find a data point that meets the above criteria then assign M end code to those meter address points which most commonly have the same DIF/VIF but assign A end code to those meter address points which have the same DIF but different VIF. The AV of the meter address points with A end code assigned will become redundant and the required DIF/VIF setting in those cases should be applied to the first available AV following the their address point.

Gateway Point Structure

With the exception of the DVIF, the point configurations are made up of point (AV) number, four bytes of configuration plus the end codes.

Meter addressing AV's are up to four bytes, data point AV's are up to three bytes. The separate configuration elements of the DVIF or AV's are separated by commas (,).

If byte locations are fixed as 0, that will be signified in the following descriptions by red character **0**. As we explain the structure we will include previously explained settings and indicate those with no direct relevance in the explanation with **blue** characters.

Common DVIF

The DVIF setting configures the common meter data point address which will be attached to all meter address points (M end code).

The configuration starts with 'DVIF=' followed by up to three bytes of DIF/VIF addressing information and one spare byte.

Using the time/date data point from the RSP1 table on page 9.

DVIF=4,6D,0,0

Because there are no other data points above the time/date in the read out sequence starting with DIF 04 then this configuration can be simplified:

DVIF=4,0,0,0

If however the time/date is not required but energy with 1kWh resolution is applicable for all meters, so suitable as a common data point for all AV's used for meter addressing, then:

DVIF=4,6,0,0

The inclusion of the VIF 06 in the above configuration will ensure the gateway skips over the earlier data point with DIF 04, the time/date data point which has VIF 6D, and reads the energy data point which is the second point in the RSP read out sequence which has DIF 04.

Meter Address (M)

Primary Addressing

The M-Bus device addressing point may be configured for identifying a device based on the M-Bus Primary address (from 0…255) as set by the user of the Secondary address which is typically the device serial number.

Primary address configuration uses the first configuration byte to signify Primary address is being used by entering **P** in this byte. The fourth configuration byte is used to indicate the Primary address which may be a number from 0…255. Using Register 4 as example, with Primary address 12:

4=P,0,0,12,MT

The end code M configures the Register as a Meter addressing point so the resultant Register value read in will be according to the DVIF's data point address. The end code T means the point will be read according to the read cycle period TS.

Secondary Addressing

Secondary address configuration uses all four configuration bytes which may include wildcard F to speed the network meter identification using only a subsegment of a meter's serial numbers to a level of least significant numbers that are unique for all meters on the network.

Using serial number 7654321 as an example without wildcard:

4=7,65,43,21,MT

Using serial number 7654321 as an example with least significant three digits unique on the network wildcard F may be used:

4=FF,FF,F3,21,MT

Meter Address (A)

When the A end code is applied the primary or Secondary addressing format is the same as M end code instructions above except the DVIF data point is not assigned to the related AV (AV result = 0 at all times).

This A end code format is used when devices on a network are of mixed manufacture or mixed metering size and so it is not necessarily possible to define a sequentially-first data point that is common to all devices.

Data Point (D)

Data points required from within a meter are built up in sequence following a meter's addressing point when more data points are required in addition to the data point retrieved via the DVIF address which is attached to the meter addressing AV.

These data point AV's are constructed similar to the DVIF except they have end code D so that they are configured such that they are read from the meter address preceding them.

If we assume that the M point is utilising the DVIF set up for time/date data point (DVIF=4,0,0,0) and we want to read next the energy and volume from this meter:

DVIF=4,0,0,0
4=FF,FF,F3,21,MT
5=4,0,0,0,DT
6=4,0,0,0,DT

The end code D configures AV5 and AV6 as data points from within the preceding meter address. Because all the data points so far configured have DIF 04, are entered in the same sequence as they appear in the manufacturer's RSP table and do not have another point above them in the RSP table that starts with DIF 04 then only the DIF need be used because the gateway will simply read out the first three data points that it encounters which start with DIF 04.

