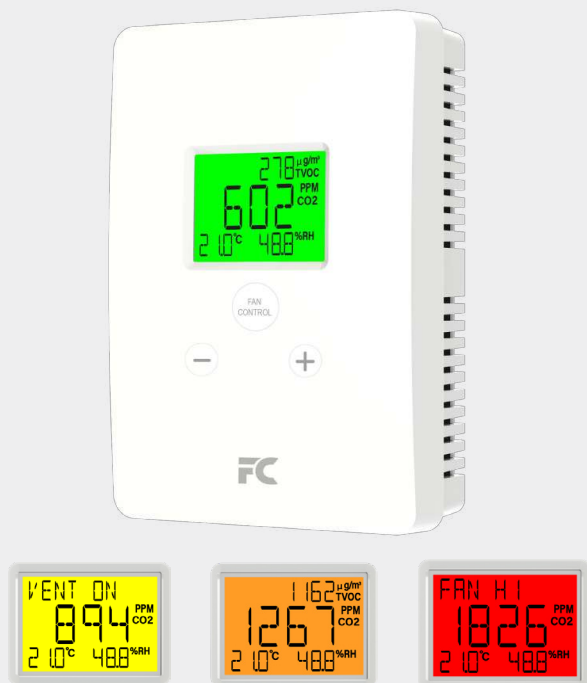




| OVERVIEW |

The new Smart Sensor from Flamefast Controls is one of the most versatile sensors available, with unrivalled levels of flexibility and a wide range of network writable inputs and outputs, effectively doubling up as a controller.

BACnet and Modbus are provided as standard, as are two 0-10V inputs to allow monitoring of external devices with an analogue output. With the optional I/O module, the Smart Sensor can also provide 3x 0-10V outputs, 1x Digital Input and 1x Relay Output, all of which are network writable, so can be driven remotely to control a wide range of HVAC systems.

With capacitive touch sensors providing either 1, 2 or 3 buttons on the front, the units can be fully configured to provide Temperature Set Point Adjust, Boost, and Fan Control facilities.

With the optional signature Flamefast multi-colour display, the sensor can provide a clear, bold indication of the air quality in the monitored space.

| KEY FEATURES |

- BACnet and Modbus as standard
- 24V AC/DC Power Supply
- Pluggable terminal block, with two 24V and 0V connections for ease of termination
- Optional multi colour display based on CO2 & TVOC levels (network writable)
- Multi-parameter device
- 2x Analogue Inputs for monitoring external devices
- Optional I/O Module with 3x AO, 1x DI, 1x DO (network writable)
- Optional Touch Button interface for:
 - Temperate Set Point Adjust
 - Fan Control / On-Off / Boost facility
- Typical 10+ year life expectancy
- **UK MANUFACTURED**

SMART SENSOR (SS)

CO2, TVOC, TEMP & RH (24V AC/DC)

DIMENSIONS

Height 125mm | Width 86mm | Depth 36mm

TECHNICAL SPECIFICATION

Power Supply	24V AC/DC $\pm 10\%$
Power Consumption	100mA Max
BACnet	MS/TP over RS485 (1/10th Load) Baud: 9k6, 19k2, 38k4 or 76k8 127 Addresses (508 Unit IDs with P1/P2)
Modbus	RTU over RS485 (1/10th Load) Baud: 9k6, 19k2 or 38k4 Parity Odd/Even, 1 or 2 Stop Bits 255 Address
Analogue Outputs	3x 0-10V (on I/O Module)
Analogue Inputs	2x 0-10V (2nd uses AO-3)
Binary Input	1x 24V Input (on I/O Module)
VFC Output	SPST – 100mA @ 24V Max (on I/O Module)
CO2 Range	0 - 10,000ppm
CO2 Output Scaling	0 - 2,000ppm
CO2 Accuracy	± 40 ppm $+3\%$ @ NTP
CO2 Display Resolution	1ppm
CO2 Sensing Method	Non Dispersive Infra-red (NDIR)
CO2 Typical Sensor Life	10+ Year
TVOC Range	0 - 2,000 μ g/m3
TVOC Output Scaling	0 - 2,000 μ g/m3
TVOC Accuracy	$\pm 5\%$ @ NTP
TVOC Display Resolution	1 μ g/m3
TVOC Sensing Method	Metal-oxide (MOx)
TVOC Typical Sensor Life	10+ Year
Temp Range	0 - 50°C
Temp Accuracy	$\pm 0.3^\circ\text{C}$ @ 25°C
Temp Display Resolution	0.1°C
RH Range	0 - 100%
RH Accuracy	$\pm 2\%$ @ 20 - 80%
RH Display Resolution	0.1%
Operating Conditions	Temp 0 - 50°C Humidity 0 - 95% (NC)
Sampling Method	Diffusion
IP Rating	IP40
Housing Material	PC/ABS
Colour	Pure White (RAL9010)
Approvals	CE, UKCA

