FUNCPROG Guide

V4.02, from November, 2013
V4.02, additions from November, 2014
V4.02, ECO functions, from September, 2018
Above highlighted features not valid for V4.01 devices

FUNCPROG is an application creation tool for controllers and I/O expansion units manufactured by HRW Limited.

The purpose of FUNCPROG is to reduce programming time by presenting a visual representation of the control application and by compiling all the required programming lines in a single file for download to the devices. All the devices compatible with FUNCPROG can also be programmed directly by entry of configuration text lines which is useful for application debugging and commissioning.

All function blocks have predefined main functions or ranges of selectable function choices. They also have sub-parameter sets to define operation boundaries. In many cases the setting choices have their basis in HVAC applications but the scope is not limited in any way to HVAC applications only…

Benefits

- No programming code to learn
- Simple numerical function and parameter settings for application creation

Compatible Devices

All controller and I/O expansion devices are compatible with FUNCPROG. The range of function blocks available in each device will differ based on physical I/O count. Some devices, such as the HPD0460 units and the HPV0662 have dedicated functionality for some physical I/O.

- **HPC0662**…* 12 point universal controllers
- **HPC8884**…* 28 point universal controllers
- **HPD0440BNMR** 8 point multi-function room unit with Modbus RTU gateway
- **HPD0460**…* 10 point multi-function room units
- **HPE0662MR** 12 point I/O expansion for Modbus RTU networks
- **HPE8884**…* 28 point I/O expansion units
- **HPV0662**…* 13 point VAV / universal controllers

* **BN**=BACnet MS/TP **MR**=Modbus RTU 485 **P1**=P1 FLN

Function Block Numbering

Regardless of the type of device the number reference for a particular function block, if present in a particular device, will be identical.

Throughout this document the function block numbers will be referred to as a ‘Point #’. In general the point is the function block output. For Control Loop (CL) function blocks however there are three points; the function block output point # plus three additional points for network read/write of critical control parameters.

In respect of BACnet devices the point # can be interpreted as the BACnet Object Instance #. All function blocks descriptions in this guide include a list of the relevant BACnet object instances.

FUNCTION SCOPE BY DEVICE 3
POINT# SCOPE BY DEVICE 4
SETTINGS COLOUR KEY 5
FUNCTION BLOCK SETTING OPTIONS 6
PHYSICAL DIGITAL INPUT 6
PHYSICAL DIGITAL OUTPUT 6
PHYSICAL UNIVERSAL INPUT 7
PHYSICAL ANALOGUE OUTPUT 8
VIRTUAL DIGITAL INPUT 8
DIGITAL LOGIC 9
VIRTUAL UNIVERSAL INPUT 10
ANALOGUE LOGIC 11
CONTROL LOOP 15
CLOCK CHANNEL 16
NETWORK INTERFACE OBJECT 16
POINT SUMMARY SCREEN 17
SCREEN FEATURES 17
Screen Line (SL) *18*
Screen Point (SP) *18*
Screen Line Logic (SLL) *18*
Screen Line Size (SLS) *18*
UI LINEARISATION TABLES 19
TABLE FEATURES 19
Reference Column *19*
Sensor Type Columns/Rows *19*
Units Tags (Rows 1…3) *20*
Decimal Shift (Row 13) *20*
Multiplier (Row 14) *20*
Intercept (Offset) *20*
Shift+Multiplier *20*
SENSOR TYPES 21
CUSTOM PASSIVE SENSORS 21
NETWORK SETTINGS 21
ADDRESS / MAC 21
BAUDRATE 22
DEVICE INSTANCE 22
MAXIMUM MASTER 22
DEVICE LIST 23
ACCESSORIES 24

Function Scope by Device

Function & Feature Scope	HPC0662…	HPV0662…	HPC8884…	HPE0662MR	HPE8884…	HPD0440BNMR	HPD0460…	HPD0460…C	HPD0460…CT	HPD0460…T
Digital Input (DI)			1…8		1…8	1…4 (Button 1..4)	1…4 (Button 1..4)	1…4 (Button 1..4)	1…4 (Button 1..4)	1…4 (Button 1..4)
Universal Input (UI)	1…6	1…7 (7=Velocity)	1…8	1…6	1…8	1…4 (1=℃/℉ on-board 2=10kNTC or DI)	1…4 (1=℃/℉ on-board 2=10kNTC or DI)	1…4 (1=℃/℉ on-board 2=10kNTC or DI)	1…4 (1=℃/℉ on-board 2=10kNTC or DI)	1…4 (1=℃/℉ on-board 2=10kNTC or DI)
Digital Output (DO)	1…4 5…6	1…4 5…6	1…8	1…4 5…6	1…8	1…4	1…8 (7..8=LED 1& 2)	1…8 (7..8=LED 1& 2)	1…8 (7..8=LED 1& 2)	1…8 (7..8=LED 1& 2)
Analogue Output (AO)	1…2 (Jumper select)	1…2 (Jumper select)	1…4	1…2 (Jumper select)	1…4	1…3 (1..2=LED 3 & 4 3=beeper)	1…3 (1..2=LED 3 & 4 3=beeper)	1…3 (1..2=LED 3 & 4 3=beeper)	1…3 (1..2=LED 3 & 4 3=beeper)	1…3 (1..2=LED 3 & 4 3=beeper)
Virtual DI (VDI)	1…8	1…8	1…8			1…8		1…8	1…8	
Virtual UI (VUI)	1…8	1…8	1…8			1…8		1…8	1…8	
Digital Logic (DL)	1…8	1…8	1…8			1…8		1…8	1…8	1…8
Analogue Logic (AL)	1…8	1…8	1…8			1…8		1…8	1…8	1…8
Control Loop (CL)	1…8	1…8	1…8			1…8		1…8	1…8	
Sceen Line (SL)	1…32	1…32	1…32	1…32	1…32	1…32 (LCD)	1…32 (LCD)	1…32 (LCD)	1…32 (LCD)	1…32 (LCD)
Screen Point (SP)	1…32	1…32	1…32	1…32	1…32	1…32 (LCD)	1…32 (LCD)	1…32 (LCD)	1…32 (LCD)	1…32 (LCD)
Screen Line Logic (SLL)	1…32	1…32	1…32	1…32	1…32	1…32 (LCD)	1…32 (LCD)	1…32 (LCD)	1…32 (LCD)	1…32 (LCD)
Network Interface Object* (NIO)	1…48	1…48	1…48	1…48	1…48	1…48	1…48	1…48	1…48	1…48
Custom UI Linearisation	0…5	0…5	0…5	0…5	0…5	0…5	0…5	0…5	0…5	0…5
Clock & Calendar / Time Switch Channel						1 / 4			1 / 4	1 / 4