Referencing again the RSP table on page 9; if time/date was not needed but 'Current Error Duration' was used as the DVIF, and energy & volume are to be read:

DVIF=34,0,0,0
4=FF,FF,F3,21,MT
5=4,6,0,0,DT
6=4,0,0,0,DT

In this case AV4 will return the current error duration time. AV5 has been set up as energy with 1kWh resolution (VIF 06) because if only DIF 04 was used then AV5 would read out the time/date data point as it is the first data point having DIF 04. Including VIF 06 ensures any unwanted data points having DIF 04 which are earlier in the sequence are skipped.

If time/date was not needed and energy was used as the DVIF because it's units 1kWh resolution is common to all devices on the network (VIF06), and volume is also to be read:

DVIF=4,6,0,0
4=FF,FF,F3,21,MT
5=4,0,0,0,DT

In this case AV4 will return the energy value related to the DVIF setting, skipping the previous data point with DIF 04 (time/date) because it includes VIF 06 in it's configuration, then volume is readout based on DIF only because it is the next data point with DIF 04, immediately after the energy data point.

Now an example having a second meter on the network, Secondary address 7654642 wildcarded to three least significant serial number digits, which also has energy with 1kWh resolution. Volume also to be read:

DVIF=4,6,0,0
4=FF,FF,F3,21,MT
5=4,0,0,0,DT
6=FF,FF,F6,42,MT
7=4,0,0,0,DT

AV4 returns energy from meter 7654321 based on the DVIF setting, AV5 returns volume from meter 7654321, AV6 defines meter 7654642 and returns energy based on the DVIF setting, AV7 returns volume from meter 7654642.

Here is an expanded example including further data points taken from RSP 2 (response page 2) of the SC531 energy integrator; high & low temperatures, flow rate and power, entered in sequence order as always. In the second meter the temperatures are not required to be read so the flow rate data point has the VIF included so as to skip the temperature points which have the same DIF as flow and power (DIF 05):

DVIF=4,6,0,0	*kWh for M data point with VIF included for 1kWh resolution*
4=FF,FF,F3,21,MT	*Meter Addressing point with kWh from, DVIF setting, at it's AV*
5=4,0,0,0,DT	*volume*
6=5,0,0,0,DT	*high temperature*
7=5,0,0,0,DT	*low temperature*
8=5,0,0,0,DT	*flow rate*
9=5,0,0,0,DT	*power*
10=FF,FF,F6,42,MT	*Meter Addressing point with kWh, from DVIF setting, at it's AV*
11=4,0,0,0,DT	*volume*
12=5,3E,0,0,DT	*flow rate **with VIF included***
13=5,0,0,0,DT	*power*

531 rsp_2

Respond with user data RSP_UD, Variable structure response (slave to master)

		Field	Frame bytes in hex	Bytes						
Header		Start, Length	#NAME?	4	See Note 1					
		Control	08	1	Respond with user data, RSP_UD					
		Address	xx	1						
		Control Information	72	1	Variable structure respond (mode 0: LSByte first)					
User Data Header				0	*Coding*					
		Identification number	xx xx xx xx	4	A, 32 bits					
		Manufacturer ID: "SON"	EE 4D	2	C, 16 bits					
		Generation of meter	0D	1	C, 8 bits					
		Measured media: Heat	04	1	D, 8 bits					
		Access number	xx	1	C, 8 bits					
		Status	xx	1	Ds, 8 bits					
		Signature (not used)	00 00	2	C, 16 bits					
				0	*Coding*	*Fun*	*Stora*	*Tar*	*Dev*	*Value Info*
	§	High temperature	05,5B,xx xx xx xx	6	H, 32 bits		0	0	0	Flow temperature; 1 °C
	§	Low temperature	05,5F,xx xx xx xx	6	H, 32 bits		0	0	0	Return temperature; 1 °C
	§	Flow	05,3E,xx xx xx xx	6	H, 32 bits		0	0	0	Volume flow; 1 m3/h
	§	Power	05,2B,xx xx xx xx	6	H, 32 bits		0	0	0	Power; 1 W
		Pt type	01,FF 07,pt	4	C, 8 bits		0	0	0	Manufacturer specific; PT type
	§	Pulse Factor	05,96 28,xx xx xx xx	7	H, 32 bits		0	0	0	Pulse factor ; m3/pulse
		Energy remainder	05,FF 01,xx xx xx xx	7	H, 32 bits		0	0	0	Manufacturer specific, Energy remainder; same unit as Energy tot.
		Volume remainder	05,FF 02,xx xx xx xx	7	H, 32 bits		0	0	0	Manufacturer specific, Volume remainder; same unit as Volume tot.
		Device write protect	01,FF 04,wp	4	D, 8 bits		0	0	0	Manufacturer specific

