HPD0460BN Multi-Function Room Units, BACnet MS/TP

FW4.02

The HPD0460BN devices may be used as BACnet networked HVAC devices or standalone; as an HMI for control and display of multiple controllers on a local network, as a controller with high flexibility for user configuration to suit a wide variety of control applications or as a network manager including multi-zone annual time scheduling. The display is programmable to indicate user specific text and dynamic data points. Data points may be adjusted directly at the LCD (parameters such as set-points, fan-speeds and manual overrides). The text and dynamic values for each of the 32 user lines may be set as small font size or large font size.

The user push-buttons, indication LED's and an audible sounder may be independently programmed to suit the user application. Physical I/O points may be used in the system independently or, subject to the version, by the internal control loops and logic blocks.

Depending on the version, logic function blocks enable easy configuration of a variety of functions including Economy Changeover (temperature or enthalpy), VAV Volume, Occupancy, Hours Run monitoring, Minutes Run monitoring, Lead/Lag changeover, instantaneous Power calculation (kW, BTU) and a wide array of hysteresis & dead-band/live-band choices (Compare function).

The time clock version features a 365 day clock/calendar with four channel time-switch, 20 holidays (one-off or annually recurring) and summer/winter time.

Common Features

- 32 line user programmable dot matrix LCD display with pop-up alarm text feature
- 1 Room temperature sensor on-board
- 1 Input programmable as DI or 10k NTC
- 2 Universal inputs (DI, 10k NTC, 100k NTC, 0-10Vdc or 4…20mA)
- 6 Digital outputs (ON/OFF, single or multi stage, 3-point floating, PWM)
- 4 User programmable operator buttons
- 4 User programmable indication LED's
- 1 User programmable audible alert beeper
- 48 Network Interface Objects (NIO's) for Peer-to-Peer communication
- 8 Virtual Digital Inputs (VDI)
- 8 Virtual Universal Inputs (VUI)

Typical Applications

- Temperature, humidity, pressure, IAQ, universal
- On/off, 3-point modulating, PWM (Pulse Width Modulation), step control, DX
- Residential, Commercial, Hotels
- Local User Interface, network interface, networked or standalone controller
- Time-clock & calendar / time-switch, networked or standalone

Versions

HPD0460BN	Network HMI, 10 Point, 24Vac
HPD0460BNC	Network HMI / Universal Controller, 10 Point, 24Vac
HPD0460BNCT	Network HMI / Universal Ctrl / Scheduler, 10 Point, 24Vac
HPD0460BNT	Network HMI / Scheduler, 10 Point, 24Vac

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Feature Summary

- 6 Digital Outputs (DO) with power up presetting
- 1 NTC 10k temperature sensor internal (UI1)
- 1 Universal input (UI) fixed NTC 10k or DI n/o or n/c (UI2)
- 2 Universal Inputs (UI - user configurable analogue [AI] or binary [DI, n/o or n/c])
- 8 Virtual Digital Inputs (VDI)
- 8 Virtual UI's (VUI)
- 8 Digital Logic blocks (DL) © 🕓
- 8 Analogue Logic blocks (AL) © 🕓
- 8 PI Control Loop blocks (CL) ©
- 48 Network Interface Objects (NIO) for peer-to-peer connectivity
- 32 user programmable LCD lines (text and dynamic point per line)
- UI's user scalable and units user settable (C, F, rH, %, Pa, kPa, PPM, etc.)
- Connected sensors may be calibrated and filtered by way of the UI configuration
- DO change-of-state delay timer (short cycle timer)
- 365 day time clock & calendar 🕓
- 20 holidays, recurring or one-off event 🕓
- Summertime/Wintertime 🕓
- 4 Channel time switch 🕓
- 4 Push buttons, programmable to suit application (DI1, DI2, DI3, DI4)
- 4 Navigation buttons, up/down/right/left (DI5, DI6, DI7, DI8)
- 4 LED's, indication programmable to suit application (DO7, DO8, AO1, AO2)
- Audible alarm programmable to suit application (AO3)
- LCD Backlight, 60 sec after any button press
- Isolated, 256 node (1/8th load), RS485 network driver
- Communication speeds from 2400 baud up to 76800 baud
- System-wide unique device addressing
- BACnet application services; Single-Read, Multiple-Read, Single-Write, Who Is, I Am, Who Has, I Have
- BACnet priority array
- Automatic communication resumption after a power loss
- PC configuration by text file download using FUNCPROG or by direct parameter settings entry
- Upload text file data for retrieving lost application settings, for re-use in other controllers

© = Available in Controller versions 🕓 = Available in Time Clock versions

Operation Overview

All physical inputs, outputs and internal logic & control function blocks, and critical control loop parameters are numerically represented as an 'Object'. The object is a function block's output value. Depending on the purpose of a function block the object may have a range of sub-parameters available for defining the block's function and the operational features & limitations of the function. In the case of control loops the active set point, the proportional band and the integral time sub-parameters are also represented as objects for network access and remote tuning of a control loop if required.

In this document the term 'Objects' will mainly be used in the context of BACnet networks but will otherwise be referred to as a 'point' or 'points' when discussing specific control applications.

The process of setting up function blocks and connecting function blocks to form an application uses simple text lines therefore it is not necessary to learn a complex programming language. The settings may be manually typed in to the device or, using the **FUNCPROG 141101** programming tool which provides a visual representation of each block, an application text file may be created, saved and downloaded to the device as a complete group of settings. Earlier versions of FuncProg may be used but the latest feature settings will not be directly available in those earlier versions.

The ability to make single setting changes directly at the device makes for easy debugging and commissioning.

The function blocks comprise:

- Physical I/O for connection of input switches, sensors and output control devices
- Virtual inputs for taking over external commands and values from other network devices or for manual settings and overrides
- Logic blocks for event based reactions and influences © 🕓
- PI Control Loop blocks for set point based control reactions ©
- Time Switch channels 🕓
- Network settings

In all cases points may be manually overridden for testing & commissioning purposes or for service override. In respect of BACnet priority arrays manual overrides are Priority 9 (factory default = Null / internal program control = 16).

Connection to the device for programming and service is via a terminal program such as HyperTerminal (recommended). While on-line to the device it is possible to view point statuses and where applicable, any dependent or influencing point's connections. Statuses are updated live to the terminal screen every 10 seconds or manually refreshed any time by pressing the enter key.

In additional to the predefined point displays a user-defined display is available for a customised point summary related to an application. The user display may contain up to 32 lines of user text with or without dynamic points included.

In the base HPD0460BN version which is without PI controller or time clock functions, the physical inputs may be read from other controllers on the network and the outputs may be driven by other controllers on the network. This means the HPD0460BN may be used as a user interface to a single controller or as a user interface to multiple controllers on the network.

The HPD0460BNC, T and CT versions feature control and/or logic and/or time-switching capabilities which enable them to work as controllers in their own right, either locally or providing control to remote controllers and I/O expansion devices. In all versions the user has the freedom to specify own display text in up to 32 lines with or without dynamic object displays. Text lines may be programmed to be invisible until a specific object (or group of objects) met a predefined criteria at which time the text will 'pop-up' at the top of the display. When the predefined criteria is no longer true then the text will no

longer be displayed. This feature is designed for use as alarm indication and can be used together with the programmable LED's and audible beeper to raise attention to an alarm situation.

BACnet Object Instances

Up to 110 function blocks exist in the device depending on the version. Because many objects may be Binary or Analogue, and may be seen as an Input, an Output or a Value, the final total of discoverable and device relevant object instances may be up to 124.

- A physical universal input (UI) may be an AI (Analogue Input) or AV (Analogue Value) but when used as a digital input then it's object instance would be a BV (Binary Value)
- A Virtual Universal Input (VUI) is seen as an AV (Analogue Value)
- A physical digital output is a BO (Binary Output) by default but if programmed for PWM control, which has a control value of 0…100%, then it is seen as an AV (Analogue Value)

Using UI3 as an example:

Description:	Physical universal input
Object #:	19
Object Instance when binary DI:	BV19
Object Instance when analogue sensor:	AI19 or AV19

Using AL1 as an example:

Description:	Analogue Logic block
Object #:	53
Object Instance when Digital function:	BV53
Object Instance when Analogue function:	AV53

The common reference in all cases is the object # therefore during device Object Discovery over the network the option of Input, Output or Value is decided based on the programmed application use of the object in question.

BACnet Priority Array

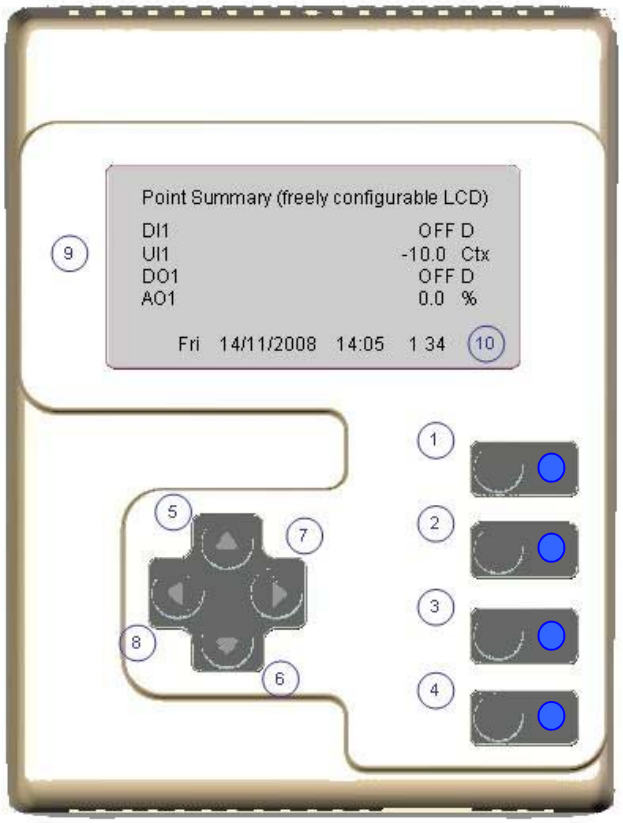
The BACnet protocol utilises a Priority Array for each object to enable various network devices to take control of a device's object based on the level of need. Priority 16 is the least significant level and may be considered normal 'Auto' operating level. Priority 1 is the highest control level, generally used for emergency control under fire condition or similar events.