PART NUMBERS & COMMON ACCESSORIES

PART NO	DESCRIPTION
SS-TH	Smart Sensor – Temp & RH
SS-CO2TH	Smart Sensor – CO2, Temp & RH
SS-AQTH	Smart Sensor – TVOC, Temp & RH
SS-CO2AQTH	Smart Sensor – CO2, TVOC, Temp & RH
SS-THL	Smart Sensor – Temp & RH c/w LCD
SS-CO2THL	Smart Sensor – CO2, Temp & RH c/w LCD
SS-AQTHL	Smart Sensor – TVOC, Temp & RH c/w LCD
SS-CO2AQTHL	Smart Sensor – CO2, TVOC, Temp & RH c/w LCD
- I	Smart Sensor I/O Module – 3xAO, 1xDI, 1xD
- T	Smart Sensor Touch Module (Setpoint Adjust)

Contact to discuss your touch module requirements.

INSTALLATION & OPERATION

SMART SENSOR

TECHNICAL SPECIFICATION

Power Supply	24V AC/DC $\pm 10\%$
Power Consumption	100mA Max
BACnet	MS/TP over RS485 (1/10th Load) Baud: 9k6, 19k2, 38k4 or 76k8 127 Address
Modbus	RTU over RS485 (1/10th Load) Baud: 9k6, 19k2 or 38k4 Parity Odd/Even, 1 or 2 Stop Bits 255 Address
Analogue Outputs	3x 0-10V
Analogue Inputs	2x 0-10V (2 nd uses AO-3)
Binary Input	1x 24V Input
VFC Output	SPST – 100mA @ 24V Max
CO2 Range	0 - 10,000ppm
CO2 Output Scaling	0 - 2,000ppm
CO2 Accuracy	± 40 ppm +3% @ NTP
CO2 Display Resolution	1ppm
CO2 Sensing Method	Non Dispersive Infra-red (NDIR)
CO2 Typical Sensor Life	10+ Year
TVOC Range	0 - 2,000 $\mu\text{g}/\text{m}^3$
TVOC Output Scaling	0 - 2,000 $\mu\text{g}/\text{m}^3$
TVOC Accuracy	$\pm 5\%$ @ NTP
TVOC Display Resolution	1 $\mu\text{g}/\text{m}^3$
TVOC Sensing Method	Metal-oxide (MOx)
TVOC Typical Sensor Life	10+ Year
Temp Range	0 - 50°C
Temp Accuracy	$\pm 0.3^\circ\text{C}$ @ 25°C
Temp Display Resolution	0.1°C
RH Range	0 - 100%
RH Accuracy	$\pm 2\%$ @ 20 - 80%
RH Display Resolution	0.1%
Operating Conditions	Temp: 0 - 50°C, Humidity: 0 - 95% (NC)
Sampling Method	Diffusion
Warm-up Time	5 Seconds
Colour	Wall - Pure White (RAL9010) Duct – Black/Clear
Approvals	CE, UKCA

IMPORTANT – Please read carefully:

1. This product must be installed by a competent/qualified person in accordance with all relevant regulations and legislations.
2. This product must be mounted flush to the wall (or similar) using secure fixings to prevent access to the rear.
3. The sensors must be continuously powered for auto-calibration purposes.
4. The use of solvents, cleaning fluids or fine dusts near to the unit can damage the sensing elements.
5. If there is any question over the application, please contact to discuss.
6. If this equipment is used in a manner not specified by the manufacturer, protection provided may be impaired.
7. This product is designed for indoor use with standard atmospheric conditions.

MOUNTING LOCATION

Application specific mounting positions should be considered, however the below guidance will be suitable for most installations.

Typical Mounting Heights:

Application	Mounting Height
General Areas	1500mm Above Finished Floor Level
Science Classrooms	1500mm Above Finished Floor Level
Food Tech Rooms	2500mm Above Finished Floor Level (not within 100mm of ceiling)
Kitchens	2500mm Above Finished Floor Level (not within 100mm of ceiling)

Important Notes:

- Do not install in high velocity air streams (near an air Inlet/Outlet).
- Do not install next to doors or opening windows.
- Do not install in direct sunlight.

INSTALLATION

All installation details shown on the wiring diagram should be followed carefully, failure to do so could result in irreparable damage to the unit.

Screened cable should be used at all times. Any voltage induction can result in corruption of the RS485 driver or irreparable damage to the sensor.

The connection details for the Wall and Duct mount units are the same, the only difference is the mounting.

Wall Mount Enclosure

The wall mount enclosure is designed to fit on a standard single gas junction box or conduit box. Please take care when tightening fixing screws as overtightening can distort the plastic.

To open/close:

1. Remove securing screw from the bottom of the enclosure.
2. Insert a flat screwdriver into the slot behind the screw and apply pressure until the bottom of the enclosure releases.
3. Pull the front of the enclosure outward from the bottom then up to release hooks securing the top.
4. When closing, hook the clips into place, then push the bottom until the securing clip fully engages.

Duct Mount Enclosure

The duct mount enclosure is IP66 external to the duct and although a foam gasket is provided, additional sealant may be required to maintain the integrity of the duct (the use of solvent based sealant may damage the sensing elements).

To open/close:

1. Remove securing screw from the lid of the enclosure.
2. Press on both securing clips simultaneously to release then simply open using the hinge mechanism.

OPERATION

On power up, the LCD will cycle through Green, Yellow, Amber, Red then White with all segments lit to prove the correct operation of the display. During this warm-up, the volt free contact will be in the default position for the selected programme and the analogue outputs will provide 6V.

Once the warm-up is complete, the LCD will display the levels for any connected sensors, provide a traffic light indication based on live CO2/TVOC level, the relay output will change to the correct position for the programme and the voltage outputs will reflect relevant levels.

If no CO2 sensor is present, the relay will be in an alarm state.

MAINTENANCE

Due to the CO2 Automatic Background Calibration (ABC) algorithm, the sensor is effectively maintenance free. Some applications may require this to be disabled – please contact Flamefast for further details. To allow calibration to take place, the sensor must be exposed to atmospheric levels (400ppm) for at least two hours every 8 days.

If the sensor is installed as part of a Gas Safety system, the sensor should be ‘bump’ tested by applying a CO2 test gas, although the same result can be achieved by breathing on the sensor.

TEMPERATURE & RELATIVE HUMIDITY

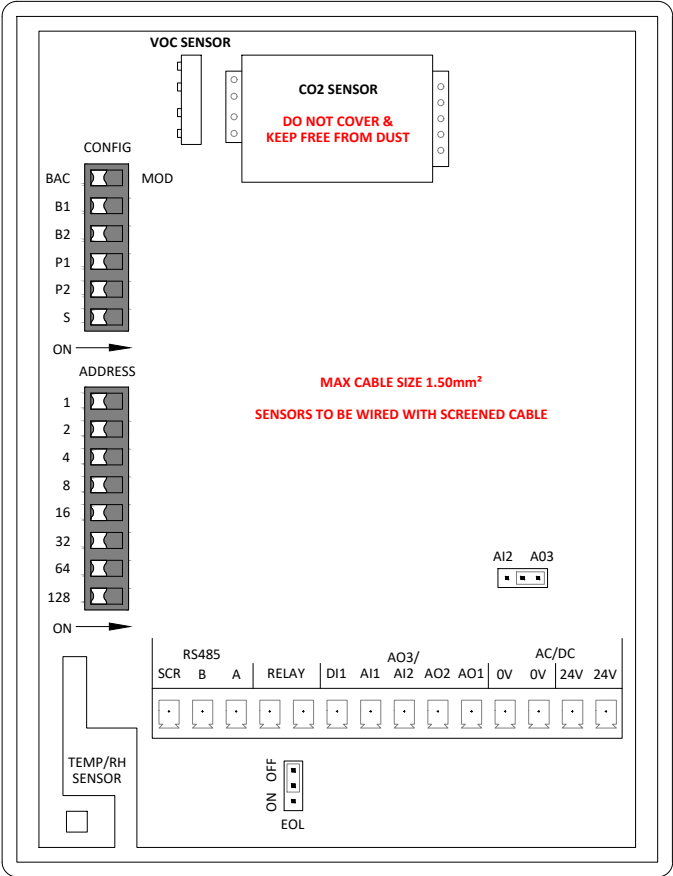
WARNING – whilst the unit is able to operate on 24V +10%, anything over 24V may adversely affect the temperature and relative humidity readings due to the additional heat generated by the voltage regulators.

This can be compensated for using AV-3 and AV-4. It is suggested to compensate at the target ambient levels.

TROUBLESHOOTING

If you are having any issues, please contact Flamefast to discuss.

CONNECTION DETAILS
SMART SENSOR



ADDRESS & RS485 CONFIGURATION

Table with 3 columns: Label, Configuration, Setting. It details MAC address configuration and address calculation examples for BACnet and Modbus.

Table with 4 columns: Label, Configuration, BACnet, Modbus. It shows configuration options for BACnet and Modbus communication.

Table with 3 columns: Modbus, Configuration, Baud Rate, Stop Bits & Parity. It defines Modbus communication parameters.

Table with 3 columns: BACnet, Configuration, Prefix for additional unique Object Identifiers. It lists BACnet object identifier prefixes.

Table with 2 columns: Label, Reserved. A single row indicating reserved status.

MODBUS SPECIFICATION
SMART SENSOR

Table with 5 columns: #, Configuration, Unit, Range, Default. It provides a detailed specification of Modbus registers and coils, including CO2 concentration, temperature, humidity, and various scaling and offset values.

BACNET SPECIFICATION

SMART SENSOR

BACnet Interoperability Building Blocks Supported (Annex K)

Description	BIBB	Comments
Read Property	DS-RP-B	
Read Property Multiple	DS-RPM-B	
Write Property	DS-WP-B	
Dynamic Device Binding	DM-DDB-B	Execute Who-Is, Initiate I-Am
Dynamic Object Binding	DM-DOB-B	Execute Who-Has, Initiate I-Have
Device Comm Control	DM-DCC-B	
Reinitialize Device	DM-RD-B	

BACnet Standard Object Types Supported

Object	No Of Instance	Instance Assignments
Device Object	1	
Analog Input	7	AI-1 CO2 AI-2 TVOC AI-3 Temperature AI-4 Relative Humidity AI-5 Analog/Voltage Input 1 AI-6 Analog/Voltage Input 2 AI-7 Setpoint Adjust
Analog Output	3	AO-1 Voltage output 1 AO-2 Voltage output 2 AO-3 Voltage output 3
Analog Value	10	AV-1 CO2 offset AV-2 TVOC offset AV-3 Temp offset AV-4 RH offset AV-5 CO2 Yellow set point AV-6 CO2 Amber set point AV-7 CO2 Red set point AV-8 TVOC Yellow set point AV-9 TVOC Amber set point AV-10 TVOC Red set point
Binary Input	1	BI-1 Digital Input
Binary Output	1	BO-1 Relay
Multi-state Input	2	MSI-1 LCD Backlight MSI-2 Momentary Switch

Device Object Properties (Required Object Properties)

Property Name /ID	Default	R/W
Object Identifier	1090000 + MAC_Address	R/W
Object Name	"FFSS_XXX", XXX = MAC address	R/W
Object Type	2	R
System Status	OPERATIONAL	R
Vendor Name	Flamefast (UK) Ltd	R
Vendor Identifier	1090	R
Model Name	FFSS	R
Location	Location	R/W
Description	Flamefast Smart Sensor	R/W
Application Software Revision	1.00	R
Protocol Version	1	R
Protocol Revision	10	R
Protocol Services Supported		R
Object List		R
Max APDU Length	480	R
Segmentation Support	NONE	R
APDU Timeout	3000 ms	R
Number APDu Retries	3	R
MaxMaster	127	R
Max_Info_Frames	1	R
Database Revision	0	R

Temperature Setpoint Adjust (AI-7)

The temperature setpoint is defined by Analog Input 7 (AV-5). When the PLUS and MINUS buttons on the front of the sensor are pressed, this adjusts the temperature setpoint by using Analog Input 7 (AI-7). The minimum and maximum temperature setpoints are set within the AI object, as is the resolution which can be set to 0.5 of 1.0 degrees Celsius.

Momentary Button Control Facility (MSI-2)

The Momentary button controls MSI-2, and can be configured to provide up to 8 states. Line 1 of the display can be set to display the State Text permanently or momentarily.

This can be configured to control and of the Analogue Outputs or Binary Output 1 (BO-1) depending on the setting of Proprietaries 1000 to 1003.

PRESSING A BUTTON WILL DISPLAY A WHITE BACKLIGHT FOR 5 SECONDS.

Proprietary Properties

Property ID	Description	Range
1000	Analogue Output 1 (Default 5)	0 = Network Writable 1 = AI-1 CO2 2 = AI-2 TVOC 3 = AI-3 Temperature 4 = AI-4 Relative Humidity 5 = AI-1/2 CO2/TVOC Peak Value 6 = MSI-2 Step Based No States
1001	Analogue Output 2 (Default 3)	
1002	Analogue Output 3 (Default 4)	
1003	Binary Output 1 (Default 1)	0 = Network Writable 1 = AI-1 CO2 2 = AI-2 TVOC 3 = AI-3 Temperature 4 = AI-4 Relative Humidity 5 = MSI-2 Max 2 States
1004	Relay set point	1000.0 (depends on program)
1005	Relay hysteresis	50.0
1006	LCD Backlight Brightness (Default 100) <i>No CO2/TVOC Sensor Default 0</i>	0, 25, 50, 75, 100%
1007	LCD Config (Based on unit ordered) No CO2/No TVOC CO2 TVOC CO2/TVOC CO2/TVOC/Momentary CO2/TVOC/Momentary (Must Select) <i>Unit will default to the above on power up, unless set over BACnet.</i>	Line 1 1 = MSI State* Temp 2 = MSI State* CO2 3 = MSI State* TVOC 4 = TVOC CO2 5 = MSI State CO2/TVOC (5s) 6 = TVOC CO2 <i>*Blank if parameter not present</i>
1008	Display Temp (Default 1)	0 = Off 1 = On
1009	Display RH (Default 1)	0 = Off 1 = On
1010	CO2 Auto-Calibration (Default 1)	0 = Off 1 = On
1011	Force Calibrate (in Air)	1 = Calibrate
1012	Factory Reset	1 = Factory Reset
1020	MSI-2 Time Delay (1 to 86,400) (Reverts to State 1)	0 = Disabled 1+ = Seconds
1021 - 1028	MSI-2 State 1 to Sate 8 Text	Max 8 Characters

Analog Input Objects

Property Name /ID	Comments/Default Value	R/W
Object Identifier	OBJECT_ANALOG_INPUT:X	R
Object Name	AI-1 CO2 AI-2 TVOC AI-3 Temperature AI-4 Relative Humidity AI-5 Analog/Voltage Input 1 AI-6 Analog/Voltage Input 2 AI-7 Setpoint Adjust	R R R R R/W R/W R/W
Object Type	0	R
Present Value	REAL	R/W
Status Flag	0000	R
Event State	NORMAL	R
Out-Of-Service	FALSE	R/W
Units	AI-1 PART-PER-MILLION AI-2 MICROGRAMS-PER-CUBIC-METER AI-3 DEGREES-CELSIUS AI-4 PERCENT-RELATIVE-HUMIDITY AI-5 VOLTS AI-6 VOLTS AI-7 DEGREES-CELSIUS	R R R R R/W R/W R/W
Min Pres Value	AI-1 0 (0 to 10000) AI-2 0 (0 to 5000) AI-3 0.0 (0.0 to 50.0) AI-4 0.0 (0.0 to 100.0) AI-5 0 (0.00 to 10.00) AI-6 0.0 (0.00 to 10.00) AI-7 18.00 (0.0 to 50.0)	R R R R R/W R/W R/W
Max Pres Value	AI-1 5000 (0 to 10000) AI-2 2000 (0 to 5000) AI-3 50.0 (0.0 to 50.0) AI-4 100.0 (0.0 to 100.0) AI-5 10.00 (0.00 to 10.00) AI-6 50.0 (0.00 to 10.00) AI-7 23.00 (0.0 to 50.0)	R R R R R/W R/W R/W
Resolution	AI-1 1 AI-2 1 AI-3 0.1 AI-4 0.1 AI-5 0.01 AI-6 0.01 AI-7 0.5 (0.5 or 1.0)	R R R R R/W R/W R/W

BACNET SPECIFICATION

SMART SENSOR

Analog Output Objects

Property Name /ID	Default	R/W
Object Identifier	OBJECT_ANALOG_OUTPUT:X	R
Object Name	AO-1 Voltage Output 1 AO-2 Voltage Output 2 AO-3 Voltage Output 3	R/W
Object Type	1	R
Present Value	REAL	R/W-OS
Status Flag	0000	R
Event State	NORMAL	R
Out-Of-Service	FALSE	R/W
Units	VOLTS	R
Min Pres Value	0.0 (0.0 to 10.0)	R/W
Max Pres Value	10.0 (0.0 to 10.0)	R/W
Resolution	0.001	R

Analog Value Objects

Property Name /ID	Default	R/W
Object Identifier	OBJECT_ANALOG_VALUE:X	R
Object Name	AV-1 CO2 offset AV-2 TVOC offset AV-3 Temp offset AV-4 RH offset AV-5 CO2 Yellow set point AV-6 CO2 Amber set point AV-7 CO2 Red set point AV-8 TVOC Yellow set point AV-9 TVOC Amber set point AV-10 TVOC Red set point	R
Object Type	2	R
Present Value	AV-1 0 (-1000 to 1000) AV-2 0 (-500 to 500) AV-3 0 (-20.0 to 20.0) AV-4 0 (-50.0 to 50.0) AV-5 800 (0.0 to 10000) AV-6 1000 (0.0 to 10000) AV-7 1500 (0.0 to 10000) AV-8 530 (0.0 to 5000) AV-9 935 (0.0 to 5000) AV-10 1620 (0.0 to 5000)	R/W
Status Flag	0000	R
Event State	NORMAL	R
Out-Of-Service	FALSE	R/W
Units	AV-1 PART-PER-MILLION AV-2 MICROGRAMS-PER-CUBIC-METER AV-3 DEGREES-CELSIUS AV-4 PERCENT-RELATIVE-HUMIDITY AV-5 PART-PER-MILLION AV-6 PART-PER-MILLION AV-7 PART-PER-MILLION AV-8 MICROGRAMS-PER-CUBIC-METER AV-9 MICROGRAMS-PER-CUBIC-METER AV-10 MICROGRAMS-PER-CUBIC-METER	R

Binary Input Objects

Property Name /ID	Default	R/W
Object Identifier	OBJECT_BINARY_INPUT:X	R
Object Name	BI-1 Digital Input	R/W
Object Type	3	R
Present Value	0 = OFF 1 = ON	R
Description	Digital Input	R/W
Polarity	0 = Normal 1 = Reverse	R/W
Status Flag	0000	R
Event State	NORMAL	R
Out-Of-Service	FALSE	R/W

Binary Output Objects

Property Name /ID	Default	R/W
Object Identifier	OBJECT_BINARY_OUTPUT:X	R
Object Name	BO-1 Relay	R/W
Object Type	4	R
Present Value	0 = OFF MSI-2 State 1 = OFF 1 = ON MSI-2 State 2 = ON	R/W
Description	High CO2 Level / MSI-2	R/W
Polarity	0 = Normal 1 = Reverse	R/W
Status Flag	0000	R
Event State	NORMAL	R
Out-Of-Service	FALSE	R/W

Multi-state Input Objects

Property Name /ID	Default	R/W
Object Identifier	OBJECT_MULTI_STATE_INPUT:X	R
Object Name	MSI-1 LCD Backlight Colour MSI-2 Momentary Switch	R R/W
Object Type	13	R
Present Value	REAL	R/W*
Description	MSI-1 Display Colour MSI-2 Boost / On/Off / Fan Control	R R/W
Status Flag	0000	R
Event State	NORMAL	R
Out-Of-Service	FALSE	R/W
Number of States	MSI-1 6 MSI-2 (See below specification)	R R/W
State Text	MSI-1 1 = Green 2 = Yellow 3 = Amber 4 = Red 5 = White 6 = Off MSI-2 Writable – Proprietary 1021-1028 (See below specification)	R/W-OS R/W
Time Delay	MSI-2 Writable – Proprietary 1020 (Max 86,400 seconds)	

Multi State Input 2 Configuration

The default for Multi-state Input 2 (MSI-2) will depend on the product ordering configuration. The number of states and associated text will default to the below, however the number of states (max 8) and text can be fully customised to suit your application, with a maximum character string of 8 displayed for each state-text.

When the button is pressed, the specified state-text will show on line 1 of the display for 5 seconds with a white backlight, unless Line 1 function is adjusted using Proprietary Property 1007 in which case it will be permanently displays (the white backlight will still timeout after 5 seconds).

If the time delay is implemented, the unit will default back to State 1 after the set number of seconds.

The factory default settings will depend on the specified Button text, however the Button print can be customised at point of order:

State	Vent Boost	Fan Off/On	Fan Control
1		Fan Off	Auto
2	Vent ON	Fan On	Fan Low
3	-	-	Fan Mid
4	-	-	Fan Hi
5	-	-	Fan Off
No of States	2	2	5
Time Delay	1800	0	0

For further information on the BACnet protocol, please visit www.bacnet.org