One more example; with differing VIF for energy so using A end code applied to the second meter:

DVIF=4,6,0,0	*kWh for M data point with VIF included for 1kWh resolution*
4=FF,FF,F3,21,MT	*Meter Addressing point with kWh, from DVIF setting, at it's AV*
5=4,0,0,0,DT	*volume*
6=5,0,0,0,DT	*high temperature*
7=5,0,0,0,DT	*low temperature*
8=5,0,0,0,DT	*flow rate*
9=5,0,0,0,DT	*power*
10=FF,FF,F6,42,AT	*Meter Addressing point with **inactive AV***
11=4,7,0,0,DT	*kWh with **VIF included for 10kWh resolution***
12=4,0,0,0,DT	*volume*
13=5,3E,0,0,DT	*flow rate **with VIF included***
14=5,0,0,0,DT	*power*

Note: In all cases where it is possible to define only the DIF we recommend that if you have the VIF information then it should also be defined to ensure the integrity of the data search.

Extension Point (X)

Data Extension points are only required if the preceding data point's read value contains more than 4 bytes of data. Each X point gives an extra 4 bytes of data capacity.

A data point which includes information that it has 32 bits of data (4 bytes) does not require an X point. A data point with more than 32 bits, say 64 bits will require one X point to follow the related D data point.

As a hypothetical example, assume the energy data has 6 bytes of data (1 X data point needed) and the volume data has 10 bytes (2 X data points needed):

DVIF=4,6,0,0
4=FF,FF,F3,21,MT
5=0,0,0,0,XT
6=4,0,0,0,DT
7=0,0,0,0,XT
8=0,0,0,0,XT

Only AV4 (energy) and AV6 (volume) need be read by the BMS as the gateway will automatically calculate the final data point values including the related X point values.

Time Scanned Point (T)

The end Code T sets that the point will be scanned every *n* minutes as set with TS= (Time Scan period).

The time scan period is particularly important when networking battery powered M-Bus devices which may require that they are read no more than once per day so as to conserve their battery life. In the case of once per day reading then TS=1440 (minutes).

In any case we recommend to use the T (time scan) configuration, setting the TS period to allow 15 seconds per meter; if four meters then set TS=1 (minute). If 10 meters then set TS=3, and so on.

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 M-Bus mapping Tool for creation of a table of data base settings which can be downloaded to the gateway as a text file (*.txt).

Copy the Point Configuration Text from the tool to Notepad text file and save for download to the gateway:

Complete one row at a time, starting at Row 13						HRW Limited	
STEP 1	STEP 2				STEP 3	v v SELECT v v	
						HPE-BNMBUS	
Data Format	Meter # (M) / Data Location (D or X) Byte 1	Byte 2	Byte 3	Byte 4	Scan Freq.	Point	Point Configuration Text
TS	5						TS=5
DVIF	4	6	0	0			DVIF=4,6,0,0
M	FF	FF	F3	21	TS Period	4	4=FF,FF,F3,21,MT
D	4	0	0	0	TS Period	5	5=4,0,0,0,DT
D	5	0	0	0	TS Period	6	6=5,0,0,0,DT
D	5	0	0	0	TS Period	7	7=5,0,0,0,DT
D	5	0	0	0	TS Period	8	8=5,0,0,0,DT
D	5	0	0	0	TS Period	9	9=5,0,0,0,DT
M	FF	FF	F6	42	TS Period	10	10=FF,FF,F6,42,MT
D	4	0	0	0	TS Period	11	11=4,0,0,0,DT
D	5	3E	0	0	TS Period	12	12=5,3E,0,0,DT
D	5	0	0	0	TS Period	13	13=5,0,0,0,DT
					TS Period	14	10000=13
					TS Period	15	