In respect of this device:

- The objects are null priority by default
- Commands from the internal control program of the device are at priority level 16
- Manual commands via terminal mode operate at priority level 9
- Release of a manual results in an object reverting to next lowest and still valid priority level
- Commands from the network to DO, AO, VUI and VDI objects are remembered after a power reset if priority 1…8
- Commands from the network to Proportion Band & Integral Time points of Control Loops are written to those objects if other than null priority

User Interface

The illustration below shows a factory default HPD0460BNCT (full controller & time-clock functionality)



1 – Button 1 / LED 1

2 – Button 2 / LED 2 **All LED's invisible unless active**

3 – Button 3 / LED 3

4 – Button 4 / LED 4

5 – LCD scroll UP / adjust value UP

6 – LCD scroll DOWN / adjust value DOWN
(hold continuous to access clock setting)

7 – LCD select value for adjustment / Write value

8 – LCD release manualled value to AUTO

9 – LCD user display

10 – Calendar/Clock/Time Switch channels status

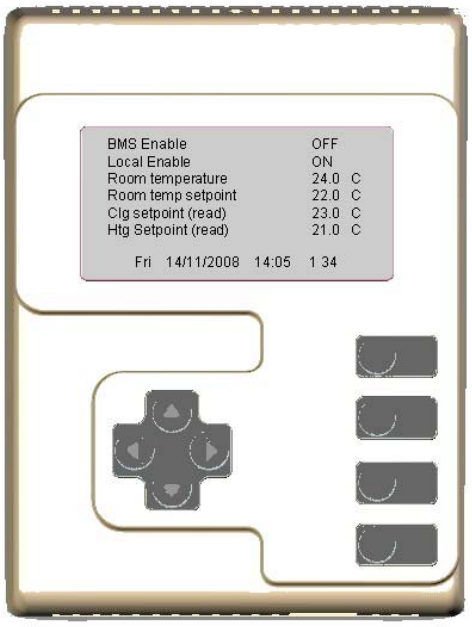
Using HyperTerminal the display may be customised either by manual configuration or download of an application text-file.

- Up to 32 display lines
- Small or large font
- Up to 21 text characters per line (small font)
- Each display line may include a dynamic point
- The dynamic point's unit tag may be customised

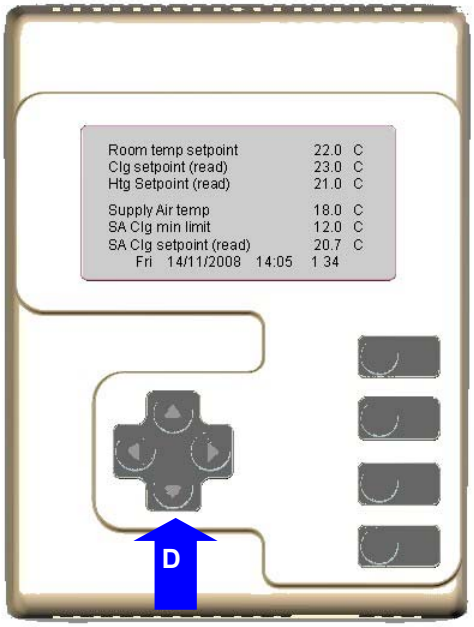
The time switch display above indicates '1 34' which tells us that switch channels 1, 3 & 4 are ON

Interface Operation

After download of an application text-file the HPD0460 screen may appear as in the following example:

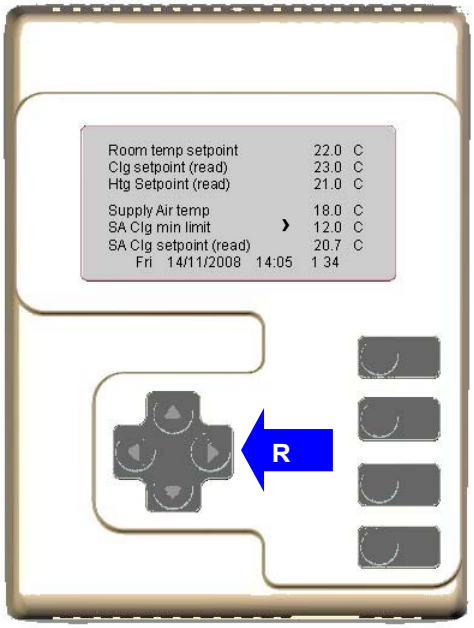


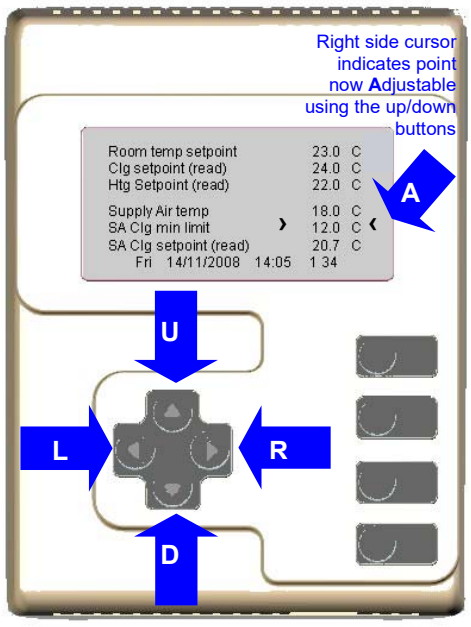
Press the down navigation button **(D)** to scroll down to see up to 32 lines of user display:



Press the up or down button to scroll through display lines. A press of the right button **(R)** makes cursor aligned point available for adjustment **(A)** via the up and down buttons **(U/D)**. To save the change press and hold the right button **(R)** until a beep is heard. To exit adjustment mode without saving the change press the left button **(L)**.

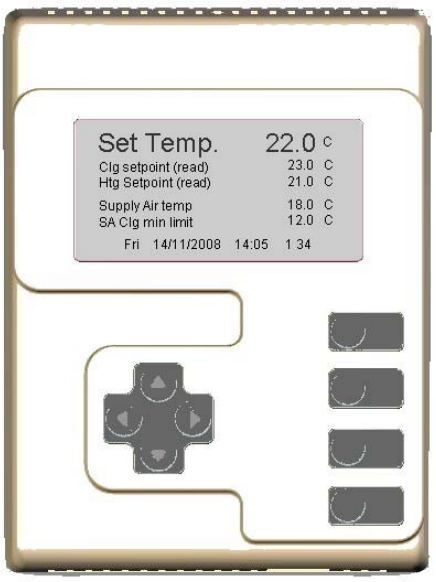
Exiting a set point adjustment without saving the change will result in the start up default being retained after a power reset. If an output is being manualled via the LCD and the change is to be a start-up default then after making the adjustment press and hold the right button until the a beep is heard. To release a **M** (Manualled) point back to auto align the cursor with the point and press the left button.





Large Font Display

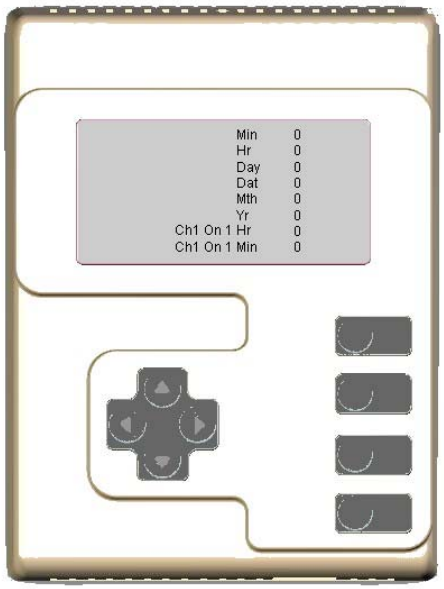
Any of the 32 display lines may be programmed for large font. Below are two example display possibilities using both standard and large fonts



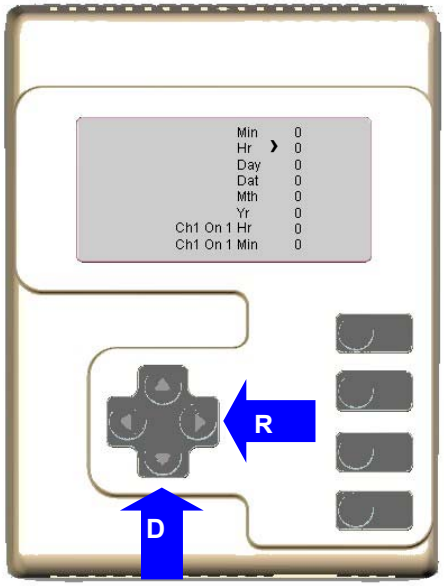
Clock & Time-switch Setting

In versions with 365 day time-clock & four-channel time-switch.