Point# Scope by Device

Point/Object# Scope	HPC0662…	HPV0662…	HPC8884…	HPE0662MR	HPE8884…	HPD0440BNMR	HPD0460…	HPD0460...C	HPD0460...CT	HPD0460...T
DI			1..8	1..8	1..8	1..4	1..4	1..4	1..4	1..4
UI	17..22	17..23	17..24	17..22	17..24	17..20	17..20	17..20	17..20	17..20
DO	9…14	9…14	9…16	9…14	9…16	9…12, 15…16	9…16	9…16	9…16	9…16
AO	25..26	25..26	25..28	25..26	25..28	25..27	25..27	25..27	25..27	25..27
VDI	29..36	29..36	29..36			29..36		29..36	29..36	
VUI	45..52	45..52	45..52			45..52		45..52	45..52	
DL	37..44	37..44	37..44			37..40		37..40	37..40	37..40
AL	53..60	53..60	53..60			53..56		53..56	53..56	53..56
CL	69…77	69…77	69…77			69…72		69…72	69…72	
Setpoint (Read only)	61…68	61…68	61…68			61…64		61…64	61…64	
Proportional Band	77..84	77..84	77..84			77..80		77..80	77..80	
Integral Time	85..92	85..92	85..92			85..88		85..88	85..88	
NIO*	105…152	105…152	105…152	105…152	105…152	105…152	105…152	105…152	105…152	105…152
Clock & Calendar / Time Switch Channel						101…104			101…104	101…104
Data logger channel						186…193				
Modbus RTU Integration Registers						153…184			101…104	101…104

- NIO blocks are only present in devices running BACnet protocol
- Time Switch blocks cannot be read over P1 FLN unless connected to another function block with point # <100 (DL for example)

Settings Colour Key

The various cells in a function block are colour coded to differentiate their options of use:

1

A black number in a white cell indicates the function block output point #. CL blocks have the block output point # plus three additional points for remote reading/writing of critical control parameters.

7

A red number in a yellow cell indicates a setting choice to be made. The settings seen in the base FUNCPROG are the factory default settings specific to a particular function block type.

10

A black number in a yellow cell indicates a numerical value that defines the actions of a function block, such as delay on time in a Digital Logic block, or Deadband value in a Control Loop.

0

A black number in a pale yellow cell indicates a numerical value or a Point # may be set. If a Point # is used then it will be in a range defined specific for the associated function

0

A blue number in a pale yellow cell indicates a point # input to the block. **When the point # =0 the related parameter is inactive and has no affect on the function block result**.

OFF

A black status in an aqua coloured cell indicates factory default status of the block output which cannot be set as a start up default at time of programming.

OFF

A **bold Red** status in an aqua coloured cell indicates that the start-up default state of the block output can be set at time of programming. For a Digital Logic block this could be an enabled state connected to a Control Loop.

0

A black value in an aqua coloured cell indicates factory default value of the block output which cannot be set as a start up default at time of programming.

0

A **bold black** value in an aqua coloured cell indicates that the start-up default value of the block output can be set at the time of programming. For a Virtual Universal Input this could be a set point value connected to a Control Loop.

DIGITAL INPUT

The text in the name bar of each function block may be changed to give a description of use relating to your control application

Function Block Setting Options

In the descriptions below, x represents the point # of the function block being configured. The numerals following the point # relate to a specific sub-parameter within the function block.

Physical Digital Input

DI1…8	Point 1…8	BACnet Object	Sub-parameters
		BI1…8 BV1…8 AV1…8	00…02

	DIGITAL INPUT		
	DI 1	1	OFF
…00	7	D	Sen. Type
…01	0	Output OR	
…02	0	Output AND	

x00=	**Input Type**	**6**	Pulse input up to 10Hz or to zero the pulse count register [P]
		7	Digital input, normally open (n/o) [D]
		14	Digital input normally closed (n/c) [Dnc]
		15	Toggle (flip/flop) on with pulse, off with next pulse [D T]
x01=	**Output OR**	**FB #**	Function Block which will override this block on
x02=	**Output AND**	**FB #**	Function Block which will enable this block

Physical Digital Output

DO1…8	Point 9…16	BACnet Object	Sub-parameters
		BO9…16 BV9…16 AV9…16	00…09

	DIGITAL OUTPUT		
	DO 1	9	OFF
…00	0	OR 1	
…01	0	OR 2	
…02	0	AND	
…03	0	PWM cycle time	
…04	0	On %	
…05	0	Off %	
…06	10	Minimum on time	
…07	10	Minimum off time	
…08	0	3-point Run Time	
…09	0	Remember state	

x=	**Power-up default**	**OFF (0), ON (1)**	
x00=	**Input OR 1**	**FB #**	Function Block which will turn the DO on
x01=	**Input OR 2**	**FB #**	Function Block which will turn the DO on
x02=	**Input AND**	**FB #**	Function Block which will enable this block
x03=	**Span / PWM Cycle**	**0**	If On% (x04) = Off% (x05) or On% is at least 2 > Off% then normal demand based on/off operation
		0…4	When On% is exactly 1 > Off% then DO operates within a fixed Span of demand. Suitable for sequence such as 3-speed fans **0 = 10% Span** When block value at Or1 achieves On% then DO is ON. When block value at Or1 exceeds On% + 10% then DO is OFF

1 = 20% Span	When block value at Or1 achieves On% then DO is ON. When block value at Or1 exceeds On% + 20% then DO off
2 = 30% Span	
3 = 40% Span	
4 = 50% Span	

≥5 then Pulse Width Modulation application of the DO:

5…255 seconds cycle time if DO action to be Pulse Width Modulation

x04= On % *
0…100 rising demand value at which the DO will switch on
For tight hysteresis DO on/off operation x04 can be equal to x05
For broad hysteresis DO on/off operation x04 is at least 2 > x05
For Stepped DO operation x04 must be exactly 1 > x05
For PWM operation x04 is the demand point at which the DO will be on continuously

x05= Off % *
0…100 falling demand value at which the DO will switch off
For tight hysteresis DO on/off operation x05 can be equal to x04
For broad hysteresis DO on/off operation x05 is at least 2 < x04
For Stepped DO operation x05 must be exactly 1 < x05
For PWM operation x05 is the demand point at which the DO will be off continuously

x06= Min. On Time
0…255 minimum time in seconds that the DO will remain on after being activated

x07= Min. Off Time
0…255 minimum time in seconds that the DO will remain off after being deactivated

x08= Max. Run Time
0…1000 maximum running time once the output achieves and remains at 100% or 0%. Typically used for 3 point actuator applications to limit wear and tear on the actuator once it achieves its open or closed end-stop

x09= Remember Last
Non-BACnet devices only
0 if the output should adopt the written default state at time of power return after a power failure
1 if the output should Remember and revert to the last BMS commanded state at time of power return after a power failure

* The values may be swapped to invert the DO response.