Untitled ... File Edit Format View Help

```
TS=5
DVIF=4,6,0,0
4=FF,FF,F3,21,MT
5=4,0,0,0,DT
6=5,0,0,0,DT
7=5,0,0,0,DT
8=5,0,0,0,DT
9=5,0,0,0,DT
10=FF,FF,F6,42,MT
11=4,0,0,0,DT
12=5,3E,0,0,DT
13=5,0,0,0,DT
10000=13
```

Terminal Operation

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

```
HPEBNM-BUS            BACnet M-BUS
1000) 98 1001)BN = 9600 1002)M-BUS = 2400 8E1 DI) 1098 MM) 127 SV) 0
  1)Resets = 0 0 8   2)BNErrors = 0    3)M-BUSErrors = 0
  4)IDNo =   P     0 DVIF = 0406    BACnetType = 24   Data = 000000002 S 16
  5)                 DVIF = 0413    BACnetType = 24   Data = 000000254 S 16
  6)                 DVIF = 055B    BACnetType = 44   Data = 41DED280 S 16
  7)                 DVIF = 055F    BACnetType = 44   Data = 41DE7E00 S 16
  8)                 DVIF = 053E    BACnetType = 44   Data = 00000000 S 16
  9)                 DVIF = 052B    BACnetType = 44   Data = 00000000 S 16
 Pt No = nn/P,nn,nn,nn,PointType  D Diag  P = Page No  TimeOut = 200 mSecs
 E MBUS Disabled TS = 10(10)Mins  TA = 100 mSecs  X to exit  W to write values
```

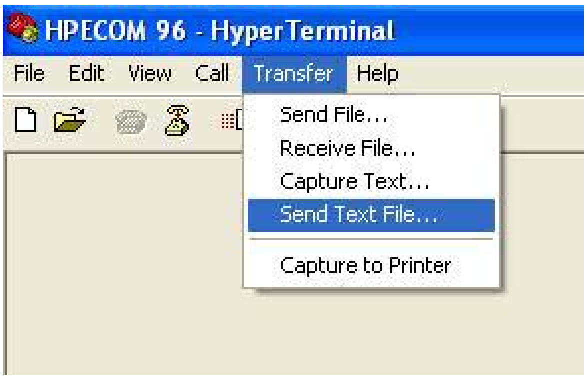
Make settings such as BACnet node, baud rate, DI and MM directly by entering the required settings. Note that after changing the BACnet baud rate the terminal mode baud rate is also changed so reconnect HyperTerminal at the newly set baud rate and then Write (W) the new setting.

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:

```
  HPE-BNMBUS V4.01          BACnet MBUS
1000) 5 1001)BN = 38400 1002)MBUS = 2400 8E1 DI) 1005 MM) 10 SV) 0
  1)Resets = 0 0 3    2)BNErrors = 0    3)MBUSErrors = 1
  4)IDNo =  P     0  DVIF = 046D     DATAType = 24   Data = 308613903 U 17
  5)                 DVIF = 04       DATAType = 24   Data = 2 U 17
  6)                 DVIF = 04       DATAType = 24   Data = 254 U 17
  7)                 DVIF = 05       DATAType = 44   Data = 41CB3F00 U 17
  8)                 DVIF = 05       DATAType = 44   Data = 41CC2900 U 17
  9)                 DVIF = 05       DATAType = 44   Data = 00000000 U 17
 10)                 DVIF = 05       DATAType = 44   Data = 00000000 U 17
Pt No = nn/P,nn,nn,nn,PointType  D Diag  P = Page No  TimeOut = 200 mSecs
E MBUS Disabled TS = 10(10)Mins  TA = 100 mSecs  X to exit  W to write values
 Blanking
 Ready
```