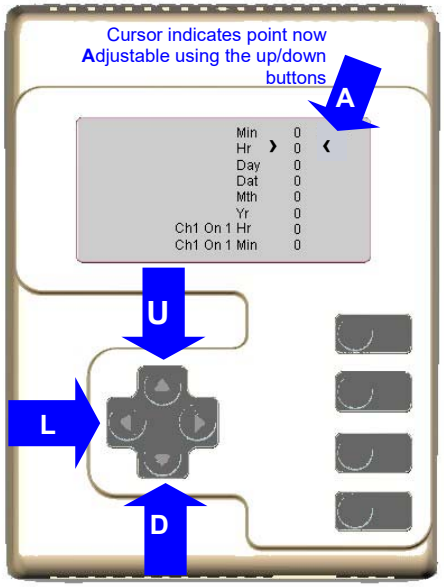
- Each time switch channel has two On times and two Off times available per day
- Twenty holidays, either recurring annually or one-off events, may be programmed
- Each time switch channel may be applied to any days of the week combination, and/or exception day 8 which is active on holidays
- Wintertime/Summertime shift may be set to occur automatically
- European or North American date format may be set



To enter the clock setting mode press and hold the down button **(D)** until the display shown below is visible (15sec). Scroll so that the line cursor is aligned with the desired setting line then press the right button **(R)** to select the value for adjustment



Press the up or down buttons **(U/D)** to adjust the setting. Press the left button **(L)** to save the exit adjustment of the current clock parameter.



A long press of the left button **(L)** after making all settings will exit back to the normal display. Saving of the new clock settings will be confirmed by a beep being heard.

Notes:

- Hours may be set in the range 0…23
- Minutes may be set in the range 0…59
- Holiday date setting with year =0 will occur every year
- Holiday date setting with year >0 will occur once only, in the set year

Function Block Objects & Sub-Parameters

The following is an overview of the function block features and options. For in-depth description of function choices and their use please also download or request the separate **FUNCPROG Application Tool** document.

Function Block	Object	Para #	Description	Selection Options
Digital Input 1…4	1…4	x00= x01= x02=	Buttons 1…4, input type Output OR Output AND	7 - Digital, 14 - n/c, 15 - Toggle on/off Object # Object #
Digital Input 5…8	5…8	x00=7	Navigation buttons	Fixed, dedicated to Up, Down, Right, Left respectively
Digital Output 1…6 *Parameters 00…05:* © 🕓 *Parameters 06…09:* *Available on all versions*	9…14	(x)x00= (x)x01= (x)x02= (x)x03= (x)x04= (x)x05= (x)x06= (x)x07= (x)x08= (x)x09=	OR1 OR2 AND PWM cycle time (sec) ON OFF Minimum ON time (sec) Minimum OFF time (sec) Maximum Run time (sec) Remember last state at power return	Object # Object # Object # 0…255 % of control loop demand % of control loop demand 0…255 0…255 0…1000 0 - Disable, 1 Enable
LED 1 & 2 (Digital Output 7…8)	15…16	(x)x00= (x)x01= (x)x02= (x)x03= (x)x04= (x)x05= (x)x06= (x)x07= (x)x08= (x)x09=	OR1 OR2 AND PWM cycle time (sec) ON OFF Minimum ON time (sec) Minimum OFF time (sec) Maximum Run time (sec) Remember last state at power return	Object # Object # Object # 0…255 % of control loop demand % of control loop demand 0…255 0…255 0…1000 0 - Disable, 1 Enable
Universal Input 1	17	1700=5	Fixed NTC 10k internal	5 - 10k NTC (-10…90°C) [Ctx]
Universal Input 2	18	1800=	Sensor type	5 - 10k NTC (-10…90°C) [Ctx] 7 - DI [D] 14 – DI n/c [DNC] 15 - Toggle on/off [D T]
Universal Input 3…4	19…20	xx00=	Sensor type	0 - 100k NTC (-10…90°C) [Ctc] 2 - 0-10Vdc (0…100%) [%V1] 3 - 4…20mA (0…100%) [%mA] 5 - 10k NTC (-10…90°C) [Ctx] 7 - DI [D] 8 - % (0-100%) [%] 9 - Seconds [Sec] 14 - Digital normally-closed [DNC] 15 - Toggle on/off [D T]
Common settings of UI 1…4		xx01=	Input calibration - Offsets the measured value up to 10% of the sensor range	Any value within 10% of the sensor range
		xx02=	Filter incoming sensor measurement when the connected sensor is unstable	0 - Minimum (factory default) 1…9 - User setting where 9 represents the maximum filtering sample time For unstable sensors then a setting of 1 or 2 will typically be enough filtering to result in a stable measurement
		xx03= xx04=	Output OR* Output AND*	Object # Object #

* Digital 1 = 1000 (100%) when applied to these analogue logic functions. Analogue values will act as a Output Minimum when applied to an Output OR and Output Maximum when applied to an Output AND.

Function Block	Object	Para #	Description	Selection Options
LED 3 & 4 ✞ (Analogue Output 1…2) *Parameters 00…04:* © 🕓	25…26	xx00= xx01= xx02= xx03= xx04=	OR1 OR2 AND 100% 0%	Object # Object # Object # % of control loop demand % of control loop demand
Audible alarm beeper ✞ (Analogue Output 3) *Parameters 00…04:* © 🕓	27	xx00= xx01= xx02= xx03= xx04=	OR1 OR2 AND 100% 0%	Object # Object # Object # % of control loop demand % of control loop demand
Virtual Digital Input 1…8	29…36	x01= x02=	Output OR Output AND	Object # Object #
Digital Logic 1…8 © 🕓	37…44	xx00= xx01= xx02= xx03= xx04= xx05= xx06= xx07= xx08= xx09=	Function Input1 Input2 Input3 Input4 Delay On Delay Off Output OR* Output AND* Occupancy	OR, NOR, AND, NAND, XOR, NXOR, Lead/Lag, Occupancy Object # Object # Object # Object # 0…44 or 53…65,535 sec, or Point # 45…52 for remote settable Object # Object # Object #
Virtual Univ. Input 1…8	45…52	xx00= xx01= xx02=	Set sensor type Output OR* Output AND*	Same as UI selection Type 0… 9, 10 - Hours Run, 11 – Minutes Run Object # Object #
Analogue Logic 1…8 © 🕓	53…60	xx00= xx01= xx02= xx03= xx04= xx05= xx06= xx07= xx08= xx09= xx10= xx11= xx12=	Function Set output-relevant sensor type Input1 Input2 Input3 Input4 Offset Value In 1 Value Out 1 Value In 2 Value Out 2 Output OR * Output AND *	Max, Min, Avg, Signal-Select, +, -, *, /, or Eco-Changeover, Proportion, VAV Volume, Up/Down counter, Power, Compare Same as UI selection Object # Object # Object # Object # Relative value Shift input start value Shifted output minimum value Shift input stop value Shifted output maximum value Object # Object #
Control Loops 1…8 ©	61…68	Read only	Setpoint	Absolute value
	69…76	xx00= xx01= xx02= xx03= xx04= xx05= xx06= xx07= xx08= xx09= xx10=	Start/Stop (Dig/Analogue) Input (Analogue) Occupied Setpoint Unoccupied Setpoint Protection Setpoint SetPoint Deadband Setpoint Max. Setpoint Min. Output action Output OR * Output AND *	Object # Object # Absolute value Absolute value Absolute value Relative value Absolute value Absolute value 0 – Direct, 1 – Reverse, 2 – Direct 50, 3 – Reverse 50 Object # Object #
	77…84	xx=	Proportional Band	Absolute value based on related sensor range
	85…92	xx=	Integral time	0…1000 Seconds
Clock Channels 1…4 🕓	101…104	xxx00= xxx01=	Output OR Output AND	Object # Object #

* Digital 1 = 1000 (100%) when applied to these analogue logic functions. Analogue values will act as a Output Minimum when applied to an Output OR and Output Maximum when applied to an Output AND.

Function Block	Object	Para #	Description	Selection Options
Network Interface Objects (NIO)	105…112	xxx00=	Target node number	Device # in the same network
		xxx01=	Object Instance type	0 - Disabled 1 - DI 2 - DV 3 - DO 4 - AI 5 - AV 6 - AO
		xxx02=	Target Object Instance within target node	1…65,535
		xxx03=	Sensor type	Same as UI selection
		xxx04=	Read/Write	0 = Read status of target Instance of target node 1…112 = Write local Instance status to target Instance of target node
		xxx05=	Read-Value Scaling	0 – Normal (apply Sensor Type units only), 1 - Raw (apply Sensor Type units, intercept & scaling)
		xxx06=	Output OR *	Object #
		xxx07=	Output AND *	Object #

* Digital 1 = 1000 (100%) when applied to these analogue logic functions. Analogue values will act as a Output Minimum when applied to an Output OR and Output Maximum when applied to an Output AND.

✞ LED 3 & 4 and the audible beeper have a fixed 5sec PWM cycle time with 1sec resolution. Therefore if digital 1 or 100% is applied then the LED/beeper will be on continuously. If 60% applied then the LED/beeper will be on for 3sec, off 2sec, on 3sec, and so on. The minimum applied value for an output reaction is 20% (1sec on, 4sec off). In HPD0460BN these outputs may be driven by peer-to-peer controllers on the network or via the internal NIO's reading in object values from other controllers on the network. HPD0460BNC, T or CT can control objects 25…27 directly using their own internal function blocks.