Physical Universal Input

UI1…8 **Point 17…24**

BACnet Object
BV17…24
AI17…24
AV17…24

Sub-parameters
00…04

	UNIVERSAL INPUT		
	UI 1	17	0
…00	0	Ctc	Sen. Type
…03	0	Output OR / Min.	
…04	0	Output AND / Max.	

x00= Input Type
0…15 See specific device's 'Sensor Type' selection for analogue sensor and digital input choices

x01=* Offset
+/- calibration offset as an absolute value, -10%...10% of the sensor range. Factory default 0

x02=* Filter
0…9 input filtering sample time for unstable sensing environments. The factory default is 0 and is usually adequate

x03=	**Output OR / Min.**	**FB #**	Digital Function Block which will override this block on
		FB #	Analogue Function Block which sets minimum limitation
x04=	**Output AND / Max.**	**FB #**	Digital Function Block which will enable this block
		FB #	Analogue Function Block which sets maximum limitation

* Sub-parameters for direct HyperTerminal setting during commissioning process, with sensors and wiring connected.

Physical Analogue Output

AO1…4	**Point 25…28**	**BACnet Object**	**Sub-parameters**
		AO25…28 AV25…28	00…04

	ANALOG OUTPUT		
	AO 1	25	0.0%
…00	0	OR 1	
…01	0	OR 2	
…02	0	AND	
…03	0	100%	
…04	0	0%	

x=	**Power-up default**	**0.0…100.0 (%)**	
x00=	**Input OR 1**	**FB #**	Function Block which will drive the AO
x01=	**Input OR 2**	**FB #**	Function Block which will drive the AO
x02=	**Input AND**	**FB #**	Function Block which will enable this block
x03=	**100 % ***	**0…100** rising demand value at which the AO will be at 100%	
x04=	**0 % ***	**0…100** falling demand value at which the AO will be at 0%	

* The values may be swapped to invert the AO response.

Virtual Digital Input

VDI1…8	**Point 29…36**	**BACnet Object**	**Sub-parameters**
		BV29…36	01…02

	VIRTUAL DIGITAL IN		
	VDI 1	29	OFF
…01	0	Output OR	
…02	0	Output AND	

x=	**Power-up default**	**OFF (0), ON (1)**	
x01=	**Output OR**	**FB #**	Function Block which will override this block on
x02=	**Output AND**	**FB #**	Function Block which will enable this block

Digital Logic

DL1…8 **Point 37…44** **BACnet Object** BV37…44 **Sub-parameters** 00…08

	DIGITAL LOGIC		
	DL 1	37	OFF
…00	0	NA	Function
…01	0	Input 1	
…02	0	Input 2	
…03	0	Input 3	
…04	0	Input 4	
…05	0	Delay on	
…06	0	Delay off	
…07	0	Output OR	
…08	0	Output AND	

x00= **Logic Function** 1 OR 2 NOR 3 AND 4 NAND 5 XOR 6 NXOR
7 Lead/Lag 8 Watchdog 9 Occupancy

Function 1…6 – Standard logic functions:

x01= **Input 1** **FB #** Function Block 1 of up to 4 included in logic result
x02= **Input 2** **FB #** Function Block 2 of up to 4 included in logic result
x03= **Input 3** **FB #** Function Block 3 of up to 4 included in logic result
x04= **Input 4** **FB #** Function Block 4 of up to 4 included in logic result

Function 7 – Lead/Lag: Utilises DL block pairs (A & B). Only DL block A of the pair needs to be configured. The following block, B, is automatically assigned in the Lead/Lag pairing

x01= **Input 1** **FB #** Function Block which activates the lead DL on a flip/flop basis
x02= **Input 2** **FB #** Function Block which is the Load A fault signal
x03= **Input 3** **FB #** Function Block which is the Load B fault signal
x04= **Input 4** **#** any number **>0** in this input cell will cause the leading DL block's output to be disabled in the event of a fault signal from it's associated load. If **0** in this input cell then the leading DL block's output will remain high even in the event of a fault signal from its load

Function 9 – Occupancy / After Hours:

x01= **Input 1** **FB #** Function Block which is the Occupancy (push-button) signal
x02= **Input 2** **FB #** Function Block which is the BMS / Clock Schedule release. When this is High then Occupancy signal acts as on/off. When this is Low then Occupancy signal acts as After Hours signal in combination with Delay Off timer
x06= **Delay Off** **FB # or time in seconds**. Delay Off time does not apply when the output of the Function Block connected at **x02** is >0. See common parameters which follow for more detail…

DL Common Parameters:

x05= Delay On	**0…44 sec, 53…32768 sec or FB # 45…52** If VUI Function Block 45…52 then the value set at the connected VUI will be the Delay On time in seconds. VUI Sensor Type 6 should be used (Pulse Count type)	
x06= Delay Off	**0…44 sec, 53…32768 sec or FB # 45…52** If VUI Function Block 45…52 then the value set at the connected VUI will be the Delay Off time in seconds. VUI Sensor Type 6 should be used (Pulse Count type)	
x07= Output OR	FB #	Function Block which will override this block on
x08= Output AND	FB #	Function Block which will enable this block

Virtual Universal Input

VUI1…8 **Point 45…52** **BACnet Object** AV45…52 **Sub-parameters** 00…02

	VIRTUAL UNIV. IN		
	VUI 1	45	0
…00	0	Ctc	Sen. Type
…01	0	Output OR / Min.	
…02	0	Output AND / Max.	

x= **Power-up default** **Numerical** value related to sensor range
0 or **1** for digital Sensor Type

x00= Sensor Type	**0…9**	See specific device's 'Sensor Type' selection for analogue sensor and digital input choices
x01= Output OR / Min.	**FB #**	Digital Function Block which will override this block on2
	FB #	Analogue Function Block which sets minimum limitation
x04= Output AND / Max.	**FB #**	Digital Function Block which will enable this block
	FB #	Analogue Function Block which sets maximum limitation

x00= Sensor Type	**10**	Hours Run logging
x01= Output OR	**FB #**	Function Block that will reset and hold-off logging when >0. Restart logging by setting this FB back to 0
x02= Output AND	**FB #**	Function Block who's high state duration in Hours will be cumulatively logged

Note: Hours Run value will be displayed to 0.1 Hrs resolution. However, when the Hours Run value is used for control purposes in an application only the Hours whole number should be considered; the decimal point increment will be ignored in any control process

x00= Sensor Type	**11**	**Minutes Run logging**
x01= Output OR	**FB #**	Function Block that will reset and hold-off logging when >0. Restart logging by setting this FB back to 0
x02= Output AND	**FB #**	Function Block who's high state duration in Minutes will be cumulatively logged

Analogue Logic

AL1…8 **Point 53…60** **BACnet Object** AV53…60 **Sub-parameters** 00…12

	ANALOG LOGIC		
	AL 1	53	0
…00	0	NA	Function
…01	6	Sensor Type	
…02	0	Input 1	
…03	0	Input 2	
…04	0	Input 3	
…05	0	Input 4	
…06	0	Offset	
…07	0	Value In 1	
…08	0	Value Out 1	
…09	1000	Value In 2	
…10	1000	Value Out 2	
…11	0	Output OR / Min.	
…12	0	Output AND / Max.	

x00= Logic Function 1 (Max), 2 (Min), 3 (Avg), 4 (Signal Select), 5 (+), 6 (-), 7 (*), 8 (÷), 9 (Eco), 10 (Proportion), 11 (VAV), 12 (Up/Down Counter), 13 (instantaneous thermal Power), 14 (Compare inputs)

x01= Sensor Type 0…9 See specific device's 'Sensor Type' selection for analogue sensor and digital choices

Max / Min / Avg / Sum(+) :

x02=	**Input 1**	**FB #**	1 of up to 4 Function Block outputs included in logic result
x03=	**Input 2**	**FB #**	2 of up to 4 Function Block outputs included in logic result
x04=	**Input 3**	**FB #**	3 of up to 4 Function Block outputs included in logic result
x05=	**Input 4**	**FB #**	4 of up to 4 Function Block outputs included in logic result

Subtraction(-) :

x02=	**Input 1**	**FB #**	The block who's output is the starting value (base)
x03=	**Input 2**	**FB #**	The 1st block who's output will be subtracted from the base
x04=	**Input 3**	**FB #**	The 2nd block who's output will be subtracted from the base
x05=	**Input 4**	**FB #**	The 3rd block who's output will be subtracted from the base

Multiplication(*) / Division(÷) :

x02=	**Input 1**	**FB #**	The block who's output is the starting value (base)
x03=	**Input 2**	**FB #**	The block who's output is the multiplier / divider

Signal Select :

x02=	**Input 1**	**FB #**	The block who's output value decides the selection output result. The connected block's Sensor Type must be set as Pulse Count (x00=6) to ensure whole number scaling throughout the function processing. The applied values may be; **0** - output Input 2 value **1** - output Input 3 value **2** - output Input 4 value
x03=	**Input 2**	**FB #**	The 1st block who's output will be included in the selection
x04=	**Input 3**	**FB #**	The 2nd block who's output will be included in the selection
x05=	**Input 4**	**FB #**	The 3rd block who's output will be included in the selection

Economy Changeover:

x02=	**Input 1**	**FB #**	UI for Room/Return Air Temperature (RAT)
x03=	**Input 2**	**FB #**	UI for Room/Return Air Humidity (RAH) – optional*
x04=	**Input 3**	**FB #**	UI for Outside Air temperature (OAT)
x05=	**Input 4**	**FB #**	UI for Outside Air Humidity (OAH) – optional*

- The AL output is Digital (On/Off) based on temperature comparison when only IN1 & IN3 are connected
- The AL output is Digital based on actual Enthalpy comparison when IN1… IN4 are connected
- The AL output is Analogue actual room/return air Enthalpy when only IN1 & IN2 are connected*
- The AL output is Analogue true outside air Enthalpy when only IN3 & IN4 are connected*

* When analogue Enthalpy, assign any Sensor Type from 0…5 which is not used by other inputs, set units at Linearisation Table rows 1…3 (**kJ** for example) and set row 13 value as **-1** for output value resolution to one (1) decimal place. Other row values for the selected Sensor Type may be ignored

Proportion:

x02=	**Input 1**	**FB #**	The block who's output ranges from 0…100 as the driver of the proportional output range Input 2…Input 3
x03=	**Input 2**	**FB #**	The block who's output will be the result minimum value
x04=	**Input 3**	**FB #**	The block who's output will be the result maximum value

VAV Volume:

x02=	**Input 1**	**FB #**	The UI to which the velocity sensor is connected
x03=	**Input 2**	**FB #**	The VUI who's value represents the Duct Area
x04=	**Input 3**	**FB #**	The VUI who's value represents the velocity Probe Factor
x05=	**Input 4**	**FB #**	The VDI used to activate the AutoCalibrate at zero airflow

Count UP / Count DOWN:

x02=	**Input 1**	**FB #**	The DI or UI who's pulsed activation will increment the counter upwards
x03=	**Input 2**	**FB #**	The DI or UI who's pulsed activation will increment the counter downwards. If not used then the pulse at Input 1 will scroll up then roll over to the start value
x06=	**Offset**		**Numerical** maximum value to be attained by the counter before it (the value at which the counter rolls over to zero when Input 1 only is used)
x08=	**Value Out 1**		**Numerical** enter x08=1 if the counter should skip zero (0)

Thermal Power:

x02=	**Input 1**	**FB #**	The UI who's value is the HIGH temperature for the Δt calculation
x03=	**Input 2**	**FB #**	The UI who's value is the LOW temperature for the Δt calculation
x04=	**Input 3**	**FB #**	The UI who's value is the instantaneous flow rate
x05=	**Input 4**	**FB #**	The VUI who's value is the thermal constant of the medium being monitored, expressed as an whole number up to five digits
x06=	**Offset**		**Numerical** Offset +/- * 10^1, 10^2,… (enter -1, -2…1, 2, … etc.) for scaling the function block output according the true decimal placement of the thermal constant set at parameter x05

Compare:

x01= Output Type 7 Digital on/off

x02= Input 1 **0…5** In previous V4.02 versions this was a FB#. The connected FB was the 0…5 setting facility. From November 2014 the 0…5 choice is set directly at In1 sub-parameter

0 – EQUALS (=)

IF (In2 ≥ In3 + In4 – Offset) AND (In2 ≤ In3 + In4 + Offset) THEN ON, ELSE OFF
This function provides an On window of operation with a span magnitude equal to the Offset value x 2. If the Offset value is zero then the function result is purely an EQUALS result.

1 – NOT EQUAL (≠)

IF (In2 < In3 + In4 – Offset) OR (In2 > In3 + In4 + Offset) THEN ON, ELSE OFF
This function provides an Off window of operation with a span magnitude equal to the Offset value x 2. If the Offset value is >0 then the Offset value x2 defines the operation Dead-band. If the Offset value is zero then the function result is purely a NOT EQUALS result.

2 – GREATER Than (>)

IF (In2 > In3 + In4) THEN ON, ELSE IF (In2 ≤ In3 + In4 – Offset) THEN OFF
This function provides a hysteresis based operation whereby the result is On when In2 value exceeds the threshold and Off when In2 falls to the threshold less the Offset value

3 – GREATER Than or EQUALS (≥)

IF (In2 ≥ In3 + In4) THEN ON, ELSE IF (In2 < In3 + In4 – Offset) THEN OFF
This function provides a hysteresis based operation whereby the result is On when In2 value equals or exceeds the threshold and Off when In2 falls below the threshold by the Offset value

4 – LESS Than (<)

IF (In2 < In3 + In4) THEN ON, ELSE IF (In2 ≥ In3 + In4 + Offset) THEN OFF
This function provides a hysteresis based operation whereby the result is On when In2 value falls below the threshold and Off when In2 rises to equal or exceed the threshold plus the Offset value

5 – LESS Than or EQUALS (≤)

IF (In2 ≤ In3 + In4) THEN ON, ELSE IF (In2 > In3 + In4 + Offset) THEN OFF
This function provides a hysteresis based operation whereby the result is On when In2 value equals or falls below the threshold and Off when In2 exceeds the threshold plus the Offset value

x03= Input 2 **FB #** The block who's output value is the basis of the comparison

x04= Input 3 **FB #** The first block who's value is to be compared against In2 value

x05= Input 4 **FB #** The second block, if needed, who's value is to be compared with (added to the value at In3)

x06= Offset/Hysteresis **+/- 0…44, 53…32768 or FB # 45…52**
The 3rd value In1 is compared with as a constant in the comparison. This value may be 0 (zero).
If VUI Function Block 45…52 then the value set at the connected VUI will be the Offset/Hysteresis value. VUI Sensor Type 6 should be used (Pulse Count type)

AL Common settings:

x06=	**Offset**	**Numerical**	Multiplication, VAV Volume, Power: Offset +/- * 10^1, 10^2,… (enter 1, 2, … etc.). Other functions; Offset +/- by the entered number as an absolute value
x07=	**Value In 1**	**Numerical**	Shift influence start value
x08=	**Value Out 1**	**Numerical**	Shifted output Min. value
x09=	**Value In 2**	**Numerical**	Shift influence stop value
x10=	**Value Out 2**	**Numerical**	Shifted output Max. value
x11=	**Output OR / Min.**	**FB #**	Digital Function Block which will override this block on
		FB #	Analogue Function Block which sets minimum limitation
X12=	**Output AND / Max.**	**FB #**	Digital Function Block which will enable this block
		FB #	Analogue Function Block which sets maximum limitation

Control Loop

CL1…8	**Point 69…76**	**BACnet Object**	**Sub-parameters**
		AV69…76	00…10
Proportional Band	Point 77…84	AV77…84	
Integral Time	Point 85…92	AV85…92	

	CONTROL LOOP		
	CL 1	69	0
…00	0	Start / Stop	
…01	0	Sensor Input	
	Current Setpoint		61
…02	0	Occupied Setpoint	
…03	0	Unocc. Setpoint	
…04	0	Protect. Setpoint	
…05	0	Deadband	
	10	P Band	77
	180	Int Time	85
…06	92	Setpoint Max.	
…07	-10	Setpoint Min.	
…08	0	Direct Acting	
…09	0	Output OR / Min.	
…10	0	Output AND / Max.	

x00=	**Start/Stop**	**FB #**	Function Block output which will start or stop the control; **0** - Select Protection setpoint if used, else Stop **1** - Select Unoccupied setpoint if used, else Occupied setpoint **2** - Select Occupied setpoint
x01=	**Sensor Input**	**FB #**	Function Block output which is the value to be controlled
x02=	**Occupied Setpoint**	**FB #**	Function Block output which is the Occupied setpoint
x03=	**Unoccupied Setpoint**	**FB #**	Function Block output which is the Unoccupied setpoint
x04=	**Protection Setpoint**	**FB #**	Function Block output which is the Protection setpoint
x05=	**Setpoint Deadband**	**Numerical** value to be added to the active Setpoint value in a Direct Acting CL block and subtracted from the active Setpoint in a reverse acting CL block	
x06=	**Setpoint Max.**	**Numerical** maximum setpoint limitation	
x07=	**Setpoint Min.**	**Numerical** minimum setpoint limitation	
x08=	**Control Sequence**	**0** Direct Acting, **1** Reverse Acting, **2** Direct Acting 50% at setpoint, **3** Reverse Acting 50% at setpoint DA50 and RA50 may be used for 3-point actuator control or heat/cool (for example) from one CL block where the loop output equals 50% at setpoint	
X09=	**Output OR / Min.**	**FB #** **FB #**	Digital Function Block which will override this block on Analogue Function Block which sets minimum limitation
X10=	**Output AND / Max.**	**FB #** **FB #**	Digital Function Block which will enable this block Analogue Function Block which sets maximum limitation

Clock Channel

CLK1…4 **Point 101…104** **BACnet Object** BV101…104 **Sub-parameters** 00…01

	CLOCK		
	CLK 1	101	OFF
…00	0	Output OR	
…01	0	Output AND	

x00=	**Output OR**	**FB #**	Function Block which will override this block on
x01=	**Output AND**	**FB #**	Function Block which will enable this block

Clock channels are present in HPD0460…T versions. The 365 day calendar / Holidays operation is set via the device LCD and setting keys.

Network Interface Object

NIO1…48 **Point 105…152** **BACnet Object** BV105…152 AV105…152 **Sub-parameters** 00…07

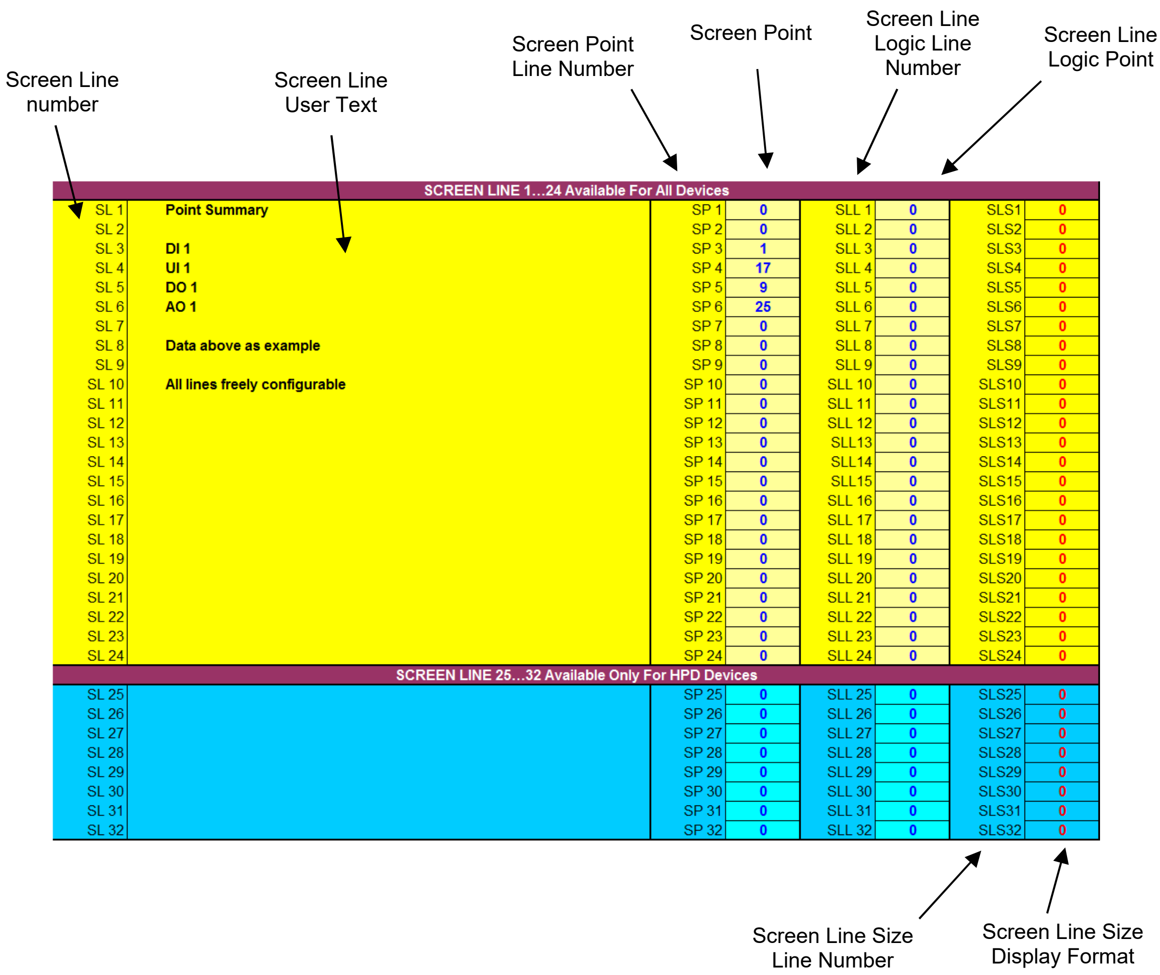
	NETWORK INTERFACE		
	NIO 1	105	0
…00	0	Dev Inst	
…01	0	Obj Type	
…02	0	Obj Inst	
…03	0	SType	
…04	0	Read In	
…05	0	Read Scaling	
…06	0	Output OR / Min.	
…07	0	Output AND / Max.	

x00=	**Device Instance**	**Numerical** Network Node # of the Device who's object value will be either read in to the NIO or written to by the NIO. Whether the NIO is reading or writing is defined at parameter x04	
x01=	**Object Type**	**0** Not used, **1** BI, **2** BV, **3** BO, **4** AI, **5** AV, **6** AO	
x02=	**Device Instance**	**Numerical** Object Instance # within the network node being written to or read from	
x03=	**Sensor Type**	**0…9**	See specific device's 'Sensor Type' selection for analogue sensor and digital input choices. This setting defines what units will be displayed for the NIO result and any scaling to be applied if parameter x 05=1 (Raw value read scaling)
x04=	**Read/Write**	**0**	Read in from target network device's object instance
		FB #	who's value will be written out to target network device's object instance
x05=	**Read Scaling**	**0**	Use value in read format, applying only Sensor Type units to the value for display purposes
		1	For pulse count registers that require scaling according to linearization table rows 13 & 14 settings of the applied Sensor Type
X06=	**Output OR / Min.**	**FB #**	Digital Function Block which will override this block on
		FB #	Analogue Function Block which sets minimum limitation
X07=	**Output AND / Max.**	**FB #**	Digital Function Block which will enable this block
		FB #	Analogue Function Block which sets maximum limitation

Point Summary Screen

The Summary Screen allows the user to create terminal display of important application measurements and statuses using their own terminology. HPC, HPE and HPV devices support 24 lines of user display in terminal mode. HPD devices support 32 lines in terminal mode and on the LCD.

Screen Features



SCREEN LINE 1…24 Available For All Devices							
SL 1	Point Summary	SP 1	0	SLL 1	0	SLS1	0
SL 2		SP 2	0	SLL 2	0	SLS2	0
SL 3	DI 1	SP 3	1	SLL 3	0	SLS3	0
SL 4	UI 1	SP 4	17	SLL 4	0	SLS4	0
SL 5	DO 1	SP 5	9	SLL 5	0	SLS5	0
SL 6	AO 1	SP 6	25	SLL 6	0	SLS6	0
SL 7		SP 7	0	SLL 7	0	SLS7	0
SL 8	Data above as example	SP 8	0	SLL 8	0	SLS8	0
SL 9		SP 9	0	SLL 9	0	SLS9	0
SL 10	All lines freely configurable	SP 10	0	SLL 10	0	SLS10	0
SL 11		SP 11	0	SLL 11	0	SLS11	0
SL 12		SP 12	0	SLL 12	0	SLS12	0
SL 13		SP 13	0	SLL13	0	SLS13	0
SL 14		SP 14	0	SLL14	0	SLS14	0
SL 15		SP 15	0	SLL15	0	SLS15	0
SL 16		SP 16	0	SLL 16	0	SLS16	0
SL 17		SP 17	0	SLL 17	0	SLS17	0
SL 18		SP 18	0	SLL 18	0	SLS18	0
SL 19		SP 19	0	SLL 19	0	SLS19	0
SL 20		SP 20	0	SLL 20	0	SLS20	0
SL 21		SP 21	0	SLL 21	0	SLS21	0
SL 22		SP 22	0	SLL 22	0	SLS22	0
SL 23		SP 23	0	SLL 23	0	SLS23	0
SL 24		SP 24	0	SLL 24	0	SLS24	0
SCREEN LINE 25…32 Available Only For HPD Devices							
SL 25		SP 25	0	SLL 25	0	SLS25	0
SL 26		SP 26	0	SLL 26	0	SLS26	0
SL 27		SP 27	0	SLL 27	0	SLS27	0
SL 28		SP 28	0	SLL 28	0	SLS28	0
SL 29		SP 29	0	SLL 29	0	SLS29	0
SL 30		SP 30	0	SLL 30	0	SLS30	0
SL 31		SP 31	0	SLL 31	0	SLS31	0
SL 32		SP 32	0	SLL 32	0	SLS32	0

Screen Line (SL)

Screen Lines accept alpha numeric characters and standard mathematical operators. The number of lines and characters per line are device specific:

Device	Lines	Characters
HPC, HPE, HPV	32	40
HPD	32	21 in small font, standard number format 16 in small font, long number format 9 in large font, standard number format 4 in large font, long number format

Screen Point (SP)

Screen Points are dynamic display points that can be assigned along with the Screen Line text. Any of the function block points may be assigned as a Screen Point.

In terminal mode the value is dynamically updated every 10 seconds or whenever the enter key is pressed.

In HPD devices the LCD values are updated every 6 seconds. Note that the LCD is not updated when the device is in terminal mode (during engineering).

Screen Line Logic (SLL)

Screen Line Logic creates dynamic text in a Screen Line; the text is hidden and will only appear in the Summary Display when the SLL point value >0.

This feature is designed for displaying warning or alarm text associated with an alarm point in an application. This is particularly suited to alarm text display on the LCD of the HPD devices.

The SL text associated with SLL points should be placed last in the display sequence and without any SP assigned. If an SP is also assigned then the text will appear in the normal display and will also be displayed at the top of the display when the SLL point has a value >0.

Screen Line Size (SLS)

The ability to set a large display font applies to HPD devices only. The choices are small or large font for the SL text and SP point and standard or long number format for the SP point value display.

SLS1…32=
0 Small Font, 21 characters / 5 digit point number format
1 Small Font, 16 characters / 8 digit point number format
2 Large Font, 9 characters / 5 digit point number format
3 Large Font, 4 characters / 8 digit point number format

If more text characters are required for description of a long number format value then use one screen line for the text descriptor only and the following screen line for the point value (and additional text descriptor if required).

UI Linearisation Tables

Six user configurable linearization tables are available for setting sensor units and for scaling the inputs according to the sensor's measuring range (active sensors). The tables are also applied to NIO function blocks for the purpose of assigning units tags to NIO displays and, in the case of NIO read-in of whole number meter registers, assignment of units tags and scaling factors if required.

Table Features

LINEARISATION (Sensor Types)							
	1	2	3	4	5	6	7
	Ref.	Type 0	Type 1	Type 2	Type3	Type4	Type5
1		C	C	%	%	C	C
2		t	n	V	m	p	t
3		c	i	1	A	t	x
4	0	852	243	0	200	205	819
5	150	723	319	150	320	339	695
6	300	554	393	300	440	466	546
7	450	385	465	450	560	586	399
8	600	249	535	600	680	699	277
9	750	154	604	750	800	806	188
10	900	95	671	900	920	908	124
11	1020	59	723	1007	1007	979	89
12		-100	-100	0	0	-100	-100
13		-1	-1	-1	-1	-1	-1
14		1	1	1	1	1	1

Column numbers
Row numbers
Sensor Types
Units tags
Microprocessor input raw count value in respect to reference value
Engineered Curve Reference values
Multiplier
Decimal shift (Slope)
Intercept

Reference Column

The reference column is fixed and is the basis of the engineered display and calculation result for any sensor type. The nominal range is 0…1000.

Examples:

- A 0-10Vdc sensor (Type 2) with decimal shift -1 (x0.1) and multiplier 1 will display as 0…100 range. The units setting %V1 means that the display will be 0…100 %V1
- If the decimal shift is changed to -2 (x0.01) then the result will be 0…10 in which case the units can be changed to include the 'V' only (0…10V)
- If the decimal shift is changed to 0 (x1) then the result will be 0…1000 (the reference column range without any manipulation)

Sensor Type Columns/Rows

The Sensor Type 0…5 data (columns 2…7) may be customised for passive sensors from 1kΩ and higher by setting microprocessor raw count data for a given resistance at a given reference value. Active sensors may be scaled by setting the parameters at rows 12…14. Unit tag customisation is made at rows 1…3.

The default raw curve data for 0-10Vdc and 4…20mA sensors (Type 2 & 3 respectively) at rows 4…11 can be copied to other columns when multiple sensors of the same element are used but require different units tags and/or scaling. The 0-10Vdc curve data can be used for 0…20mA sensors and the 4…20mA data can also be used for 2…10Vdc sensors.

Units Tags (Rows 1…3)

Unit tag customisation is made at rows 1…3. These may be changed to suit the measured value (PPM, Pa, Bar as examples). For a blank space in any of these three fields then enter a space (keyboard Space Bar).

Decimal Shift (Row 13)

The decimal shift manipulates the 0…1000 reference range in a factor of 10.

Shift setting	Resultant Range	Slope (P1 devices)
0	0…1000	1
-1	0…100.0	0.1
-2	0…10.00	0.01
-3	0…1	0.001
-4	0…0.1	0.0001
1	0…10000	10
2	0…100000	100
3	0…1000000	1000

Example: A 4…20mA sensor measuring 0…10 Bar would use a decimal shift of -2 at row 13 to change the reference range from 0…1000 to 0…10.00

Multiplier (Row 14)

The multiplier manipulates the 0…1000 reference range in a factor of 1…9.

Example: A 0-10Vdc sensor measuring 0…2000 PPM would use a multiplier 2 at row 14 to change the reference range from 0…1000 to 0…2000

Intercept (Offset)

The intercept provides a shift from the standard 0…1000 reference range. An intercept of -20 will result in a -20…980. The possible setting range is -32000…32000.

Important: The intercept value entered will be processed with the decimal shift and the multiplier before being applied to the reference value.

Example: Decimal shift = -1 and -20 shift required. Enter -200 in the intercept cell (-200 x 0.1=-20)

Shift+Multiplier

Using a combination of row 12…13 settings a wide range of sensor scales may be created.

Example: 0-10Vdc sensor with measurement 0…50°C.

- Base reference 0…1000
- Decimal shift at row 13 = -2 results in 0…10 range
- Multiplier at row 14 = 5 gives final result of 0…50
- If the range should be -5…45 then to achieve -5 offset the intercept at row 12 = -100
  (-100 / 100 decimal shift x 5 multiplier = 5)

Sensor Types

Default sensor linearisations are as follows:

Type	Element	Default Units Tag	Range
0	Passive 100k NTC	Ctc	-10…90°C
1	Passive Nickel 1000	Cni	-10…90°C
2	Active 0-10Vdc	%V1	0…100%
3	Active 4…20mA	%mA	0…100%
4	Passive PT1000	Cpt	-10…90°C
5	Passive 10k NTC, curve G	Ctx	-10…90°C

All default passive sensor ranges are set with -10°C intercept which means the raw count value at -10 is entered in to the 0 reference row. The 5°C raw count is entered at the 15 reference row, and so on.

Custom Passive Sensors

Other passive sensors such as 5kΩ, 8kΩ, 20kΩ can be configured in the linearization tables. Please provide us with the sensor temperature/resistance table and measurement range required.

Network Settings

Each device has factory default settings depending on the communication protocol utilised. Generally these settings are customised at the time of downloading the application as each device is unique.

However, it is possible to include network settings in the application file download by way of the Network Settings block at the top of the FuncProg canvas. If no change is made in the FuncProg settings facility then the normal factory default settings will remain and can be manually changed via Terminal connection.

Network Settings	Common:		BACnet only:	
Optional text	Address / MAC	0	Device Instance	0
download items	Baudrate	0	Maximum Master	0

Address / MAC

The local RS485 network address

- Factory default = 98
- BACnet MS/TP devices
  - o 1…98 or 100…127 for Token-Passing-Master operation
  - o 128…247 for Slave operation
- Modbus RTU
  - o 1…98 or 100…247
- P1 FLN
  - o 1…32

Baudrate

The network communication speed

- 2400
- 4800 – P1 FLN factory default
- 9600 – BACnet MS/TP & Modbus RTU default
- 19200
- 38400
- 57600
- 76800

The device will run at the current baudrate until the new baudrate setting is Written (W). The Write is automatic when setting is changed during text file download process.

After the Write is made then you will need to reconnect the terminal program at the new baudrate to continue the terminal session.

Device Instance

Only for BACnet MS/TP devices. This is the system wide unique identifier

- Factory default = 1098
- Maximum value 4194303

Maximum Master

Only for BACnet MS/TP devices. The MM setting serves to improve network data efficiency by indicating to devices in the network how many devices are operating in Master mode, ensuring the last device on the network does not waste time searching for non-existent devices

- Factory default = 127
- May not be less than the Address / MAC value
- Should be set equal to, or only slightly higher than, the highest local network Address / MAC existing in the network
- Recommendations for time-efficient network data exchange;
    - Set device addresses sequentially starting at #1
    - If 15 devices in the network then set addresses as #1, #2, #3,…#15
    - In this case set MM=15

Device List

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
HPC0662MR	Universal Controller, 12 Point, Modbus RTU 485, 24Vac
HPC8884MR	Universal Controller, 28 Point, Modbus RTU 485, 24Vac
HPD0460MR	Network HMI, 12 Point, Modbus RTU 485, 24Vac
HPD0460MRC	Network HMI / Universal Controller, 10 Point, Modbus RTU 485, 24Vac
HPD0460MRCT	Network HMI / Universal Ctrl / Scheduler, 10 Point Modbus RTU 485, 24Vac
HPD0460MRT	Network HMI / Scheduler, 10 Point, Modbus RTU 485, 24Vac
HPE0662MR	I/O expansion, 12 Point, Modbus RTU 485, 24Vac
HPE8884MR	I/O expansion, 28 Point, Modbus RTU 485, 24Vac
HPV0662MR	VAV / Universal Controller, 13 Point, Modbus RTU 485, 24Vac
HPC0662P1	Universal Controller, 12 Point, P1 FLN, 24Vac
HPC8884P1	Universal Controller, 28 Point, P1 FLN, 24Vac
HPD0460P1	Network HMI, 12 Point, P1 FLN, 24Vac
HPD0460P1C	Network HMI / Universal Controller, 10 Point, P1 FLN, 24Vac
HPD0460P1CT	Network HMI / Universal Ctrl / Scheduler, 10 Point, P1 FLN, 24Vac
HPD0460P1T	Network HMI / Scheduler, 10 Point, P1 FLN, 24Vac
HPE8884P1	I/O expansion, 28 Point, P1 FLN, 24Vac
HPV0662P1	VAV / Universal Controller, 13 Point, P1 FLN, 24Vac
HSD0011	Room sensor, occupancy button, terminal access port Connect to HRW controller with RJ11 < > RJ11 (6P6C). May be used with controllers of other manufacture.
HSD0012	Room sensor, set point adjuster, occupancy button, terminal access port Connect to HRW controller with RJ11 < > RJ11 (6P6C). May be used with controllers of other manufacture.

Accessories

HPECOMU Configuration cable (USB <> RJ11)

UI Raft for HP_8884 UI1…UI8 (one raft per UI):

HPE-RA010	Active 0-10Vdc, Order in multiples of 50
HPE-RA420	Active 4…20mA, Order in multiples of 50
HPE-RC1090	Passive 100k NTC -10…90°C, Order in multiples of 50
HPE-RN1090	Passive Ni1000 -10…90°C, Order in multiples of 50
HPE-RP1090	Passive PT1000 -10…90°C, Order in multiples of 50
HPE-RS1090	Passive 20k NTC -10…90°C, Order in multiples of 50
HPE-RX1090	Passive 10k NTC -10…90°C, Order in multiples of 50 (factory default)

UI Raft for HPC0662 UI1/UI2, UI3/UI4 or UI5/UI6, HPV0662 & HPD UI1/UI2 or UI3/UI4:

HPU2-RA010	Active 0-10Vdc, pack of 50
HPU2-RA420	Active 4…20mA, pack of 50
HPU2-RC1090	NTC100k -10…90°C, pack of 50
HPU2-RX1090	NTC10k -10…90°C, pack of 50 (factory default)

HDA0002	DIN rail adapter brackets, factory fitted
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