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-BNMBUS V4.01          BACnet MBUS
1000) 5 1001)BN = 38400 1002)MBUS = 2400 8E1 DI) 1005 MM) 10 SV) 0
  1)Resets = 0 0 4    2)BNErrors = 0    3)MBUSErrors = 0
  4)IDNo =  P     0  DVIF = 0406    DATAType = 00   Data = 00000000 U T 17
  5)                 DVIF = 04      DATAType = 00   Data = 00000000 U T 17
  6)                 DVIF = 05      DATAType = 00   Data = 00000000 U T 17
  7)                 DVIF = 05      DATAType = 00   Data = 00000000 U T 17
  8)                 DVIF = 05      DATAType = 00   Data = 00000000 U T 17
  9)                 DVIF = 05      DATAType = 00   Data = 00000000 U T 17
Pt No = nn/P,nn,nn,nn,PointType  D Diag  P = Page No  TimeOut = 200 mSecs
E MBUS Disabled TS = 10(10)Mins  TA = 100 mSecs  X to exit  W to write values
```

The download above is one meter using Primary address 0 & DVIF 04,06,0,0 assigned to the M point. All points are as yet unread (U) on TS period operation (T) and at BACnet priority 17 (NULL priority).

Enable M-Bus Port

Enter E to enable the M-Bus 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.

Scan M-Bus Network

In terminal mode any scanning of the M-Bus 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 M-Bus devices and data points).

```
  HPE-BNMBUS V4.01          BACnet MBUS
1000) 5 1001)BN = 38400 1002)MBUS = 2400 8E1 DI) 1005 MM) 10 SV) 0
  1)Resets = 0 0 5    2)BNErrors = 0    3)MBUSErrors = 1
  4)IDNo =  P     0  DVIF = 0406    DATAType = 24    Data = 2 S T 17
  5)                 DVIF = 04      DATAType = 24    Data = 254 S T 17
  6)                 DVIF = 05      DATAType = 44    Data = 41CDBA80 S T 17
  7)                 DVIF = 05      DATAType = 44    Data = 41CE3E00 S T 17
  8)                 DVIF = 05      DATAType = 44    Data = 00000000 S T 17
  9)                 DVIF = 05      DATAType = 44    Data = 00000000 S T 17
 Pt No = nn/P,nn,nn,nn,PointType  D Diag  P = Page No  TimeOut = 200 mSecs
 E MBUS Disabled TS = 10(10)Mins  TA = 100 mSecs  X to exit  W to write values
```

After refresh, instead of U for unread the points now indicate S to indicate 'Scanned'.

AV4=2 (kWh)
AV5=0.254 (m^3)
AV6= high temperature in IEEE coding
AV7= low temperature in IEEE coding
AV8= flow rate (no flow present)
AV9= power (no power due to no flow)

To see the IEEE floating point values (temperatures) in decimal coding enter D for Diagnostic display.

Diagnostic Display

The Diagnostic display serves two purposes; display read values in decimal coding if not already decimal and to provide a real time feedback of the network activity for identifying incorrect data point addresses.

```
  HPE-BNMBUS V4.01          BACnet MBUS
1000) 5 1001)BN = 38400 1002)MBUS = 2400 8E1 DI) 1005 MM) 10 SV) 0
  1)Resets = 0 0 5    2)BNErrors = 0    3)MBUSErrors = 14
  4)IDNo =  P     0  DVIF = 0406    DATAType = 24    Data = 2 S T 17
  5)                 DVIF = 04      DATAType = 24    Data = 254 S T 17
  6)                 DVIF = 05      DATAType = 44    Data = 41C9DA00 S T
                                                   25.231445 17
  7)                 DVIF = 05      DATAType = 44    Data = 41C9EC00 S T
                                                   25.240234 17
  8)                 DVIF = 05      DATAType = 44    Data = 00000000 S T
                                                   0.000000 17
  9)                 DVIF = 05      DATAType = 44    Data = 00000000 S T
                                                   0.000000 17
 Pt No = nn/P,nn,nn,nn,PointType  D Diag  P = Page No  TimeOut = 200 mSecs
 E MBUS Disabled TS = 10(10)Mins  TA = 100 mSecs  X to exit  W to write values
```

In Diag display the temperatures can be seen to be 25.23°C and 25.24°C respectively.

With Diag display already active, now when you press Enter to force a network scan you will see the communication gateway requests and device response, including the gateway's recognition of required data point values.