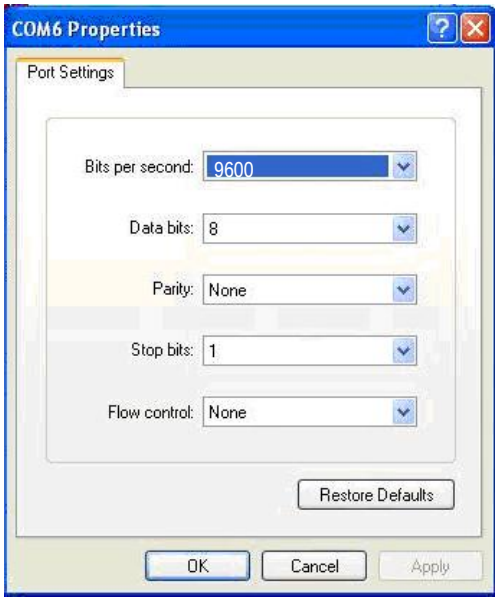
Terminal Mode

The HPECOMU data cable with USB connection is used for terminal mode between the device and a PC running a terminal program. HyperTerminal is recommended. The driver for the HPECOMU cable may be downloaded from www.hrw.hk, Resources / Tools, section.

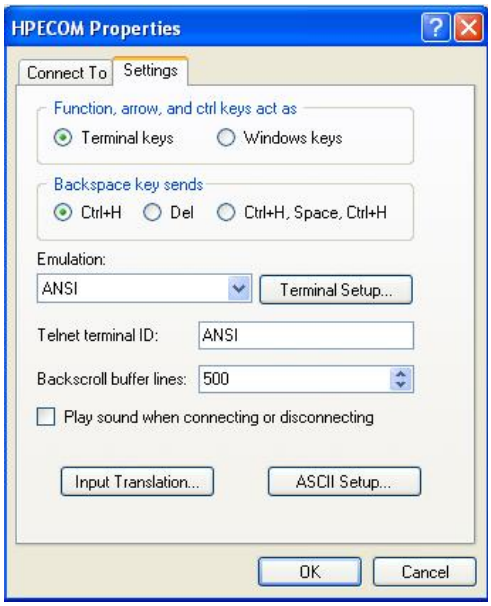
HyperTerminal Settings

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

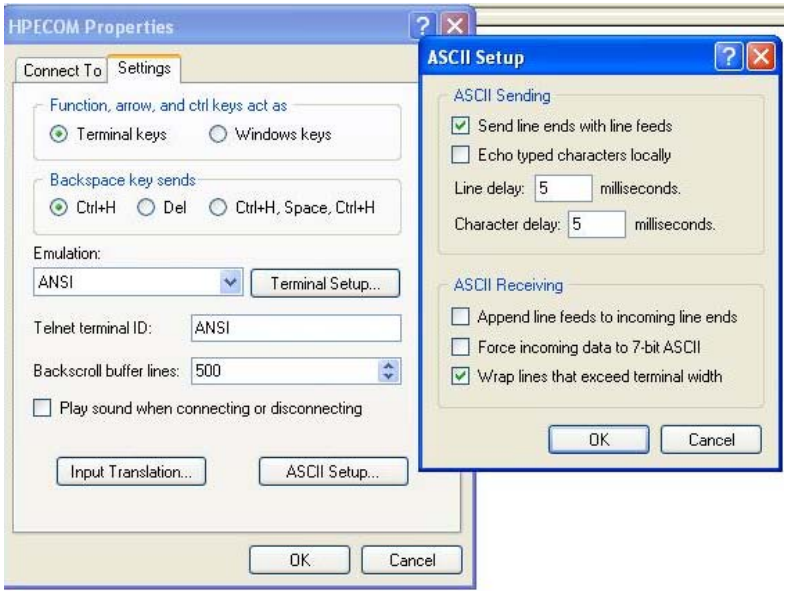
'Connect to' Comm Configuration:



'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)

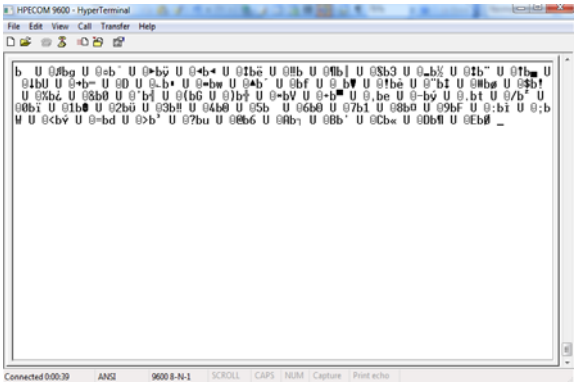
Changing Baud Rate

After changing to a new baud rate the controller will not start running at the new baud rate until the change has been Written (W). If setting a new baud rate via text file application download the new baud rate will be applied immediately the download is completed (auto-Write).

In either case, after the Write action, you will need to reconnect the terminal program at the new baud rate if you wish to continue the terminal session.

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.

Administration Commands

Function	Enter	Result	Options / *Comments*
Start communication	TTTTT(TTT…)	Display of configuration and I/O status	*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.*
Download text file	DE	Make ready for file path	Menu: Transfer > Send textfile > *file*
Upload text file	UE	All settings are uploaded to the terminal for archive or re-use	*HyperTerminal: Start a Capture Text procedure before invoking UE then stop the Capture after Upload complete.* *Indigo you may simply copy the text on the terminal screen to a text file.*
Reset to Factory Default	FD=1	Reset to ex-factory settings	*FD will be displayed in the top line of the I/O summary screen after reset*
Set node address (MAC)	98=1…98, 100…127, 128…247	Network node number is assigned	*Example: 98=25* *1…98 / 100…127 the device will be a 'token passing master'* *128… 247 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 baud rate	99=…	Network comms speed is set	2400, 4800, **9600**, 19200, 38400, 57600, 76800 *Example: 99=9600* ***After Writing new comm. speed it will be necessary to reconnect with Terminal at the new comm. speed to continue the terminal session!***
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	95=0, 96=0, 97=0	Each Reset counter is zeroed	*Factory diagnostics* *Resets = <95> <96> <97>* *Rx timeout, Tx timeout, Hardware reset*
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***

Display Navigation

Function	Enter	Result	Options / *Comments*
Display Control Commands	A1…8	Display **Analogue Logic** block	A1, A2, … A8
	C1…8	Display **Control Loop** block	C1, C2, … C8
	D1…8	Display **Digital Logic** block	D1, D2, … D8
	M	Display **I/O** summary screen	M
	N	Display **Network Interface Object** (NIO) bindings	N
	P	Display **Point** status list	Enter P or P1 to display the first 21 Objects. Enter Pxx (where 'xx' is a point #) to display any other point and the following 20 points
	S	Return to User **Summary** display	S
	SS	Screen **Static**	Disable 10 sec live update
	SL	Screen **Live**	Enable 10 sec live update
	SLLD	**Screen Line Logic** Display	Enable/Disable display of object numbers and screen line numbers in the summary display

Summary Screen & LCD Setting

Function	Line	Method	Result	Options / *Comments*
Summary Display Lines & dynamic point setting	SL1…32	SL(x)x=abc…	Assign **Screen Line** text as information or in relation to SP1…24	Alpha/numeric, 40 characters max.
	SP1…32	SP(x)x=nnn	Assign **Screen Point** dynamic point value	Object #
	SLL1…32	SLL(x)x=nnn	Assign **Screen Line Logic** point who's value >0 will cause the related screen line to appear at the top of the display (alarm state for instance)	Object #
	SLS1…32	SLS(x)x=1…3	Assign LCD font size & point number format per line. Type 0 & 1 are small font. Type 2 & 3 are large font. 5 digit point format is standard. 8 digit point format would normally be for pulse counts or other metering related values read in via NIO	0 = 21 character/5 digit 1 = 16 character/8 digit 2 = 9 character/5 digit 3 = 4 character/8 digit

Manual Override / Release

Values that have been manually set will be indicted in HyperTerminal by an **M** tag next to the displayed value. The BACnet priority level = 9

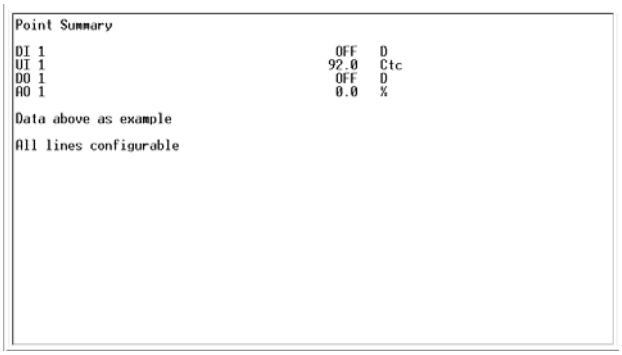
Manualled physical inputs (points 1…4 & 17…20) will revert to 'Auto' after being Released or after a power reset. Physical outputs will retain the Manual setting after a power reset if the Manual state is Written (**W**) before being released, thereby making the Manual state the power-up default state.

Function	**Enter**	**Result**	**Options / *Comments***
Manual a Digital	Object #=1, 0	Digital on or off	1=On 0=Off *Example: 37=1*
Manual an Analogue	Object #=0…*n*	0…100% block output	Block range 0….max *Example: 25=50 (AO1 50% output / 5Vdc output)*
Release Manual overrides back to 'Auto' *	R R=1…152	Inputs will return to auto state/value. Other points will remain at manualled state/value until power reset or commanded	*Example 1: R* *All overrides are cleared* *Example 2: R=9* *DO1 (point 9) only return to Auto*

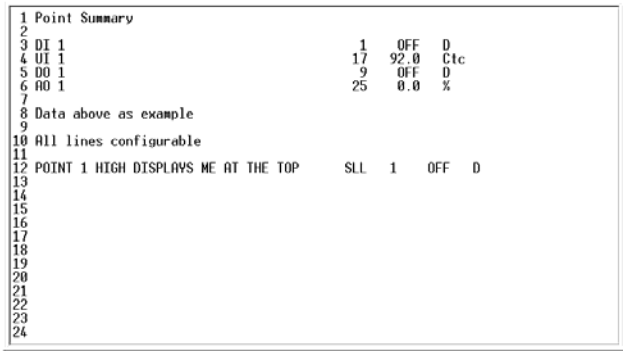
Operational Displays

User Summary Screen

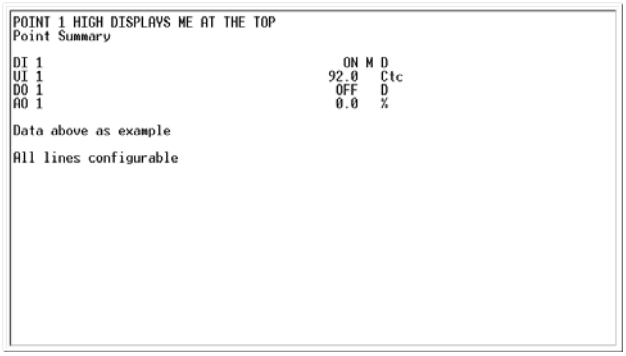
After breaking in to terminal mode the user defined point summary screen appears. This screen may be programmed by the user to provide a dynamic listing of point values specific to the application running in the device. Below is the factory default summary screen.



By entering **SLLD** (Screen Line Logic Display) the text line numbers, the point numbers relating to the dynamic points assigned to each line and any SLL (Screen Line Logic) links are displayed.



On line 12 you can see a text entry that will not be seen when SLLD is off but will appear at the top of the screen when the point set for SLL12 is high, in this case point 1 (Digital Input 1). Enter SLLD again to revert to normal display mode. Below is the appearance of this hidden line when SLLD is off and DI1 is high.

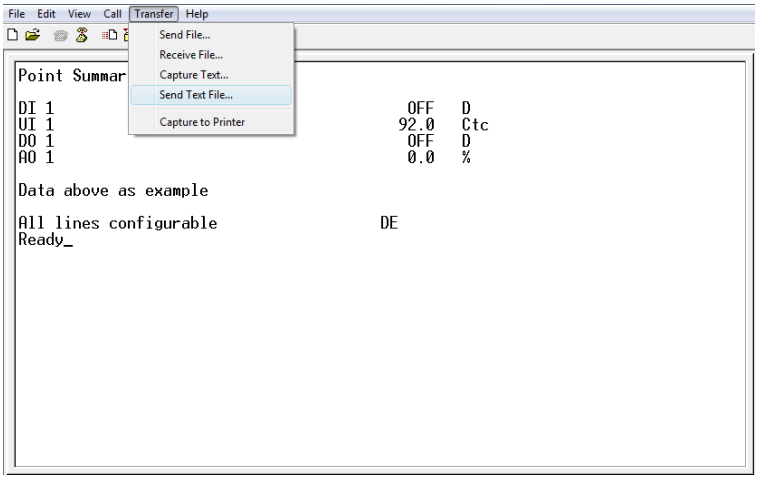


You may use SLL settings for alarm or warning text that will only appear when the assigned point has a value >0.

Download Text File

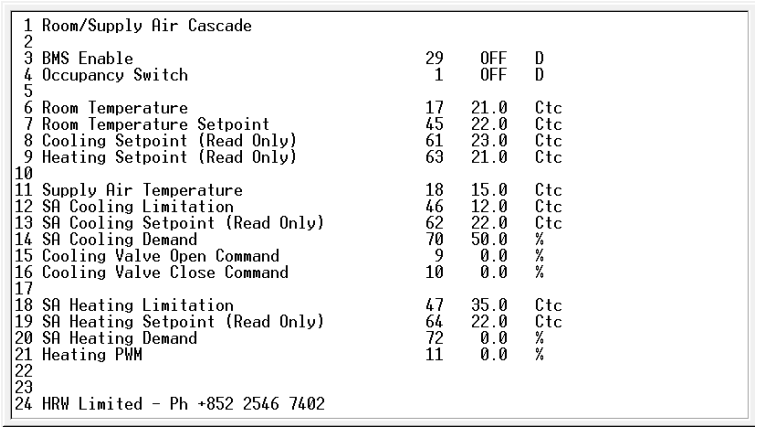
Enter DE (Download Eprom) and you will see 'Ready' bottom-left of the screen. Now go to the Transfer menu item in HyperTerminal, select Send Text File, then open the path to the text file, created in the FuncProg tool, which you want to download.

The 'Ready' state is active for 20 seconds. If the text file location on your PC has a long path to find it the 'Ready' state may time out. It is recommend that you save the application text files in a folder on your PC Desktop to locate them in a time efficient manner.



After the text file has downloaded you will briefly see a check of the number of lines expected versus the number of lines received. If the two values are equal 'Restarting…' will be displayed at which point the new configuration is written to non-volatile memory automatically.

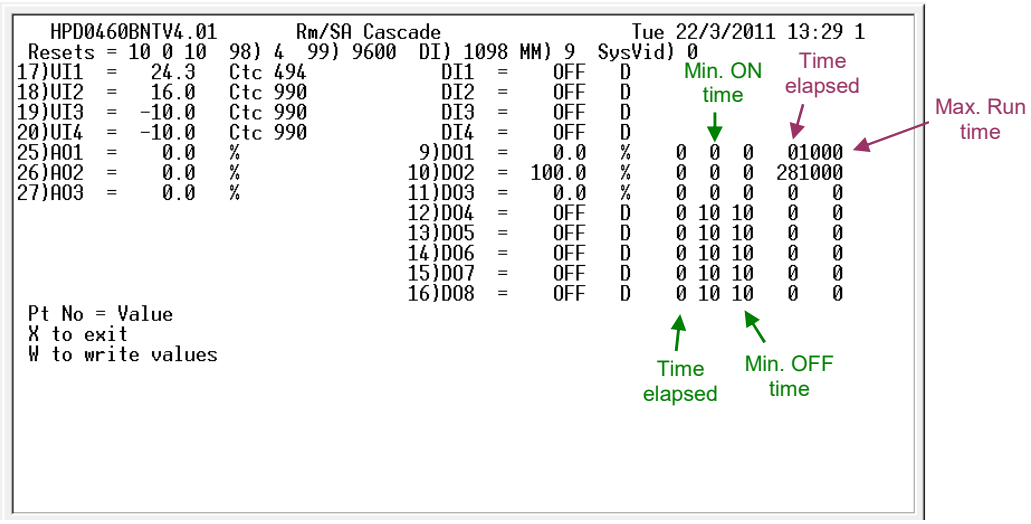
Below is the user summary screen after download of a configuration for room temperature/supply air temperature cascade with 100k NTC sensors on UI's 1 & 3 (points 17 & 18), 3-point floating cooling valve (DO1 & DO2 – points 9 & 10) and electric heating (PWM, DO3, point 11)



- Column 1 = Screen Line number (enter SLLD to toggle this column display on or off)
- Column 2 = User point description or general information text
- Column 3 = Point number of the displayed dynamic value (enter SLLD to toggle on or off)
- Column 4 = The dynamic point value
- Column 5 = Units related to the dynamic point value (as configured in the linearization table)

‘Main’ Physical I/O Display

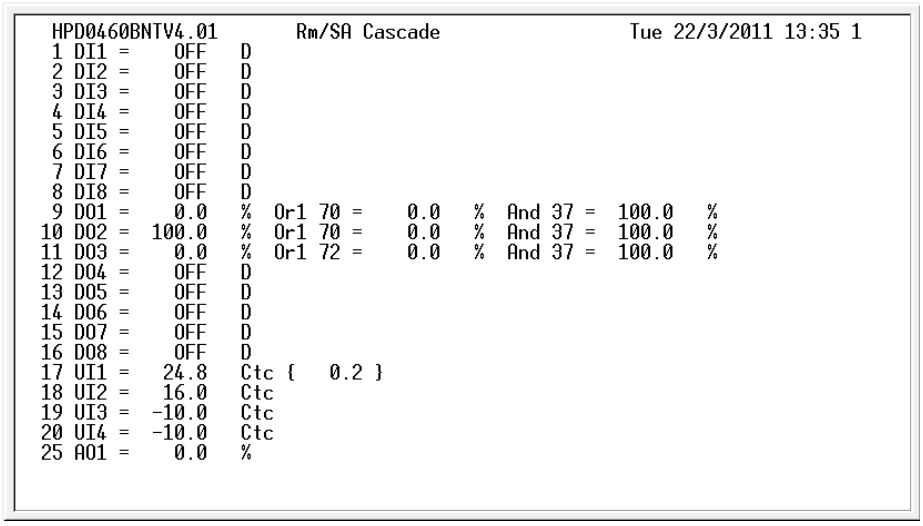
By entering **M** (Main) we can view the physical I/O summary status in the next illustration. In this example points 9 & 10 (DO1 & DO2) have Max. Run time of 1000 seconds set to reduce wear & tear of the 3-point actuator when open or closed command is at 100%; after 1000 seconds the output will electrically be switched off (logically still seen as ON) until the command value falls below 100% at which time the Max Run timer will reset. In practice it is recommended to set the Max Run timer at 2 x the actuator running time.



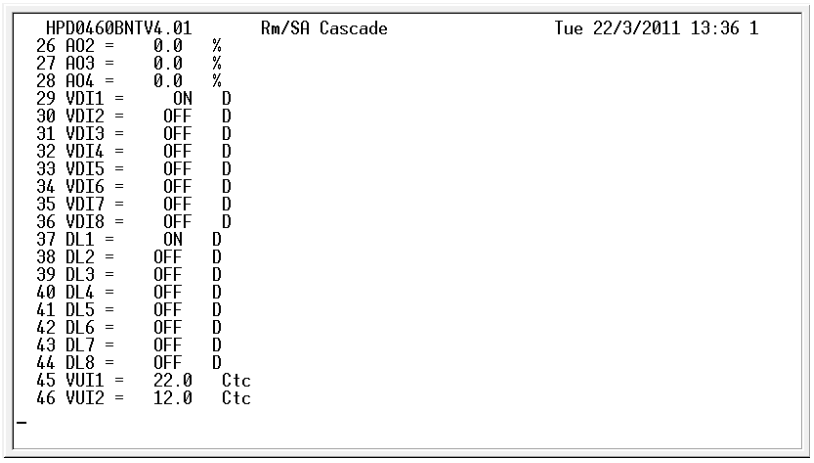
UI’s display the linearized & scaled value (including calibration offset if any), the units as set in the linearization table and, to the right of the units, the ‘raw count’ as seen by the microprocessor prior to linearization and scaling being applied.

Point List Display

Enter P to display the first 21 active points. The listing will include any active logic connections and, in the case of the UI’s the present calibration offset if used.

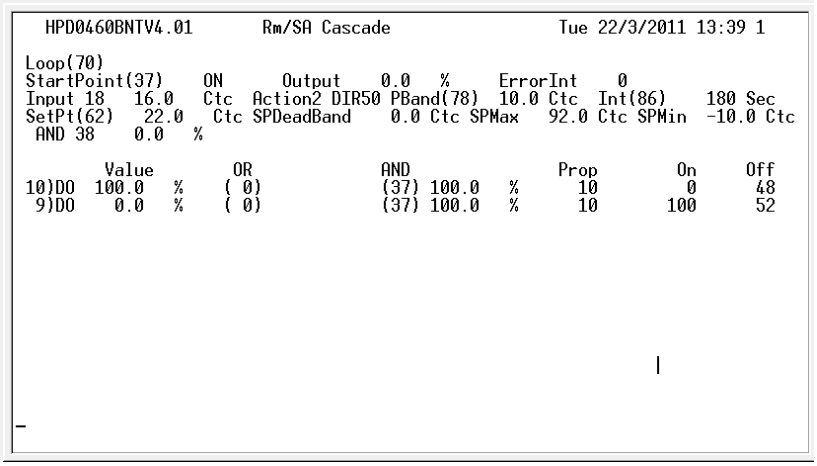


Enter P26 or any other starting point # to display another set of 21 device relevant sequential points.



Control Loop (CL) Display

To display the Control Loop statuses enter **C1** for loop 1, **C2** for loop 2, etc. Below we see the display of CL2 (point 70) which shows the relevant input connections/statuses and output values, including the connected physical outputs, for the supply air cooling control.

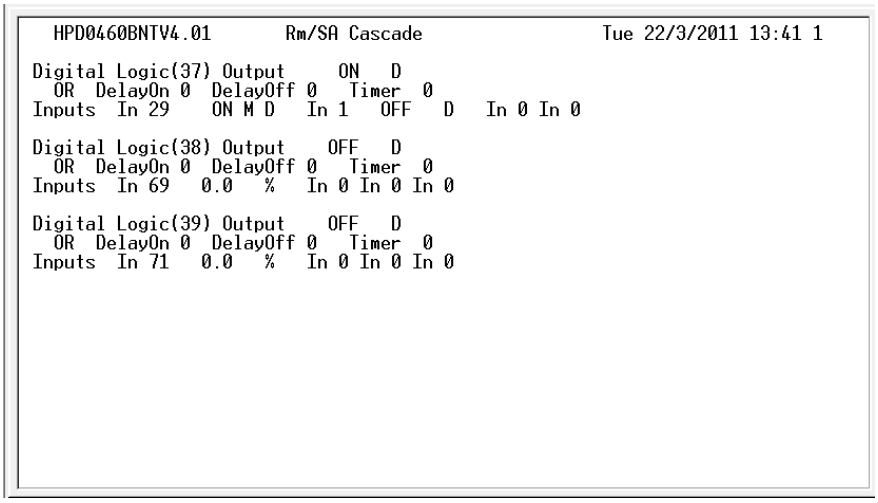


The control loop is set as DIR50 which means the loop output is 50% at set point. In this case the DIR50 control reaction is used for driving a 3-point actuator, cooling application, with the associated DO's set for 10sec PWM cycle, DO1 (point 9) operating as open command when the loop output is above 50% and DO2 (point 10) operating as the close command when the loop output is below 50%. Point 37, a Digital Logic block 1, is set as the start signal for the control loop and as the enabling point for the DO's (DO sub-parameter #02 – AND).

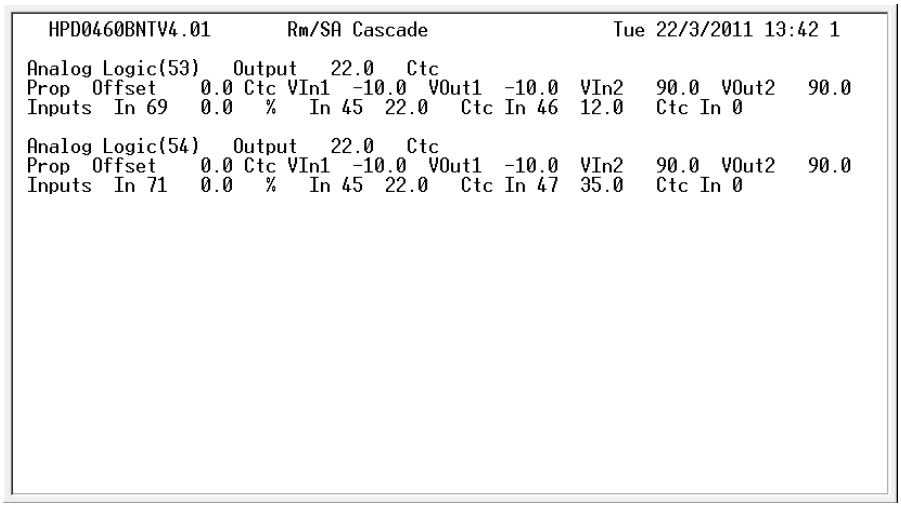
Digital Logic (DL) & Analogue Logic (AL) Display

The Digital Logic and Analogue Logic block statuses may be displayed by entering D1, D2… D8 or A1, A2… A8 respectively. Below is the display of the active Digital Logic blocks of the subject application:

- DL1, Point 37 – OR function for BMS or Local enable; either VDI1 (point 29) or DI1 (point 1) being high will result in point 37 being high
- DL2, Point 38 – OR function for release of SA cooling when the room cooling loop (point 69) has demand present
- DL3, Point 39 – OR function for release of SA heating when the room heating loop (point 71) has demand present



- AL1, Point 53 – Proportion (shift) function; CL1 output (point 69, room cooling demand) proportionally shifts the supply air cooling set point from 22°C down to 12°C
- AL2, Point 54 – Proportion (shift) function; CL3 output (point 71, room heating demand) proportionally shifts the supply air heating set point from 22°C up to 35°C



Network Interface Object (NIO) Display

Peer-to-peer operation is achieved by creating bindings between controllers on the same network using up to eight (48) NIO's. Using the NIO's it is possible to communicate with other controllers without having to route data through a network management device.

- Share the measurement of common sensors, such as Outside Air Temperature, between a number of controllers
- Create point expansion by remotely driving spare objects on other controllers
- Reduce wiring by remotely driving spare points on other controllers
- Influence control sequences of other controllers by sharing demand information
- When used in a network which includes the HPD0460…T, receive time switching commands, set point and other user operation inputs directly over the BACnet MS/TP network

NIO's are in the Object Instance range 105… 152. By entering N in HyperTerminal the NIO configuration page is displayed. Note that a NIO does not appear until it's sub-parameter xxx01 has a set value >0.

Below we see the settings for three NIO's; 105, 106 and 107.

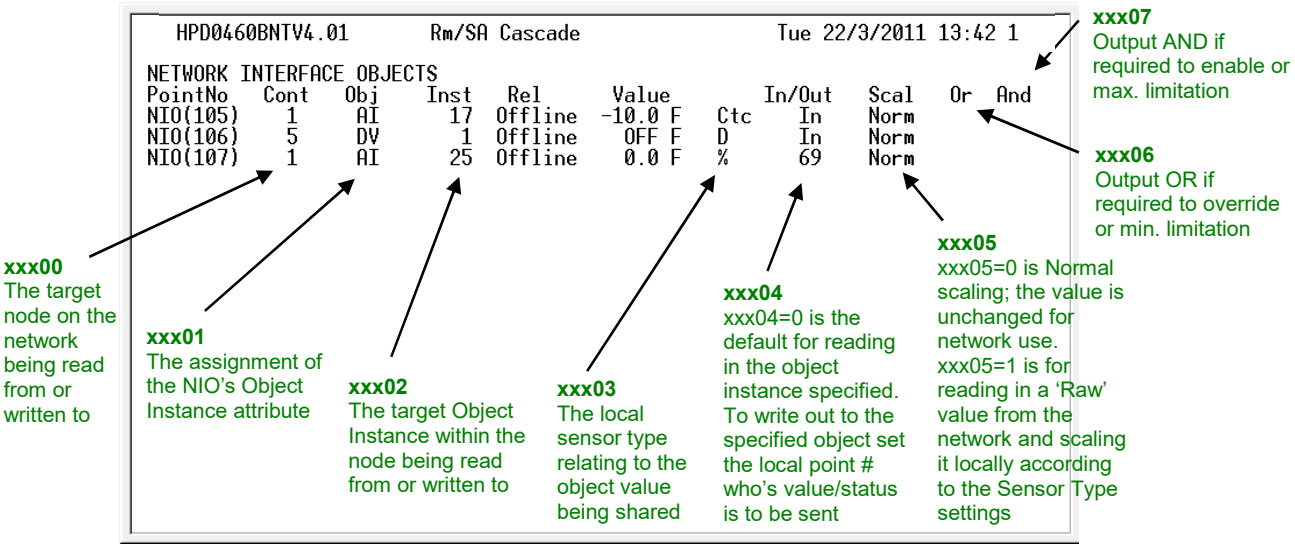
NIO's 105 and 106 are reading in values from other controllers on the network (Input). In this case controllers 1 and 5 respectively

- From controller 1 we are reading in the value of an NTC 100k sensor (Ctc) which is connected to UI 1 of controller 1 (Object Instance 17)
- From controller 5 we are reading in the status of a Digital Input (D) which is connected to DI 1 of controller 5 (Object Instance 1)

When a NIO is used to read in data (Input) the value obtained from the remote controller may be applied to any internal function block by setting the function block's input as being the Object Instance number of the related NIO.

NIO 107 is writing out the value of object 69 (the output of control loop CL1) to controller 1, analogue output 1 (Object Instance 25).

When used to write to another controller on the network (Output) the NIO will drive the remote Object Instance without any preparation required at the remote controller.



Each NIO has eight sub-parameters for configuration. These are outlined in the FUNCTION BLOCK OBJECTS & SUB-PARAMETERS section on page 2 and in the illustration above. Using NIO 105 as an example:

10500=1 - Identify the remote controller node as # 1
10501=4 - Set NIO 105's attribute as being an Analogue Input
10502=17 - Identify the remote controller object instance as # 17
10503=0 - For the purpose of providing Units to the NIO value, Identify the sensor type relating to the object being read or written to
10504=0 - Configure as an input – NIO 105 will take on the value of controller 1 object instance 17
10505=0 - No special value scaling required
10506=0 - No other point assigned to override (digital) the NIO or provide minimum limitation (analogue) to the NIO output
10507=0 - No other point assigned to enable/disable (digital) or provide maximum limitation (analogue) to the NIO output

Reset to Factory Default

If using a device that has previously been programmed it is recommended to reset the device to Factory Default before reprogramming to ensure any old settings that are unwanted in the new program do not have any influence on the new application.

To perform a Factory Default reset enter **FD=1**

A device set at Factory Default settings will have 'FD' displayed in the top line of the Main physical point summary screen [M]).

Note: If using devices with firmware less than version 4.00 then you must download the Factory Default text file to reset the device to Factory Default.

Upload Text File

In event that application files are lost it is possible to retrieve an application settings Text File from a device using the UE (Upload Eeprom) command.

After entering UE the current settings in the device will be printed on to the terminal screen. With HyperTerminal it is possible to Capture this upload:

1) Start a Capture Text from the Transfer menu of HyperTerminal
2) Enter UE
3) After the print of all settings has completed then stop the Capture
4) Locate the text file which was created during the Capture process
5) Clean up the file by deleting any lines that are not relevant setting lines
6) Count the number of lines (paste in to Excel cell A1 is a fast way to check the line count)
7) Add one more line at the bottom of the file with content 10000=nnn
    a. nnn value is the number of lines previously counted + 1
    b. Ensure there is one line return after the 10000=nnn line

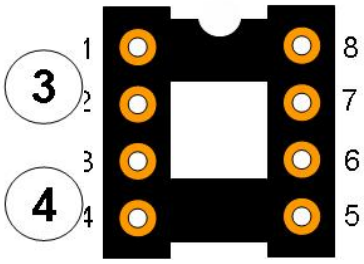
This text file is now ready for saving as a backup or for Down Load to other devices.

Other terminal programs may have other processes for saving the uploaded text. In some cases it may simply be a case of copying the relevant lines of the screen and pasting in to Notepad. Whatever the process, the 10000=nnn line must be added if the file is to be used for Down Load in future.

Universal Inputs

UI 1 is fixed as NTC 10k internal sensor. UI 2 is fixed NTC 10k external sensor or Digital Input (DI). UI 3 & 4 are configured as external **10k NTC or DI by default**. By reconfiguration of the UI resistor raft it is possible to use 100k NTC, 0-10Vdc or 4…20mA sensors at UI3 or UI4.the input.

When making own raft configurations select ¼ Watt resistors of 1% tolerance or better.



Sensor Type	Input 3	Input 4	Resistance
10k NTC / DI	**Link 1 to 8**	**Link 3 to 6**	**10kΩ**
100k NTC / DI	Link 1 to 8	Link 3 to 6	100kΩ
0-10Vdc	Link 2 to 7	Link 4 to 5	100kΩ
4…20mA	Link 1 to 2	Link 3 to 4	250Ω

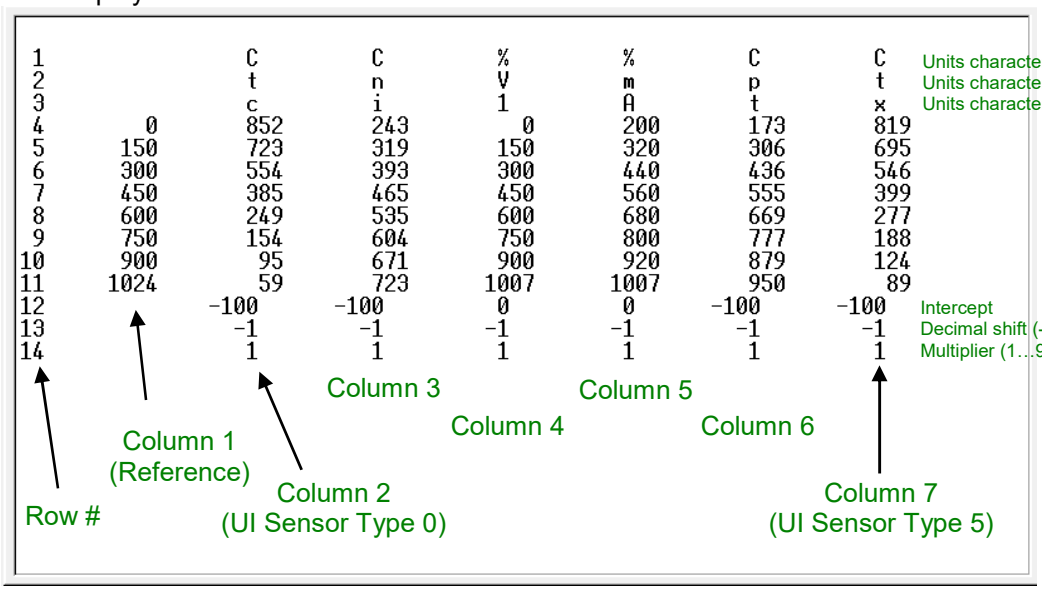
Linearisation Table

The Linearisation Table provides conversion of the UI physical signal in to an engineering value for display and control in other areas of an application. Sensor Types 0…5 may be customised to suit different scaling for a specific active sensor type or to suit a passive sensor element that is not already pre-programmed as a factory default.

Factory Default Sensor Types

UI Sensor Type	Sensor	Units Tag	Scale
0	100k NTC (B25/50: 4200) 10k NTC type 2 (B25/50: 3935)	Ctc	-10…90 °C
2	0-10Vdc	%V1	0…100%
3	4…20mA	%mA	0…100%
5	10k NTC type 3 (B25/50: 3630)	Ctx	-10…90 °C

Enter <L> to display the default linearization table.



Active Sensor Scalings

Column 1 is the fixed reference to which all display results are based. The range of the reference column 1 is effectively 0…1000.

It is important to interpret the reference values in combination with the intercept and scaling data at rows 12…14. Taking Sensor Type 2, 0-10Vdc, as an example:

- The microprocessor raw count range of 0…1000 relating to 0-10Vdc results in 0…100% display because the reference column values are being decimal shifted one place to the left (row 13 column 4 = -1
- If 0-10Vdc is to be displayed directly as 0-10Vdc then we need to decimal shift -2 at row 13 column 4 and change Units display characters
    - 134=-2
    - 14=V (row 1 column 4)
    - 24=d (row 2 column 4)
    - 34=c (row 3 column 4)

- If 0-10Vdc is to be displayed as 0…50°C then decimal shift the display reference range -2 at row 13 column 4, multiply it by 5 at row 14 column 4 and change units characters (remove surplus characters by entering a <space>)
  134=-2
  144=5
  14=C (row 1 column 4)
  24=<space> (row 2 column 4)
  34=<space> (row 3 column 4)
- If a second 0-10Vdc sensor with different scaling is needed, say, 0…2000 PPM, then copy default 0-10Vdc raw count data to a column who's existing sensor data will not be used in future. The following settings assume overwrite of the Ni1000 column 3 (Sensor Type 1)
  13=P
  23=P
  33=M
  43=0
  53=150
  63=300
  73=450
  83=600
  93=750
  103=900
  113=1007
  123=0
  133=0
  143=2

In the last example the display reference column range is unchanged, 0…1000, until the multiplier at row 14 is applied (x2) resulting in a final scale for PPM of 0…2000.

Note: The value at the intercept row, 12, will have the decimal shift (row 13) and multiplier (row 14) applied to it. Therefore, if intercept -10.0 is required and decimal shift will be -1 (x0.1) then enter -100 in row 12 as the final result after processing with the decimal shift will be an intercept of -10.0

Using the FUNCPROG tool these settings can be generated in table form for saving as a download text file.

Passive Sensor Definition

Non factory default passive sensors with thermistor element of 10kΩ or greater may be configured

1. Set up a UI raft with suitable resistance links fitted and plug it in to the raft socket of the UI being used. If the sensor was 20kΩ at 25°C then 20kΩ would be fitted in link 2 of the UI raft
2. Consult the manufacturers resistance chart for the sensor being used and connect resistance equivalent to the reference values in Column 1 (note that in the reference column 1 the reference value 150 is considered as 15°C once the decimal shift of -1 is applied at row 13)
3. Assign an otherwise unused Sensor Type to the test UI
4. In the Main I/O display read and record the raw count value, as displayed to the right of the units for the UI to which the test resistance is connected
5. Enter the raw count in the table at the corresponding reference value row and column; <row#><column#>=<raw count>
6. Complete the raw count entry for all reference points
7. If an intercept other than zero (0) is applied then raw count measurements must be at reference values shifted an equivalent amount

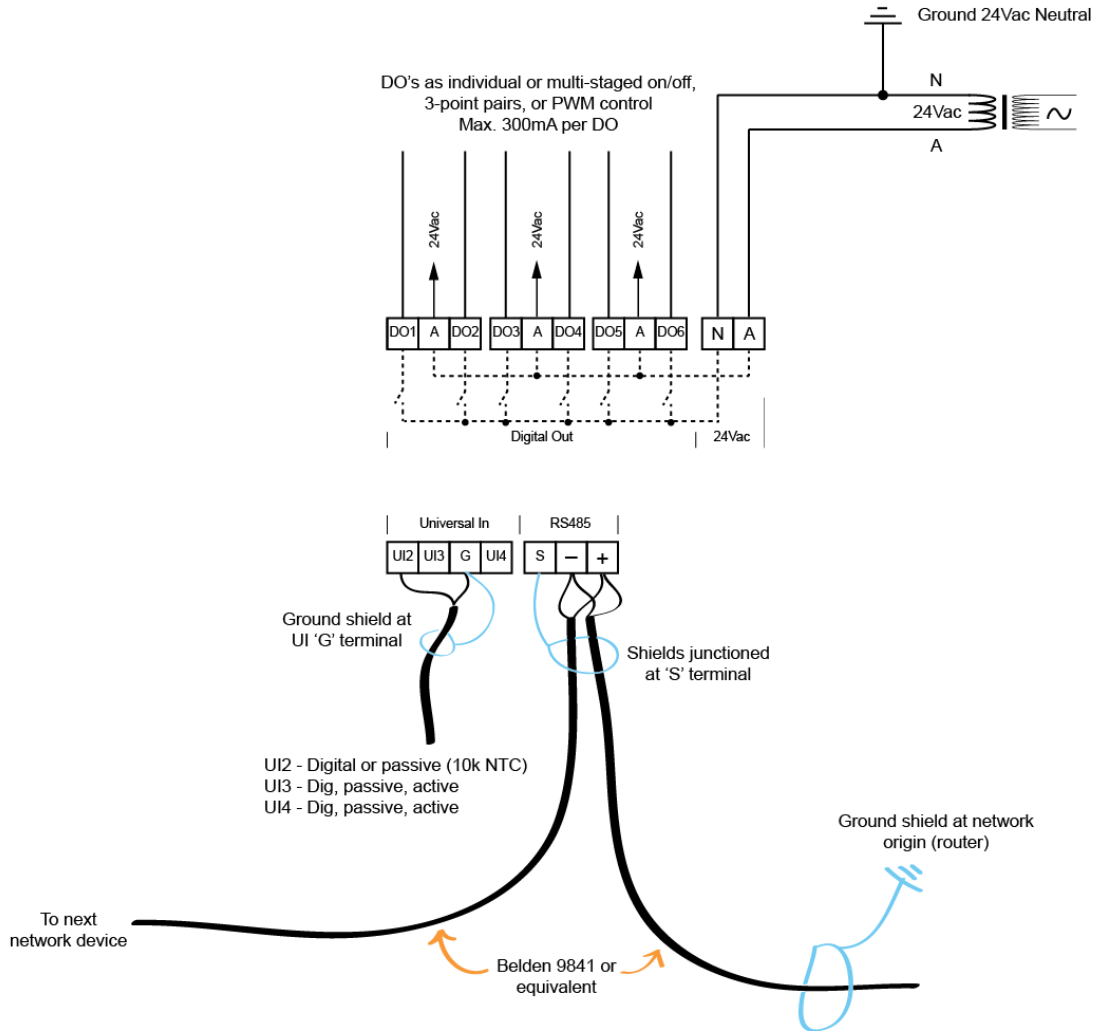
Reset to Factory Default

The **FD=1** reset command also resets changes to the linearization tables

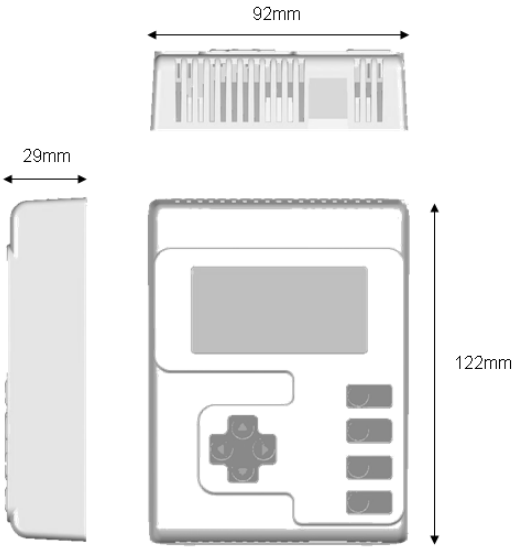
Installation & Commissioning

- This is an RS485 network device designed for indoor use, mounted in a dry electrical panel. The housing should be mounted such that the airflow slots are vertically top and bottom
- Each 24Vac power supply transformer must 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
- Twisted pair shielded cable must be used for the sensors and transmitters connected to the universal inputs (UI's). The sensor cable shield must be grounded, at the device end only
- 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



Technical Data

Inputs/Outputs	
4 DI, local user interfaces 4 DI, navigation buttons	DI1…4: User programmable buttons onboard DI5…8: Fixed functionality, display navigation & setting buttons onboard
6 DO	DO1…DO6: 24Vac, 3A in-rush, 300mA holding max., minimum load 10mA
2 DO, local user interfaces	DO7…DO8: Fixed functionality, LED1… LED2; user programmable on, off or flashing (PWM configuration)
4 UI	UI1: Local °C (10kΩ NTC internal temperature sensor) UI2: Digital Input (DI) or 10kΩ NTC thermistor UI3 & UI4: - 10kΩ NTC thermistor (default), 20kΩ, 100kΩ - 0-5Vdc, 0-10Vdc, 0-20Vdc, 0.01 Volt resolution - 0…20mA, 4…20mA, 0.016mA resolution (requires external 18…28Vdc loop power supply)
3 AO, local user interfaces	AO1 & AO2: Fixed functionality, LED3… LED4; user programmable on, off or flashing (fixed PWM, 5 second cycle time; 100% command = on continuous / 20% command = on 1sec, off 4sec) AO3: Fixed functionality, Audible beeper; user programmable on, off or intermittent beep (fixed PWM, 5 second cycle time; 100% command = on continuous / 20% command = on 1sec, off 4sec)
Sensor/Transmitter Wiring	Shielded twisted pair (shield grounded)
Network Wiring	Belden 9841 low capacitance twisted pair for RS485 networks (braided + foil shield, shield continuous throughout the network and grounded at network origin)
Comms Speed	RS485 - 2400, 4800, 9600, 19200, 38400, 57600, 76800 baud
RS485 Driver	Isolated 1/8th load, 256 nodes over max. 1.2km without repeater
Power Supply	24Vac, 50/60 Hz, max. 5VA without DO load 50VA MAX. when DO's supplied via the device's 24Vac terminals and fully loaded @ max. 300mA / DO
Conformity & approvals	BTL Listing 23710 UL 916 CAN/CSA C22.2 #205-M1983 FCC Part 15 Subpart B Class B CE/EMC EN 55022, EN 55024, EN 61000-3-2, EN 61000-3-3
Operating Temperature Range	0…50ºC (32…122ºF)
Storage Temperature Range	-5…75ºC (-40…167ºF)
Humidity Range	10…95%rH (non-condensing)
Dimensions	122mm H x 92mm L x 29mm D
LCD	8 line dot matrix 62mm x 29mm visible 54mm x 24mm usable

Ordering Information

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

Accessories

HDA0002	DIN rail adapter brackets
HPU2-RA010	HPD UI3/4 raft, Active 0-10Vdc, Order in multiples of 50
HPU2-RA420	HPD UI3/4 raft, Active 4…20mA, Order in multiples of 50
HPU2-RC1090	HPD UI3/4 raft, Passive 100k NTC -10…90°C, Order in multiples of 50
HPR6	Relays module, 6 x Opto-iso SPDT 250Vac 10(7)A n/o 6A n/c, ac/dc trigger, Auto/Off/Manual switch, 24Vac
FUNCPROG	Application creation tool
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
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, 250 point, 24Vac
HPE-BNMOD	BACnet gateway for Modbus devices, 250 point, 24Vac
HPE-BNMR10	BACnet gateway for 1 Modbus device, 10(20) point, 24Vac

Document Update History

V4.02 150622 HRW address updated

V4.02 141030 Minutes Run, Compare functions, upload application text-file, download network settings in text-file, isolated RS485