```
 Normalise
   4 =1040004016 R1 E5
 Request Data
   4 =107B007B16 R3 CA CA CRC OK
Looking for DVIF = 04 06
 68 4B 4B 68 08 00 72 50 15 28 08 EE 4D 0D 04 74 00 00 00
 02 DIF FD 17 VIF  Data2 00 00
 34 DIF 75 VIF  Data4 C7 C5 01 00
 04= DIF  6D VIF  Data4 36 14 65 12
 04= DIF  06= VIF  02 ReadData4 X0 02 00 00 00
Looking for DVIF = 04
 68 4B 4B 68 08 00 72 50 15 28 08 EE 4D 0D 04 74 00 00 00
 04= DIF  13 VIF  FE ReadData4 X0 FE 00 00 00
Looking for DVIF = 05
 68 4B 4B 68 08 00 72 50 15 28 08 EE 4D 0D 04 74 00 00 00
 8C 40 DIF 79 VIF  Data4 01 00 00 00
 84 40 DIF 14 VIF  Data4 00 00 00 00
 8C 80 40 DIF 79 VIF  Data4 02 00 00 00
 84 80 40 DIF 14 VIF  Data4 00 00 00 00

  LookNextDataPage 1F CA 16

 Request Next Data Page
```

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:

```
Normalise
   4 =1040004016 R1 E5                                  Prepare meter with Primary address 0
 Request Data
   4 =107B007B16 R3 DA DA CRC OK
Looking for DVIF = 04 06                                kWh with VIF included (1kWh resolution)
 68 4B 4B 68 08 00 72 50 15 28 08 EE 4D 0D 04 7A 00 00 00
 02 DIF FD 17 VIF  Data2 00 00
 34 DIF 75 VIF  Data4 CC C5 01 00
 04= DIF  6D VIF  Data4 3B 14 65 12               Correct DIF, incorrect VIF
 04= DIF  06= VIF  02 ReadData4 X0 02 00 00 00    OK! Read value '2 (X0 = no eXtension points)
Looking for DVIF = 04                                   Next with DIF 04, the volume
 68 4B 4B 68 08 00 72 50 15 28 08 EE 4D 0D 04 7A 00 00 00
 04= DIF  13 VIF  FE ReadData4 X0 FE 00 00 00     OK! FE (HEX) = 254
Looking for DVIF = 05                                   Next with DIF 05, High temperature
 68 4B 4B 68 08 00 72 50 15 28 08 EE 4D 0D 04 7A 00 00 00
 8C 40 DIF 79 VIF  Data4 01 00 00 00
 84 40 DIF 14 VIF  Data4 00 00 00 00
 8C 80 40 DIF 79 VIF  Data4 02 00 00 00
 84 80 40 DIF 14 VIF  Data4 00 00 00 00
  LookNextDataPage 1F DA 16                             No DIF 05 found so request next page
 Request Next Data Page
   6 =105B005B16 R3 EC EC CRC OK
Looking for DVIF = 05                                   High temperature found!
 68 77 77 68 08 00 72 50 15 28 08 EE 4D 0D 04 7B 00 00 00
 05= DIF  5B VIF  00 ReadData4 X0 00 61 C4 41
Looking for DVIF = 05                                   Next with DIF 05, Low temperature
 68 77 77 68 08 00 72 50 15 28 08 EE 4D 0D 04 7B 00 00 00
 05= DIF  5F VIF  00 ReadData4 X0 00 35 C4 41     Low temperature found!
Looking for DVIF = 05                                   Next with DIF 05, Flow rate
 68 77 77 68 08 00 72 50 15 28 08 EE 4D 0D 04 7B 00 00 00
```

```
 05= DIF  3E VIF  00 ReadData4 X0 00 00 00 00
Looking for DVIF = 05
 68 77 77 68 08 00 72 50 15 28 08 EE 4D 0D 04 7B 00 00 00
 05= DIF  2B VIF  00 ReadData4 X0 00 00 00 00
```

Flow rate found!
Next with DIF 05, Power
Power found!

After last configured point is found resolve back to summary display with found results:

```
HPE-BNMBUS V4.01           BACnet MBUS
1000) 5 1001)BN = 38400 1002)MBUS = 2400 8E1 DI) 1005 MM) 10 SV) 0
  1)Resets = 0 0 5    2)BNErrors = 0    3)MBUSErrors = 18
  4)IDNo =  P     0  DVIF = 0406    DATAType = 24   Data = 2 S T 17
  5)                 DVIF = 04      DATAType = 24   Data = 254 S T 17
  6)                 DVIF = 05      DATAType = 44   Data = 41C46100 S T
                                                  24.547363 17
  7)                 DVIF = 05      DATAType = 44   Data = 41C43500 S T
                                                  24.525878 17
  8)                 DVIF = 05      DATAType = 44   Data = 00000000 S T
                                                  0.000000 17
  9)                 DV F = 05      DATAType = 44   Data = 00000000 S T
                                                  0.000000 17
 Pt No = nn/P,nn,nn,nn,PointType  D Diag  P = Page No  TimeOut = 5 Secs
 E MBUS  Enabled TS = 1(1)Mins   X to exit  W to write values
```

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

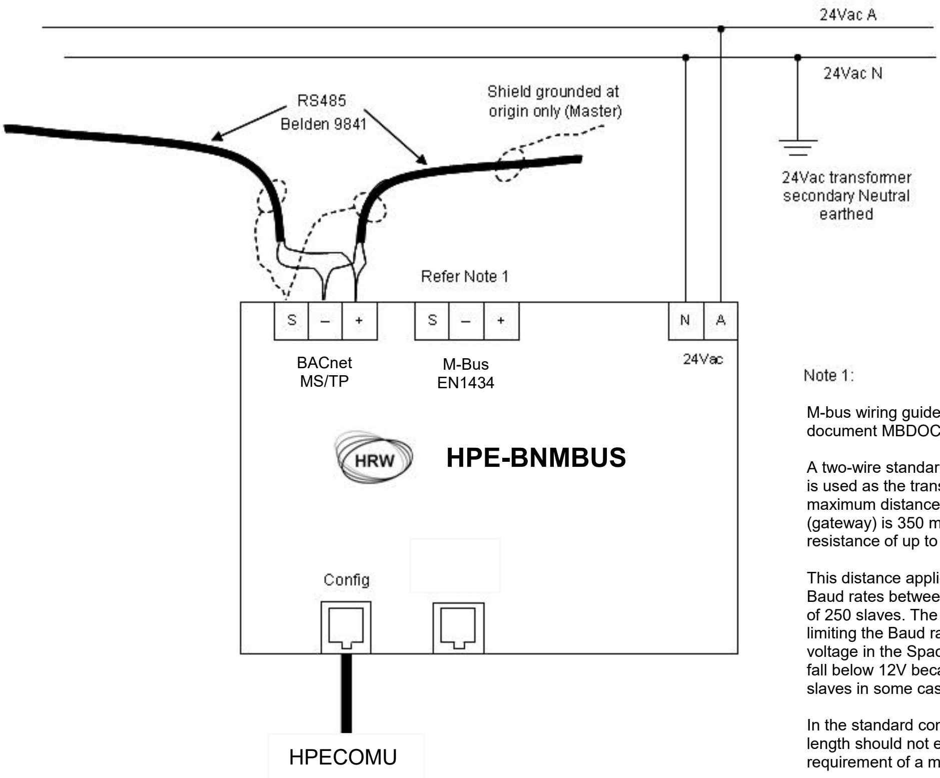
M-Bus

- **Pre April 2010 hardware versions:** To avoid damage to the M-Bus communication drive chip always ensure that there are no short-circuits on the M-Bus network before connecting to the M-Bus port and applying power. When it is confirmed that the M-Bus is free of shorts you may connect the 24Vac supply (devices after April 2010 include short-circuit protection on the M-Bus port).

- After connection of the supply check that the voltage at the M-Bus terminals is approximately 36Vdc

- Please contact us for M-Bus wiring recommendations

Connections



Note 1:

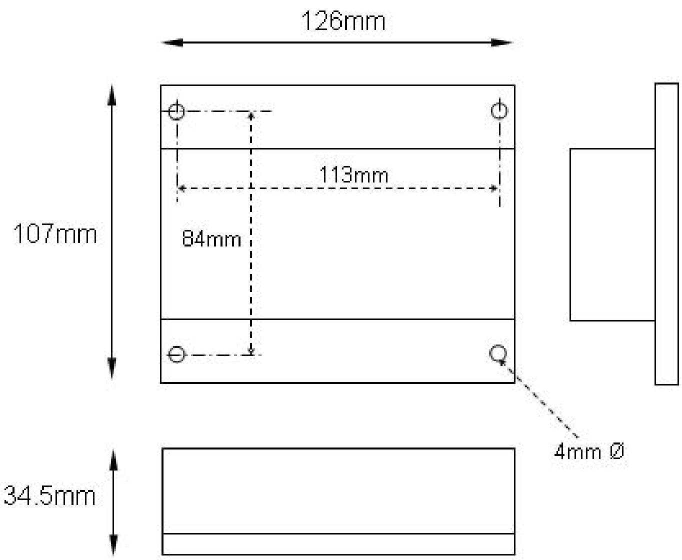
M-bus wiring guideline extracted from www.m-bus.com, document MBDOC48, page 16;

A two-wire standard telephone cable (JYStY N*2*0.8 mm) is used as the transmission medium for the M-Bus. The maximum distance between a slave and the repeater (gateway) is 350 m. This length corresponds to a cable resistance of up to 29Ω.

This distance applies for the standard configuration having Baud rates between 300 and 9600 Baud, and a maximum of 250 slaves. The maximum distance can be increased by limiting the Baud rate and using fewer slaves but the bus voltage in the Space state must at no point in a segment fall below 12V because of the remote powering of the slaves in some cases.

In the standard configuration the total cable length should not exceed 1,000m in order to meet the requirement of a maximum cable capacitance of 180nF

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	RS485 - 2400, 4800, 9600, 19200, 38400, 57600, 76800 baud
RS485 Network Capacity	256 nodes over max. 1.2km without repeater
M-Bus Comms Speed	1200, 2400, 4800, 9600 baud
M-Bus Driver Capacity	40 M-Bus loads
Power Supply	24Vac, 50/60 Hz, max. 7.5VA
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-BNMBUS

Description:	250 point gateway – BACnet MS/TP integration of M-Bus EN1434-3 devices - for control panel mounting
Standard package:	40 units per carton

Accessories

HDA0002	DIN rail adapter brackets, factory fitted
HPECOMU	Configuration cable (USB <> RJ11)

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-BNMOD	BACnet gateway for Modbus devices, 250 point, 24Vac
HPE-BNMR10	BACnet gateway for one Modbus device, 10 long registers (20 registers), c/w CT & PT ratio setting option, 24Vac
HPE-BNPMAC	BACnet module for Pilot PMAC770 power analyser (panel meter)
HPE-BNSMA	BACnet gateway for SMA inverters (solar, wind), 24Vac

Notes: