CONTROLS & OPERATION INSTRUCTIONS

nuaire

BPS with

ecosmart CONNECT

Control

ErP COMPLIANT 2016

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LEAKAGE L1 CLASS

THERMAL RIDGING TB1 CLASS

DEFLECTION D1 CLASS

THERMAL TRANSMITTANCE T2 CLASS

FOR THE COMPLETE VENTLIATION SOULTION

BOXER
PACKAGED SOLUTIONS

MADE IN THE UK

BOXER BPS ECOSMART CONNECT CONTROL (CO)
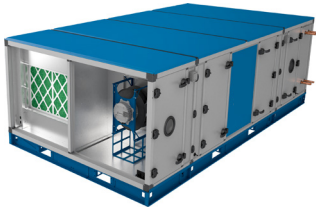
SUPPLY & EXTRACT VENTILATION UNIT

CONTROLS & OPERATION INSTRUCTIONS

CE

1.0 DESCRIPTION OF CONTROL STRATEGY (SW-FAC2612-2-9A)

1.1 General

The system incorporates a preconfigured BACnet MS/TP enabled controller.

Figure 1.

1.2 Controllable Items:

- Supply Fan
- Extract Fan
- Heat Recovery Bypass Damper (if applicable).
- Thermal Wheel (if applicable).
- Heating Coil (if fitted).
- Cooling Coil (if fitted).
- DX coil (If fitted).
- Inlet Damper (If fitted).
- Exhaust Damper (If fitted).
- Recirculation damper (If fitted).

1.3 Enable Signal

The unit can be enabled via the following methods:

- Software switch (ENABLE) via local display or network.
- Switched live (230VAC) input, PIR etc.
- Volt free input contacts.
- Night Cooling / Summer free-cooling strategy.
- Scheduled via weekly calendar (Schedules are accessed and adjusted via the ESCO-LCD).
- Fan speed override.
- Room module PIR sensor.
- Room module 3-fan speed button (While in low, med or high state).

When the enable signal is removed, the unit will run on for a time defined by the run-on setpoint.

If auto run-on is enabled, the unit will measure the each enable period and set a dynamic run-on time proportionally to this value. This time is scaled by the network input "Auto Run-on Scale Factor" and limited by the input "Auto Run-on Max Time".

1.4 Room Modules

Ecosmart Connect allows the connection of multiple Room Modules which are automatically detected and connect to the controller via a SA (Sensor Actuator) MS/TP bus. See Network Accessory section for more connection details.

1.4.1 Room Module PIR

When a Room Module PIR sensor is connected via the SA bus, the control will automatically use this as an enable signal by default. There is a non-adjustable minimum run-on time of 15mins for Room Module PIRs. This is in addition to any software run-on times.

1.4.2 RM 3-Speed Fan Override (ESCO-TDFS Only)

When a RM fan speed override is available it will override fan speed functions.

This function overrides any run-on time (except for electric heater heat dissipation). While in override mode, the unit will ignore return air temperature and set the supply air to the setpoint. Multiple fan override sensors are not supported.

Whenever a fan-speed override Room Module is connected, the display will automatically show the fan speed status at all times.

A timeout can be set for the fan mode to revert back to auto after a redetermined time period. The setting Fan Override Operation and Fan Override Timeout can be adjusted to achieve this.

Mode	Operation	Display
"Auto"	The Controller will ignore the fan speed override. Current Fan speed will still be displayed.	AUTO / AUTO / AUTO / AUTO
"Off"	The controlller will override all functions and stop the fans.	OFF
"Low"	The fans run at low speed.	
"Medium"	The fans run at medium speed.	
"High"	The fans run at high speed.	

1.4.3 RM Occupancy Display

If an RM sensor with occupancy display is connected, it will automatically display the occupancy state as follows.

State	Description	RM DIsplay
Occupied	An enable signal is present. i.e. Fans are running.	

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State	Description	RM DIsplay
Unoccupied	No enable & no trickle. i.e. Fans are stopped.	
Standby	No enable signal but fans are trickling.	

Function	Description	Available Ranges
EGG (Ecosmart Gateway Gadget)	0-10V from the EGG PCB is controls used as a fan speed demand. The optional EGG PCB can be used for backwards compatibility with some Ecosmart Classic sensors.	N/A
0-10V CO2 Sensor	0-10V is scaled as defined by the network input "CO2 0-10V Output Range"	0-2,000ppm 0-4,000ppm 0-5,000ppm 0-10,000ppm 0-20,000ppm
0-10V Temperature Sensor	0-10V is scaled as defined by the network input "Temperature Sensor 0-10V Output Range"	0 - 40°C 0 - 50°C 0 - 80°C 0 - 90°C 0 - 100°C
0-10V Pressure Sensor	0-10V is scaled as defined by the network input "Pressure Sensor"	0 - 25 Pa 0 - 50 Pa 0 - 100 Pa 0 - 300 Pa 0 - 500 Pa 0 - 1000 Pa 0 - 1600 Pa 0 - 2500 Pa 0 - 3000 Pa
0-10V Humidity Sensor	0-10V is scaled to 0-100% humidity	0 - 100% only

1.5 Thermal Wheel / Plate Heat Exchanger Bypass

The plate heat exchanger bypass damper and thermal wheel both run on the same FAC relay 5. Energised = Bypass.
See the temperature control section for info on the bypass strategy.
The 24vac bypass signal from FAC relay 5 is converted by relay logic for each of the following options:

- Thermal Wheel
  Runs on a vault free enable signal, which is produce using a combinationof the HX bypass relay and fan run relay to close the circuit of fans are running and the unit is not in bypass.
- Plate Heat Exchanger
  The HX bypass damper opens on a 24 Vac signal which is produce from the bypass damper relay.

1.6 Multiple Sensors

Where multiple sensors are connected the following options are available.

State	Description
Temp Sensor Operation	Room module average (Default) Return Air only Room Module & Return Air Average
Setpoint Operation	Last Value Changed (Default) Software Setpoint Only Last Value Changed With Timeout
Humidity Sensor Operation	Average (Default) Max Ignore
CO2 Sensor Operation	Average (Default) Max Ignore
Pressure Sensor Operation	Average (Default) Max Ignore

1.7 Auxiliary Inputs 4 & 5 (0-10V Inputs)

The function of IN4 & IN5 can be set by the network inputs IN4 Function & IN5 Function. The available options are as follows.

Function	Description	Available Ranges
None	The signal is ignored	N/A
Fan Speed Control	A 0-10V input is used as a fan speed demand. 0V = Min Speed 10V = Max Speed	N/A

1.7.1 Fan Speed Control Input

Once assigned to either input 4 or 5, the 0-10V input is scaled to 0-100% fan speed demand.

1.7.2 Ecosmart Gateway Gadget (EGG)

If an EGG PCB is installed on the system this will give an enable signal and also a 0-10V fan speed demand. The EGG allows an existing NET sensor network to give a fan speed demand to a controller.

1.7.3 CO2 Control

When a CO_2 sensor is assigned to the system and an enable signal is received, ventilation will increase fans speeds to reduce CO_2 concentration. The target CO_2 sensor setpoint can be changed as one of the commissioning setpoints. Room Module CO_2 sensors are detected automatically. 0-10V CO_2 sensors need to be assigned to input 4 or 5.

1.7.4 Humidity Control

When a humidity sensor is assigned to the system and an enable signal is received, ventilation will increase fans speed to reduce humidity. The target humidity setpoint setpoint can be changed as one of the commissioning setpoints. Room Module humidity sensors are detected automatically. 0-10V humidity sensors need to be assigned to input 4 or 5.

1.7.5 Constant Pressure Control

An extract air pressure sensor is fitted to IN4 standard. IN4 is disabled by default but constant pressure control can be enabled by setting IN4 function to 0-10v pressure sensor.
When enabled, the unit will increase the fans speeds as required until the pressure differential between the extract air and atmosphere reaches the constant pressure setpoint.
The target pressure setpoint can be changed as one of the commissioning setpoints. Room Module pressure sensors are not available.

1.7.6 Filter DP Switch

3 Filter differential pressure switches are fitted as standard. These monitor the Extract filter, Supply filter and Supply pre-filter.
These are connected in series with Alarm Circuit 2 (orange wires) and will breal the circuit on overpressure. THe adjustable range is 0.5 to 4 mbar and is set by the default to 2mbar.

1.8 Configurable Mode (Via Switched Live 2)

The switched live 2 input is a configurable input that can be set to perform a number of functions. The function is set via the network input Configurable Mode SL2.
These functions will include the following:

- **Fan boost (default setting)**
  This enables Fan Boost Mode

- **Heater boost**
  The heater function will be enabled. Fan speeds will be increased where necessary to keep supply temp at the heater boost setpoint. (Default 35°C).

- **Limit Extract Fan**
  When this SL2 is selected and active, the unit will force the extract fan to run at trickle speed, regardless of all other demands. Supply fan will operate at the normal speed. If increased demand is required (E.g via CO2 or 0-10v IN4/5 some other input) the supply fan speed will increase but the extract fan speed will not. This mode can be used when the unit is used in conjunction with a separate air system.
  This mode can be used when the unit is used in conjunction with a separate air extraction system.

1.8.2 Fan Boost

When the control receives a boost signal, from either the network input "Boost" or "Configurable SL2" configured to boost, the fans will run at their individual boost speeds. Once the signal is removed the fans will run on for a time defined by the boost run-on setpoint. Any demand in excess of the boost speed will be ignored (apart from 3 speed override and purge schedule).

1.8.1 Heat Boost

When the control receives a heat boost signal, from either the network input "Heat Boost" or "Configurable SL2" configured to "heat boost", the heater output will increase to 100%. The fan speed will be increased as required to reach the heat boost setpoint.
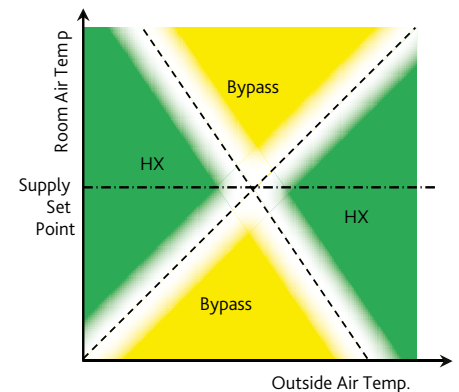
1.9 Temperature Control

1.9.1 Supply Temperature Control (Default)

While an enable signal is present, this mode modulates heating, cooling & heat exchanger bypass dampers with the aim of the supply air reaching the temperature setpoint. Please note that heating and cooling outputs will only function if the "Heating Type" or "Cooling Type" network inputs are set to heating or cooling options.
The heat exchange bypass damper operates by calculating the supply air temperature based on the return air temperature, the outside air temperature and the heat exchanger efficiency. (Eg. A 13°C outside air temperature with a 23°C return air temperature will give a supply air temperature of 20.5°C). The control then chooses the damper position which requires the minimal heat/cool tempering in order to achieve the setpoint.

Note that the white areas indicate regions where either heat exchanging or bypassing will achieve the same supply temperature.

Figure 2.

1.9.2 Room Temperature Control

While an enable signal is present, this mode modulates heating, cooling & heat exchanger bypass dampers with the aim of the room air reaching the temperature setpoint. Please note that heating and cooling outputs will only function if the "Heating Type" or "Cooling Type" network inputs are set to heating or cooling options.

Figure 3.
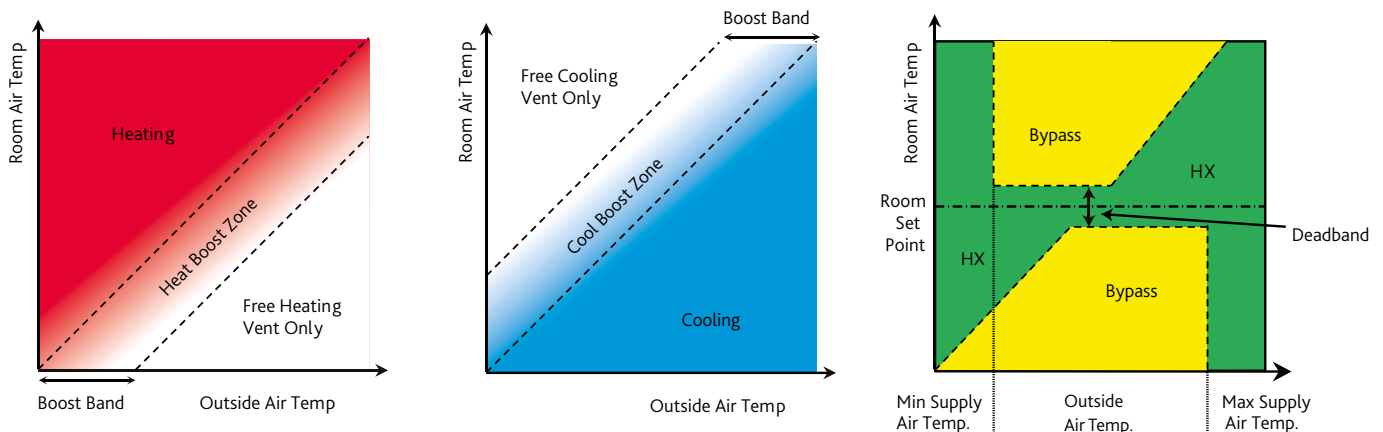
When heating or cooling is required achieve the room setpoint, the output of the heat/cool loops are split between ventilation demand or heat/cool demand according to the following graphs. The intermediate "boost" zone is the area in which a small amount of free-heat/cooling is available. In this zone, heating/cooling is used to boost the free-heating/cooling.In room temperature control mode, the bypass damper is controlled according to the following chart. A minimum supply air temperature limit is included to stop the heat exchanger being bypassed when the air temp is uncomfortably cold, even though cooling is required. In this case the heat exchanger will temper the air for comfort. The reverse applies for the maximum supply air temperature limit.

If the supply air temperature exits the min-max supply temperature range, the unit will adjust ventilation, heating or cooling to compensate.
Note: Room temperature control will only be effective if the heater unit is sized correctly for the space. If the unit is undersized, heating from an external source may be required.

1.9.3 Overrides

When the following conditions occur, the system will temporarily exit "Room Temperature Mode" and enter "Supply Temperature Mode".

- •Trickle Mode with no enable signal. (Trickle deadband applies)
- •Heat Boost Active
- •Fan Boost Active
- •Purge Mode Active
- •3-Speed override by Room Module

1.10 Trickle Mode

When trickle mode is active, the fans will run at their minimum speed even when there is no enable signal. Heating and cooling will also function in this mode if available. While in trickle mode, the unit will function in "Supply Temperature Control Mode" but with a different, wider deadband, set by the network input Trickle Deadband.

1.11 Frost Protection

Should the internal temperature of the unit fall below a value defined in the commissioning variables, the control will override all heating/cooling logic to open the LPHW or CW control valves, if fitted. This is to allow any protective flow through the heating/cooling coils. The supply fan will also stop and the appropriate frost protection software module will enter an alarm state. This period will last for a minimum of 5 minutes by default. The fault relay will also open. Heat and cool demand relays will operate and the software frost alarm will enter an alarm state.
Please note that frost protection will only function if the Heating Type or CoolingType setpoints are set to LPHW or CW.

1.12 Mitsubishi Reverse Cycle DX (Optional)

For units for use with Mitsubishi reverse cycle condenser units, one or more PACIF012B-E Interface boards are fitted inside the control panel. The controller interacts with this board in the following ways:
- • Digital Output Heat/Cool selection from FAC relay 8. Another relay is used to split output over multiple boards.
- • 0-10c Heat/Cool demand from FAC OUT4 .
- • Faults are monitored via iQ4 input 8 (Alarm circuit 2).

When Mitsubishi Reverse Cycle DX is fitted, this is selected in software by setting the cooling type "Reverse Cycle". A heating type is not required unless another heating type is fitted (eg LPHW).
Once this is selected cooling and heating demand will share FAC OUT4 and heat/cool is decided on the state of FAC Relay 8. (Energised = Cool Demand)
For the cases where Reverse Cycle DX and another heating type are both fitted, the schedule object "Reverse Cycle backup Heating" can be set to revert to the other heating option at certain times of the day.

Although the controller outputs a variable 0-10v heating/cooling voltage, the Mitsubishi condenser can only run at 7 discrete levels and so cannot supply an accurate supply air temperature. For this reason, it is recommended that the control is set to operate in room temperature control mode. This will regulate the room air temperature rather than supply air temperature.
The PAC boards are powered from the BPS control so the only connections required to the Outdoor condenser are S2 & S3. For the same reason, SW8-3 must be set to "ON" on the outdoor unit.
The enable run-on time must be set to 3 minutes for reverse cycle units. This is required in order to keep the compressor running for at least 3 minutes for each period.

1.13 Night Cooling / Summer Free Cooling

Once enabled in software, this routine uses an individual time schedule to cool the fabric of the building at night using only the external air. This mode only functions if the daytime temperature is above the setpoint, cooling is possible and if the cooling air is not too cold.

1.14 Purge Mode

Once enabled in software, this routine uses an individual time schedule to provide a period of increased air change throughout a space. This mode only functions if the inlet air is above a minimum temperature of 12°C. While purge is in progress, the unit will function in "Supply Temperature Control Mode" but with a different, wider deadband, set by the network input "Trickle Deadband".

1.15 Hibernate

This mode is available for LPHW and CW units where the valves are required to be driven open in anticipation of a period where the unit is electrically isolated and inactive. When enabled via the network input "Hibernate Mode" this will stop the fans and open all LPHW & CW valves fully. The unit can then be powered down. This mode activation is reset upon power cycle so when restarted the unit will function as normal.
This mode is for periods when to building is left dormant and will stop the coils trapping water and causing a freeze risk. It will be the buildings responsibility to provide freeze-preventative heating during this time. This can also be used for a cleaning or flushing cycle.

1.16 Inlet / Outlet Dampers (Optional)

Inlet and outlet dampers are 24vac and controlled by the fan run relay. When energised it gives a 24vac signal to both I/O dampers to open. A fan start delay can be imposed to allow the damper time to open. This is adjustable via display screens orcommissioning tools.
When installed, there is the option of connecting the internal damper close switch to the fault circuit alarm circuit 2 (orange wires).
When IO dampers are fitted the software object "IO Damper Fitted" must be set to "Yes". This will cause the software to delay the fans starting for the IO Damper delay period. It will also ignore faults on Alarm Circuit 2 if the fans are stopped and the dampers are closed intentionally.
See Internal connection section for physical damper connections.

1.17 Partial Recirculation Damper (Optional)

If a partial recirculation module is fitted, the recirculation damper will open/close via FAC Relay 9 according to the following strategy.
If the room temperature is more than 5°C (adjustable via recirc-offset variable) from the setpoint and free-cooling or free-heating is not available then partially recirculate the air.
This aids heating and cooling elements and also avoids thermal loss from the room.

1.18 Alarms

1.18.1 Critical Alarm Latching

Once in critical alarm state the unit will drive all heating and cooling outputs to 0V. In the event of fan fail other functions continue as normal. The critical alarm is latched and requires power cycle or reset via the "Reset Alarms" variable.
Causes of critical alarm:

- Fan fail via fault circuit 1
- Heater overtemp via fault circuit 1

1.18.2 Maintenance Alarms (Non-Latching)

Once in maintenance alarm state the only action taken is de-energising of the fault relay. Once the trigger is removed, the alarm will reset automatically.
Causes of critical alarm:

- Fan fail via fault circuit 1.
- Heater overtemp via fault circuit 1.

Causes of maintenance alarm:

- Sensor Failure
- Low supply temperature, default 8°C. This can be set to stop fans if required
- Frost protection routine active, default 4°C (This only runs if water valves are selected as fitted
- Excessively high supply temperature reading (This will stop heating)
- Filter dP fault (if fitted)

All alarms have a hold off period set by the setpoint "Alarm Delay".

1.18.3 Thermal Trip

In case of software failure, as a final resort, the electric heater is protected by a fail-safe thermal overload switch. This switch disables the heater controller via a contactor once the temperature reaches 80°C. When this occurs, the critical alarm will latch in software and the supply contactor will latch in the off position.

Once the unit cools, the contactor will remain latched off until power cycle.

1.18.4 Configurable Relay 8 (RL8)

Relay 8 is a configurable relay output which can be set to the following functions. It can be set by the multi-state object "RL8 Mode".

- Cooling Demand (Default Setting)
  This option will run the Relay as a cooling command relay. This output will only function if a cooling type is selected.

- Window Actuator
  This option will run a Window Indication routine with a dual CO2 setpoint strategy. Relay 8 will be used to indicate to the end user whether it is appropriate to open the windows or not. This relay can be wired to an end user's signal lamp or other signal. This relay is SPST so an additional relay is required if a light is required for each state. A multistate object, 'Window Mode Status', exists with two states, 'Open' and 'Close'.

At external temperatures less than the 'Window Open Threshold' (14°C default) the indicator will signal close windows.
The 'CO2 Winter Target' will be used as the setpoint. (1000ppm default).

At external temperatures greater than the 'Window Open Threshold' (14°C default) and CO2 level higher than the 'CO2 Winter Target', the indicator will signal open windows. The 'CO2 Summer Target' will be used as the setpoint. (1500ppm default).

If the HX bypass damper is driven to bypass while fans are enabled, the indicator will signal open windows. (HX Bypass due to Condensate pump failure will not affect windows status).

The 'Window Mode Status' will indicate close windows when the unit is not enabled and at all other times.

1.18.5 Configurable Analgoue Output 4 (OUT4)

OUT4 is a configurable analogue output which can be set to the following functions via the multi-state object "OUT4 Mode".

- Cooling Demand (Default Setting)
  This will provide a standard 0-10V cooling output. This output will only function if a cooling type is selected.

- ES Classic BMS
  This option will provide a 0-10v ESClassic BMS output based on ventilation demand. This can then be used in conjunction with the fan run relay to run multiple slave Classic units from a master Connect control.

The type of BMS output can be selected by the muti-state object 'ECS BMS Thermic Output'.

Auto - The BMS output will switch between heating and cooling depending on outdoor air temperature.

None - The unit will only supply 'Vent Only' voltages

Heating - The unit will only supply 'Heating' voltages

Cooling - The unit will only supply 'Cooling' voltages

1.18.6 ES Classic BMS Output Table

	Vent Only	Cooling	Heating
Off/Trickle	0.25V	–	–
SPEED 1	0.5V	0.75V	1V
SPEED 2	1.5V	1.75V	2V
SPEED 3	2.5V	2.75V	3V
SPEED 4	3.5V	3.75V	4V
SPEED 5	4.5V	4.75V	5V
SPEED 6	5.5V	5.75V	6V
SPEED 7	6.5V	6.75V	7V
SPEED 8	7.5V	7.75V	8V
SPEED 9	8.5V	8.75V	9V
SPEED 10	9.5V	9.75V	10V

1.18.7 Fire Alarm

Once the Fire Alarm object is switched to the Alarm State, all fans, heating and cooling elements will stop instantly. The fault relay will de-energise and a fault message will be sent to the ESCO-LCD. Once the fire alarm status is released, the units will continue running automatically.

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1.19 Exposed BACnet Object List (By Category)

ENABLE

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
34	Enable	Software enable switch	MSV	10218	Off	(1)Off (2)On
20	SL Enable	The state of the enable input (IN8)	BI	10161	N/A	(1)Off (2)On
9	Run-on (Enable)	Run-on timer value	AV	10267	0	Seconds
24	Local Calendar	0	CAL	10496	N/A	0
34	Enable via Schedule	Enabled via Schedule	MSV	10219	N/A	(1)Off (2)On

TRICKLE MODE

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
37	Trickle Mode	Enable trickle mode	MSV	10250	Off	(1)Off (2)On
15	Trickle Deadband	Setpoint deadband used when trickling with no enable signal.	AV	10316	5	Degrees-Celsius

IO DAMPERS

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
44	IO Damper Fitted	Selects whether IO dampers are fitted on alarm circuit 2	MSV	17669	No	(1)No (2)Yes
12	IO Damper Delay	Delay between starting the fan relay and the fan output.	AV	10279	0	Seconds

ANALOGUE INPUTS

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
2	IN4	The 0-10 voltage at input 4	AI	10032	N/A	volts
31	IN4 Function	Function of the UI4 input	MSV	10209	None	(1)None (2)N/A (3)N/A (4)0-10V CO2 Sensor (5)0-10V Temperature Sensor (6)0-10V Humidity Sensor (7)0-10V Pressure Sensor
2	IN5	The 0-10 voltage at input 5	AI	10035	N/A	volts
32	IN5 Function	Function of the UI5 input	MSV	10210	None	(1)None (2)Fan Speed Control (3)0-10v BMS (4)0-10V CO2 Sensor (5)0-10V Temperature Sensor (6)0-10V Humidity Sensor (7)0-10V Pressure Sensor

CONFIGURABLE INPUTS

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
20	SL2 Input	The state of the configurable input (IN9)	BI	10164	N/A	(1)Off (2)On
30	SL2 Mode	Set the function of switched live 2	MSV	10202	Fan Boost	(1)None (2)Fan Boost (3)Heater Boost (4)Extract Setback

FAN BOOST

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
34	Fan Boost	Software enabled Fan boost	MSV	10240	Off	(1)Off (2)On
10	Run-on (Boost)	Boost run-on time	AV	10272	0	Seconds
10	Supply Fan Boost Speed	Supply Fan boost speed	AV	10273	100	Percent
18	Extract Boost Speed	The extract fan boost speed	AV	17419	100	Percent

HEAT BOOST

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
30	Heat Boost	Software enabled Heater boost	MSV	10205	Off	(1)Off (2)On
11	Heat Boost Setpoint	Heater Boost Setpoint	AV	10276	35	Degrees-Celsius

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EXTRACT SETBACK

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
44	Extract Setback	Puts the extract fan to setback speed	MSV	17769	Off	(1)Off (2)On
20	Extract Setback Speed	The extract fan speed when Extract Setback is enabled.	AV	18258	30	Percent

FAN OUTPUTS

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
6	Supply Fan Output	The 0-10v signal to the supply fan	AO	10182	N/A	volts
6	Extract Fan Output	The 0-10v signal to the extract fan	AO	10176	N/A	volts
21	Fan Enabled Cmd	The state of the fan enabled relay.	BO	10191	N/A	(1)Off (2)On

FAN COMMISSIONING

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
9	Extract Fan Max	Individual fan maximum speed setting	AV	10268	100	Percent
10	Extract Fan Min	Individual fan minimum speed setting	AV	10270	20	Percent
15	Supply Fan Max	Individual fan maximum speed setting	AV	10312	100	Percent
15	Supply Fan Min	Individual fan minimum speed setting	AV	10314	20	Percent

TEMERATURE CONTROL

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
14	Software Setpoint	Software Setpoint	AV	10309	22	Degrees-Celsius
9	Deadband	Dead band for temp control	AV	10266	3	Degrees-Celsius
33	SetPoint Op	Setpoint operation	MSV	10214	Software Only	(1)Last Changed (2)Software Only (3)Last Changed with Timeout
19	Setpoint Timeout	The time before reverting to software setpoint when last changed with timeout is selected.	AV	17971	3600	seconds
27	Setpoint Schedule	A schedule for setpoint adjustment.	SCH	18215	N/A	0
19	Setpoint Schedule	Current state of the Setpoint Schedule object.	AV	18215-	22	Degrees-Celsius
33	T Sens. Op	Temperature sensor operation	MSV	10215	NS Average	(1)NS Average (2)Return Air Only (3)NS & Return Average
33	0-10v Temp Range	Temperature sensor range	MSV	10216	0 to 50°C	(1)0 to 50°C (2)0 to 40°C (3)0 to 100°C (4)0 to 80°C (5)0 to 90°C
35	Temp Control Mode	Temperature control mode	MSV	10245	Supply Temp	(1)Supply Temp (2)Room Temp
14	STC H/C Pref	STC Heat/Cool Pref	AV	10310	50	No units
15	STC HX Efficiency	STC HX Efficiency	AV	10311	0.8	No units
13	RTC Boost Band	The Return Temperature Control Boost Band	AV	10306	15	Degrees-Celsius
14	RTC Max Supply Temp	Maximum supply temp when in RTC mode	AV	10307	35	Degrees-Celsius
14	RTC Min Supply Temp	Minimum supply temp when in RTC mode	AV	10308	12	Degrees-Celsius

HEATING OUTPUT

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
31	Heating Type	Set the type of heating fitted.	MSV	10206	As Per Build	(1)None (2)LPHW (3)Electric (4)3rd-Party
6	Heating Output	The 0-10v signal to the heating output.	AO	10179	N/A	Percent

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COOLING/ CONFIGURABLE OUTPUTS

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
30	Cooling Type	Set the type of cooling fitted.	MSV	10203	None	(1)None (2)Chilled Water (3)3rd-Party (4)Reverse Cycle DX
22	Cooling Demand Cmd	The state of the cooling demand relay.	BO	10194	N/A	(1)Off (2)On
43	OUT4 Mode	Chooses the mode of Analogue Output 4	MSV	17608	Cooling Demand	(1)Cooling Demand (2) ESClassic BMS Mode
6	Output 4	Configurable output 4 (OUT4)	AO	10173	N/A	Percent
44	ESC BMS Thermic Output	Chooses whether to demand thermal output in 0-10v ESClassic BMS mode	MSV	17610	Auto	(1)Auto (2)None (3)Heating (4)Cooling

HX BYPASS DAMPER

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
21	Bypass Damper Cmd	The controller's signal to the HX bypass. (Active = Bypass, Inactive = Heat Exchange)	BO	10185	N/A	(1)Inactive (2)Active

FAN DEMAND INPUTS

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
18	Fan Speed Demand	A user entered fan speed demand. 0% = trickle speed	AV	17761	0	Percent
18	BMS 0-10v Input	A virtual BMS voltage input using an ESClassic BMS table	AV	17773	0	Volts
27	Fan Speed Schedule	A schedule for fan speed demand (0% = Trickle speed)	SCH	17798	N/A	0
18	Fan Speed Schedule	Current state of the Fan Speed Demand Schedule object.	AV	17830	0	Percent
44	Fan Override Operation	Chooses the operation of the 3-speed fan override.	MSV	17975	Override Has Priority	(1)Overide Has Priority (2) Revert to Auto after Timeout
19	Fan Override Timeout	The time before reverting to auto fan speed when revert to auto with timeout is selected.	AV	17977	3600	seconds
9	CO2 Target	Target CO2 Value	AV	10265	650	Parts-per-million
29	0-10 v CO2 Range	CO2 sensor output range	MSV	10200	N/A	(1)0-2,000ppm (2)0-4,000ppm (3)0-5,000ppm (4)0-10,000ppm (5)0-20,000ppm
29	CO2 Sensor Op	CO2 sensor operation	MSV	10201	N/A	(1)Average CO2 (2)Max CO2 (3)Ignore CO2
11	Humidity Target	Relative Humidity Target	AV	10278	50	Percent-relative-Humidity
31	H Sensor Op	Humidity Sensor Operation	MSV	10207	Average RH%	(1)Average RH% (2)Max RH% (3)Ignore RH%
13	Pressure Target	Target pressure value	AV	10303	400	Pascals
32	0-10v Press. Range	Pressure sensor range	MSV	10212	0 to 1000Pa	(1)0-25Pa (2)0-50Pa (3)0-100Pa (4)0-300Pa (5)0-500Pa (6)0-1000Pa (7)0-1600Pa (8)0-2500Pa (9)0-3000Pa
32	P sens. Op	Pressure sensor operation	MSV	10213	Average Value	(1)Average (2)Max (3)Ignore

SELECTED PROCESS VARIABLES

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
16	Room Air Temp	The room air temperature	AV	11296	N/A	Degrees-Celsius
16	CO2 Level	The CO2 Level	AV	13980	N/A	ppm
16	Humidity	The Humidity Level	AV	14297	N/A	% RH
16	Active Setpoint	The setpoint currently used	AV	14534	N/A	Degrees-Celsius

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BPS TEMP SENSORS

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
1	Supply Air Temp (B)	The supply air temperature	AI	10005	N/A	Degrees-Celsius
1	Fresh Air Temp (H)	The fresh air temperature	AI	10008	N/A	Degrees-Celsius
1	Extract Air Temp (C)	The extract air temperature	AI	10011	N/A	Degrees-Celsius

ZONE SENSORS

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
2	RM199 Temp	The temperature at RM address 199	AI	10029	N/A	Degrees-Celsius
2	RM199 Humidity	The Humidity at RM address 199	AI	10017	N/A	Percent-Relative-Humidity
7	RM199 Setpoint	The setpoint at RM address 199	AV	10023	N/A	Degrees-Celsius
28	RM199 Fan Speed	Fan Speed Override Status of RM199	MSV	10014	N/A	(1)Auto (2)Off (3)Low (4)Medium (5)High
37	RM199 Fan Display	Fan Speed Override Display at RM address 199	MSV	14703	N/A	(1)No Status (2)Off (3)Low (4)Medium (5)High (6)Auto-Off (7)Auto-Low (8)Auto-Medium (9)Auto-High
3	RM200 Temp	The temperature at RM address 200	AI	10050	N/A	Degrees-Celsius
3	RM200 Humidity	The Humidity at RM address 200	AI	10053	N/A	Percent-Relative-Humidity
7	RM200 Setpoint	The setpoint at RM address 200	AV	10074	N/A	Degrees-Celsius
3	RM201 Temp	The temperature at RM address 201	AI	10065	N/A	Degrees-Celsius
4	RM201 Humidity	The Humidity at RM address 201	AI	10077	N/A	Percent-Relative-Humidity
7	RM201 Setpoint	The setpoint at RM address 201	AV	10083	N/A	Degrees-Celsius
3	RM202 Temp	The temperature at RM address 202	AI	10068	N/A	Degrees-Celsius
4	RM202 Humidity	The Humidity at RM address 202	AI	10092	N/A	Percent-Relative-Humidity
7	RM202 Setpoint	The setpoint at RM address 202	AV	10098	N/A	Degrees-Celsius
4	RM203 Temp	The temperature at RM address 203	AI	10071	N/A	Degrees-Celsius
4	RM203 Humidity	The Humidity at RM address 203	AI	10107	N/A	Percent-Relative-Humidity
8	RM203 Setpoint	The setpoint at RM address 203	AV	10113	N/A	Degrees-Celsius
5	RM212 CO2	The CO2 at RM address 212	AI	10137	N/A	Parts-Per-Million
5	RM213 CO2	The CO2 at RM address 213	AI	10140	N/A	Parts-Per-Million
5	RM214 CO2	The CO2 at RM address 214	AI	10143	N/A	Parts-Per-Million
5	RM215 CO2	The CO2 at RM address 215	AI	10146	N/A	Parts-Per-Million

FROST PROTECTION

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
10	Frost Prot. Fan Off	Minimum time the supply fan will stop in a frost protection state	AV	10274	300	Seconds
11	Frost Prot. Temp	Supply temperature at which frost protection becomes active	AV	10275	4	Degrees-Celsius

HIBERNATE

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
34	Hibernate Mode	Unit is ready for hibernation	MSV	10241	Off	(1)Off (2)On

PURGE MODE

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
35	Purge Active	This input will enable purge mode	MSV	10243	Off	(1)Off (2)On
13	Purge Fan Speed	Purge Fan Speed	AV	10304	60	Percent
13	Purge Min Temp	The minimum temperature that will stop night cooling	AV	10305	12	Degrees-Celsius
26	Purge Time Schedule	Purge Time Schedule	SCH	10499	N/A	0
37	Purge Time Schedule	State of the Purge Time Schedule	MSV	10512	N/A	(1)Off (2)On

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NIGHT COOL MODE

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
35	Night C Mode	This input will enable night cool mode.	MSV	10242	Off	(1)Off (2)On
12	Night C Fan Speed	The night cool fan speed	AV	10281	60	Percent
12	Nigh C Min Temp	The minimum temperature that will stop night cooling	AV	10302	12	Degrees-Celsius
27	Night C Schedule	Night Cooling Schedule	SCH	16014	N/A	0
27	Night C Schedule	Night Cooling Schedule	SCH	16014	N/A	0
26	Night C Sample	Daytime schedule for winter or summer decision making	SCH	15875	N/A	0
38	Night C Sample	Night Cooling Sample Schedule	MSV	16008	N/A	(1)Off (2)On

AUTO RUN ON

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
33	Auto Run-on	Auto-run on mode	MSV	10217	Off	(1)Off (2)On
8	Auto-Run on Max-Time	Maximum Run-on Max Time	AV	10263	900	Seconds
8	Auto-run-on Scale Factor	Scale Factor for automatic run-on time	AV	10264	2	No units

FIRE ALARM

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
43	Fire Alarm	Engage Fire Alarm Mode	MSV	17365	N/A	(1)Normal (2)Alarm

ALARM

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
21	Fault Relay Cmd	The state of the fault relay. (Fault = De-energised)	BO	10188	N/A	(1)Alarm (2)Normal
8	Alarm Delay	Alarm hold off period	AV	10262	10	Seconds
23	Reset Alarms	Changing this value will reset any latched alarms	BV	10332	FALSE	(1)False (2)True
20	Alarm Circuit 1	The state of Alarm Circuit 1	BI	10167	N/A	(1)Alarm (2)Normal
21	Alarm Circuit 2	The state of Alarm Circuit 2	BI	10170	N/A	(1)Alarm (2)Normal
11	High Temp Alarm	Supply temp which will trip the high supply alarm	AV	10277	50	Degrees-Celsius
12	Low Temp Alarm	Supply temp which will trip the low supply alarm	AV	10280	8	Degrees-Celsius
32	Low Temp Action	Action taken when the low supply alarm is engaged.	MSV	10211	Alarm Only	(1)Alarm only (2)Alarm and stop fans
37	Critical Alarm	Unit is latched in critical alarm	MSV	15309	N/A	(1)Normal (2)Alarm
38	Maint. Alarm	Maintenance Alarm	MSV	15310	N/A	(1)Normal (2)Alarm
38	XBC Sensor Alarm	XBC Sensor Out of Range	MSV	17009	N/A	(1)Normal (2)Alarm
39	Low SA-T Alarm	Low Supply Air Alarm	MSV	17011	N/A	(1)Normal (2)Alarm
39	High SA-T Alarm	High Supply Air Alarm	MSV	17012	N/A	(1)Normal (2)Alarm
39	Frost Alarm	Frost Alarm	MSV	17013	N/A	(1)Normal (2)Alarm

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LCD EVENT SIGNAL

LCD Browser Page	BACnet Object	Description	Object Type	Object ID	Default Value	Units
39	Ala (A Cir 1)	For LCD Event Signal Only	MSV	17281	N/A	(1)Normal (2)Alarm
40	Norm (A Cir 1)	For LCD Event Signal Only	MSV	17282	N/A	(1)Normal (2)Alarm
40	Ala (Low Supply Temp)	For LCD Event Signal Only	MSV	17285	N/A	(1)Normal (2)Alarm
40	Norm (Low Supply Temp)	For LCD Event Signal Only	MSV	17286	N/A	(1)Normal (2)Alarm
40	Norm (High Supply Temp)	For LCD Event Signal Only	MSV	17289	N/A	(1)Normal (2)Alarm
41	Ala (High Supply Temp)	For LCD Event Signal Only	MSV	17290	N/A	(1)Normal (2)Alarm
41	Ala (A Cir 2)	For LCD Event Signal Only	MSV	17293	N/A	(1)Normal (2)Alarm
41	Norm (A Cir 2)	For LCD Event Signal Only	MSV	17294	N/A	(1)Normal (2)Alarm
41	Ala (Frost)	For LCD Event Signal Only	MSV	17316	N/A	(1)Normal (2)Alarm
42	Norm (Frost)	For LCD Event Signal Only	MSV	17317	N/A	(1)Normal (2)Alarm
42	Ala (XBC Sensor Fault)	For LCD Event Signal Only	MSV	17320	N/A	(1)Normal (2)Alarm
42	Norm (XBC Sensor Fault)	For LCD Event Signal Only	MSV	17321	N/A	(1)Normal (2)Alarm
43	Ala (Fire Alarm)	For LCD Event Signal Only	MSV	17409	N/A	(1)Normal (2)Alarm
43	Norm (Fire Alarm)	For LCD Event Signal Only	MSV	17411	N/A	(1)Normal (2)Alarm

FACTORY SETTINGS

30	Damper Override	Override bypass damper position	MSV	10204	Auto	(1)Auto (2)Heat Exchange (3)Bypass
35	Tacho PCB Fitted	Is a "Taco Bell" PCB fitted.	MSV	10244	As per Build	(1)No (2)Yes
24	Tuning Reset	Resets the PID auto tuning loops	BV	12880	FALSE	(1)False (2)True
31	Ignore PIR Sensors	Ignore all MSTP network PIR sensors	MSV	10208	No	(1)No (2)Yes
17	EF Max Volt	The upper voltage for the extract fan	AV	17273	10	Volts
17	EF Start Volt	The voltage required to start the extract fan	AV	17274	1	Volts
17	SF Max Volt	The upper voltage for the supply fan	AV	17275	10	Volts
17	SF Start Volt	The voltage required to start the extract fan	AV	17276	1	Volts
42	SW-FAC2612-2-9A	Strategy Version	MSV	17340	Off	(1)Off (2)On

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2.0 NETWORKING EXAMPLE

2.1 Network Connection Diagram

Figure 4.

Ethernet IP

MTSP to IP Router

The FC Bus has a maximum limit of 31 devices

(Field Controller) FC Bus

(Sensor Actuator) SA Bus

(Sensor Actuator) SA Bus

For best results, use a linear network and switch on the EOL resistors at each end of the FC bus.
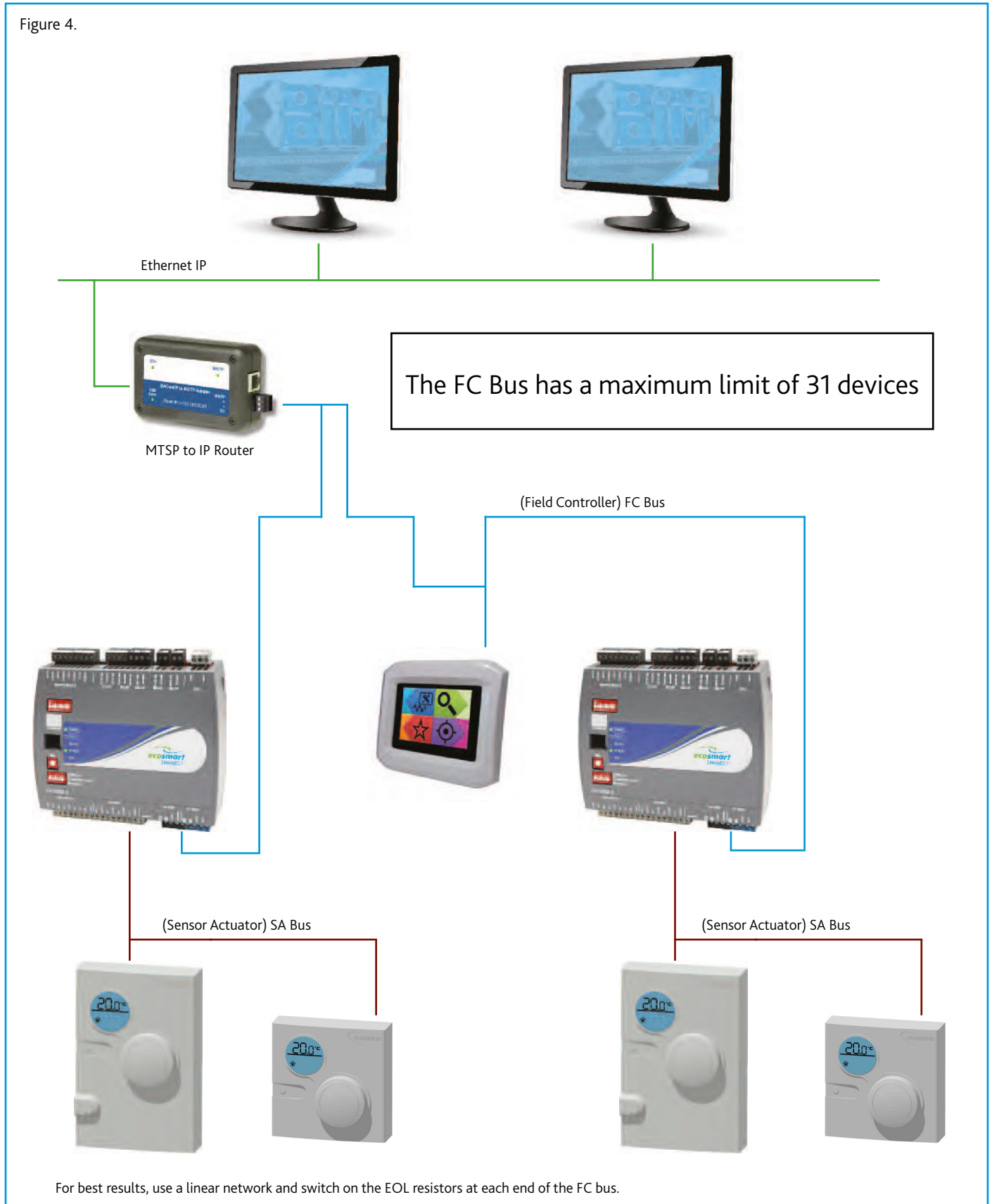
3.0 FC BUS DEVICES

3.1 FAC Controller

A FAC controller is used to control the unit. The controller can connect to the FC bus via the 4 pin FC connection.

Figure 5.

3.1.1 MAC Address

The physical MAC address of the FAC adjustable between 4-127 and is set via the DIP switch on the front of the unit. When multiple controllers are connected on the same FC bus, each controller 's MAC address must be unique.

3.1.2 BACnet Instance Number

The BACnet instance number of the FAC is factory-set to a random unique value from 0-4,194,304. This ensures that every controller will have a unique BACnet instance number on any possible network.

3.1.3 End Of Line (EOL) Resistor

When an FAC controller is used as a terminator at the end of a FC bus line, the EOL resistor dip switch can be switched on for best performance.

3.1.4 Fault Light Status

Blink 5Hz - Not all possible room modules are connected.
This is normal.
Blink 2Hz - Startup in progress
Off Steady - No Faults
On Steady - No Software

3.1.5 Current Loop DIP Switches

These should all be set to disabled.
Enabling these switches will cause incorrect sensor values.

3.2 BACnet IP To MS/TP Router (ESCO-IPN)

The BACnet IP to MS/TP Router exchanges information between networks and allows the controller to communicate on an IP network. One router is required for each MS/TP network.

Figure 6.

The BACnet router has a USB 2.0, Type B receptacle which is only used to obtain power from a computer or USB adapter. A mains adapter and cable is supplied.
The router connects to the FC bus via screwed terminals.

Address Type	Default Address
IP Address	192.168.92.68
Subnet Mask	255.255.255.0 (/24)

A reset switch is available inside a small hole located on the side of the case. If you press the reset switch with a paper clip (or similar device) for at least 1 second, the switch resets to the default values of the IP address, gateway address, and netmask. After you use the reset switch, you need to reboot the router. The BACnet/IP to MS/TP Router contains a Web server. You can access the Web server from any Internet-compatible computer on the local network To configure the router, you need a computer with an Ethernet connection, router, and standard Web browser.

3.3 Interconnection

The FC bus connects via the following MSTP cabling:
ESCO-MSTPC30M   Ecosmart Connect MSTP cable reel 30m
ESCO-MSTPC150M   Ecosmart Connect MSTP cable reel 150m

Suggested Wiring Colouring

White	+
Green	-
Black	COM
Red	Unused

Note: On the SA Bus, the + and - wire are one twisted pair, and the COM and SA PWR are the second twisted pair of wires.
These cannot be used with RJ12 connections and must be stripped and connected using screwed terminals. The shield must be earthed at the control panel end only and be made continuous along the bus length.
Room Modules must not be fitted more than 150metres (cable length) from the controller.

BOXER BPS ECOSMART CONNECT CONTROL (CO)

4.0 FC BUS DEVICES

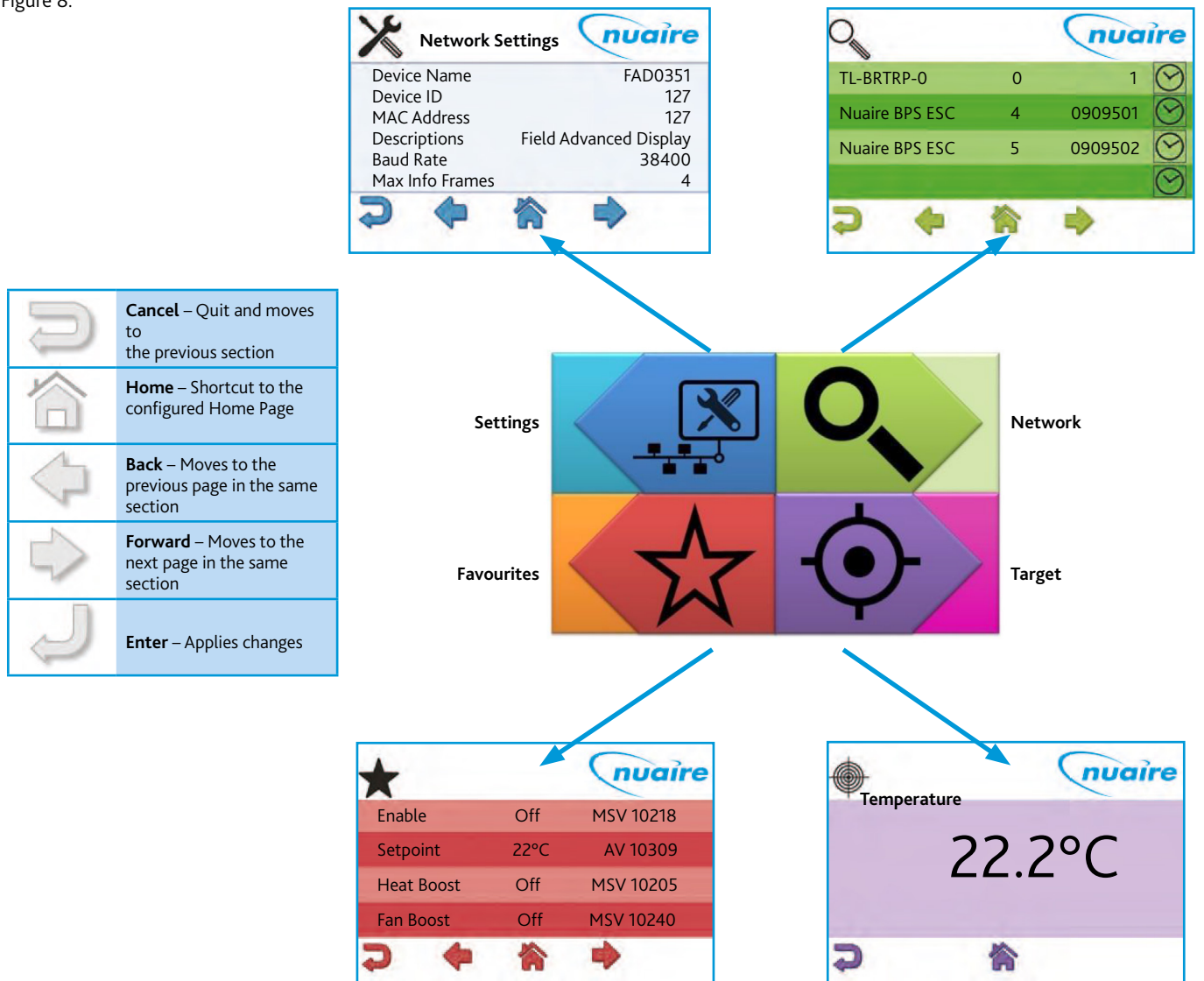### 4.1 Touch Screen (ESCO-LCD) Field Advanced Display (FAD)

The ESCO-LCD is a user friendly operator interface featuring BACnet®
communication and a colourful, graphic display with touch-screen
interface. It is powered by 12-24VAC / VDC and connected via the FC bus.

Figure 7.

4.1.1 Navigation

Figure 8.

Network Settings	
Device Name	FAD0351
Device ID	127
MAC Address	127
Descriptions	Field Advanced Display
Baud Rate	38400
Max Info Frames	4

TL-BRTRP-0	0	1
Nuaire BPS ESC	4	0909501
Nuaire BPS ESC	5	0909502

Icon	Description
Cancel	Quit and moves to the previous section
Home	Shortcut to the configured Home Page
Back	Moves to the previous page in the same section
Forward	Moves to the next page in the same section
Enter	Applies changes

Settings   Network

Favourites   Target

Enable	Off	MSV 10218
Setpoint	22°C	AV 10309
Heat Boost	Off	MSV 10205
Fan Boost	Off	MSV 10240

Temperature

22.2°C

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4.1.2 Writing Of Values

The ESCO-LCD can browse all devices and objects on the network. By default, it writes variables (BV, AV, MSV) at level 16 and outputs (BO, AO) at level 8. No BACnet device can write inputs (BI, AI). It is highly recommended that the write levels are left at the default settings of 16 for Adjust Priority and 8 for Override Priority.

The ESCO-LCD will only display the present value of the object. If required, the complete priority arrays can be viewed by connecting to the network with a computer via a router and using any BACnet browser software to browse the network.

Object Types

AI and BI object types are read only. An error will be displayed if an attempt is made to change these object types.

AO & BO values are changed by the strategy at priority level 16. By default, the ESCO-LCD will override these values at priority level 8. Overriding these values is not recommended and may cause undesirable operation. Be sure to relinquish all overrides once finished to minimise confusion.

AV, BV & MSV values are generally not altered by the strategy. By default, the ESCO-LCD will change this value at priority level 16. This is sufficient to change the value permanently.

Relinquishing

The ESCO-LCD allows the relinquishing of values by selected an **empty value** for analogue values or the '---' value for discrete values. Setting an analogue value to "0" does not relinquish the command. The relinquish command will only apply to the priority level set in the settings.

4.2 Quick Setup

The following section explains how to quickly set-up the FAD with a target object and some favourites.

4.2.1 Setting Up A Target Object

Target objects allow the user to view a "target" device and object within the entire network.

To choose a target object
- Navigate to the settings page.
- Select the right arrow four times to reach the Select Target Device screen.
- Enter the physical MAC address* of the controller (Device names or BACnetIDs can also be used but MAC addresses are shorter)
- Select the right arrow once
- Enter the object type of the required object (Eg AI, AO, MSV)**
- Enter the BACnet ID** of the object. (0-4194304)
- Select the home icon.

Figure 9.
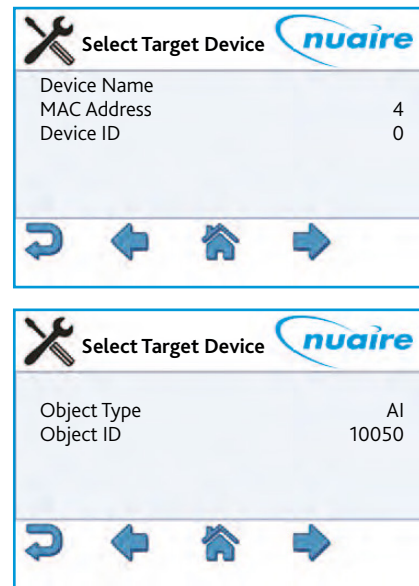
* This is the setting of the DIP switch on the front of the FAC controller. This can also be discovered by browsing to the network screen while ID is selected in the View Config settings screen.

Figure 10.

MAC Address

BACnet Device ID
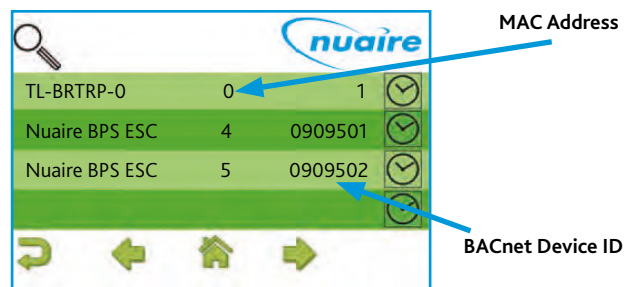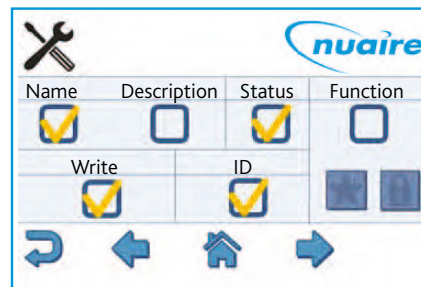
** Popular object details are listed below, or use the network browser or see "Exposed BACnet Object List" for a full list.

Network Page	Description	Object Type	Object ID
17	Room Air Temp	AV	11296
17	CO2 Level	AV	13980
17	Humidity	AV	14297
17	Active Setpoint	AV	14534
1	Fresh Air Temperature	AI	10008

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To set the target object page as the default home page.

- Navigate to the settings page.
- Select the right arrow twice to reach the display settings screen.
- Select Home Page
- Select Target
- Select the enter icon
- Select the home icon

Note: The BACnet type & ID will be displayed on the target page if 'ID' is selected on the 'View Config' settings screen.

Note: If the target page is selected as the home page and a security password is set the home page will be locked. The only way to exit the target screen in this case is to press the Nuaire logo to the top right of the screen for 5 seconds.

4.2.2 Setting Up Favourites

The "Favourite" screen displays a list of favourite objects.

To add or remove favourites.

- Navigate to the settings page
- Select the right arrow six times to reach the View Config screen.
- Select the function tickbox and favourite star.
- Select the home icon
- Navigate to the network page.
- Select the appropriate controller
- Navigate to the required object. See "Exposed BACnet Object List" for a full list.
  (Pressing for 3 seconds on an object will display the full name.)
- Select the star to turn it black
- Navigate and select any other required favourites
- When finished, navigate back to the View Config screen in the settings section and remove the function tick

Favourites can be removed by browsing the favourites page, selecting an object and then selecting the trashcan.

Favourites can be re-ordered by uploading the favourite settings to a usb memory stick and changing the order of the items in the favourites.csv file. This file can then be downloaded back to the LCD.

Figure 11.
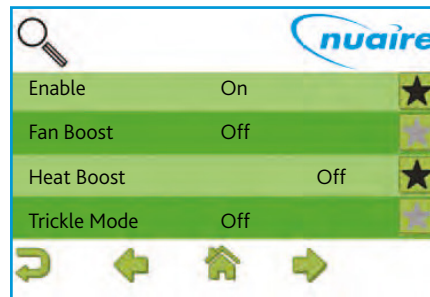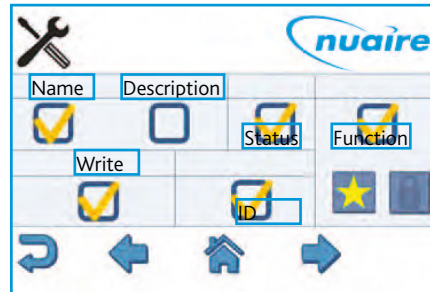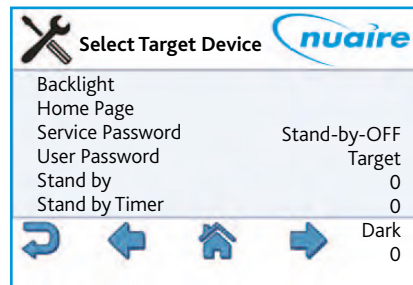
Network Page	Description	Object Type	Object ID
17	Room Air Temp	AV	11296
17	CO2 Level	AV	13980
17	Humidity	AV	14297
17	Active Setpoint	AV	14534
32	Enable	MSV	10218
25	Time Schedule	SCH	10496
32	Fan Boost	MSV	10240
28	Heat Boost	MSV	10205
1	Fresh Air Temperature	AI	10008
15	Software Setpoint	AV	10309

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4.3 Setting Up Security

4.3.1 Setting A User Password

- Navigate to the settings page
- Select the right arrow twice to reach the display settings screen
- Change the user password a 4 digit number
- The user password will now be requested each time a locked object is written
- The user password is also needed to exit the target page. (When the homepage is set to target)

4.3.2 Setting A Service Password

- Navigate to the settings page
- Select the right arrow twice to reach the display settings screen
- Change the service password a 4 digit number
- The service password will now be requested each time the settings page is accessed

4.3.3 Disable Wiriting Of Values

- Navigate to the settings page
- Select the right arrow six times to reach the View Config screen
- De-select the write tickbox. All controller points are now read only
- A service password will need to be set to stop users re-enabling the write function

4.3.4 Allow Basic Values To Be Written By The User

- Navigate to the settings page
- Select the right arrow six times to reach the View Config screen
- Select the function tickbox and lock
- Select the home icon
- Navigate to the network page.
- Select the appropriate controller.
- Navigate to the required object. See "Exposed BACnet Object List" for a full list.
- Select any values that need password protection. A black lock indicates a locked value
- When finished, navigate back to the View Config screen in the settings section. Remove the Function tick and enable writing of values
- A user password will need to be set to stop writing of locked values. It is recommended that all values are locked except the following;

Network Page	Description	Object Type	Object ID
32	Enable	MSV	10218
25	Time Schedule	SCH	10496
32	Fan Boost	MSV	10240
28	Heat Boost	MSV	10205
15	Software Setpoint	AV	10309

Note: If the target page or favourite page is selected as the home page and a security password is set, the home page will be locked. The only way to exit the target screen in this case is to press the Nuaire logo to the top right of the screen for 5 seconds. A security password will then be requested to access the main menu. The security password timeout is the same as the standby timer and set via the display settings.
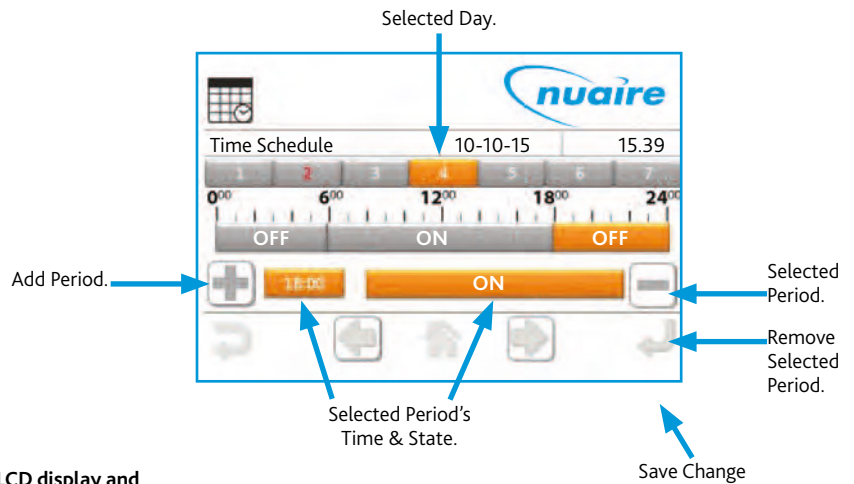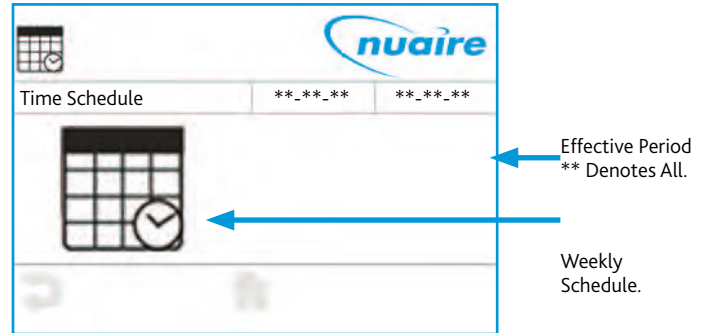
Figure 12.

ASHRAE BACnet
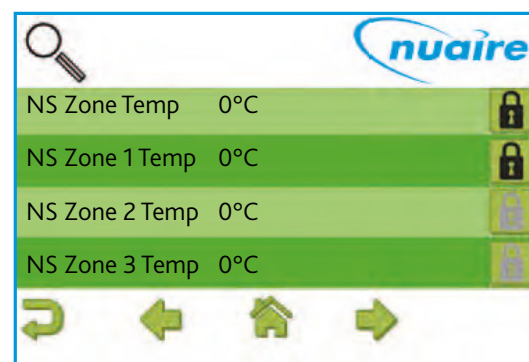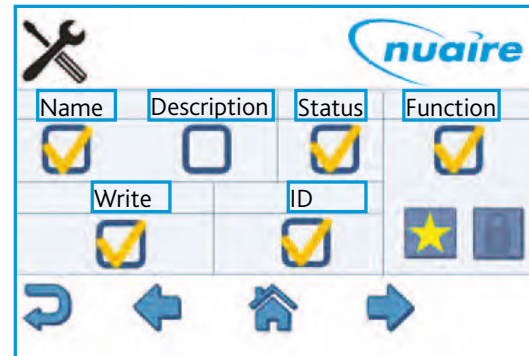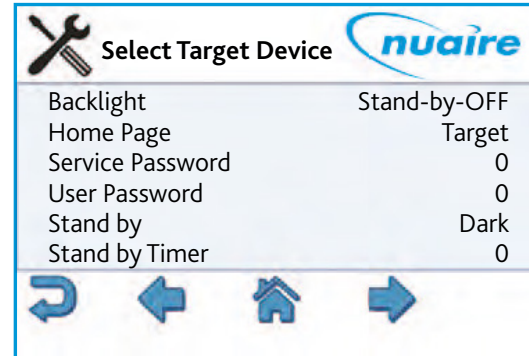
4.4 Scheduling Page

Standard BACnet schedule objects can be adjusted in the same way as any other BACnet object.

The BACnet schedule function consists of an array of singular time values with a corresponding ON/OFF state. In order to end an 'ON' period, a new value must be created with a value of 'OFF'. This new value's time can be adjusted to the desired end time.

Select a schedule object via object browser or the favourites menu to access the following screens.

Figure 13.

Effective Period ** Denotes All.

Weekly Schedule.

Selected Day.

Add Period.

Selected Period.

Remove Selected Period.

Selected Period's Time & State.

Save Change

4.5 Alarm Log

When an XBC alarm changes state, a signal is sent to the LCD display and logged on the alarm page. If there are items on the alarm page the standard top left page icons change to one of the following, depending on the current page. The alarm page can be accessed by selecting the alarm icon.

Alarm events are logged with a date and time.
'Nor' represents a change to a normal state.
'Ala' represents a change to an alarm state.

The text in parentheses denotes the alarm the event applies to. The log can hold up to 40 events.

Logged alarm events can be deleted by using the delete icon. If all events are deleted, alarm states can still be checked by navigating to the BACnet alarm objects via the network browser page. See the BACnet alarm list for alarm objects.

The LCD can be set to sound a continuous beep when a new item is added to the alarm log. This beep is silenced by any user interaction, but the alarm event is still logged. This option can be changed via the settings page.

4.6 Backup

The LCD settings, favourites and locked items can be backed up to a usb drive by plugging a usb into the rear of the LCD. The screen will automatically change to a download screen. Select the item required and choose upload. To download data to the LCD select the data type and choose download. If a user or service password is forgotten, they can be reset by re-downloading a backup file to the LCD that has no set password. It is recommended that a backup is made of a LCD with no password set.

4.7 Settings Pages

**These set of pages allow the user to configure the technical functions of
the LCD both from the BACnet and user interface perspectives.**
The settings page requires a service password for access.

4.7.1 Network settings page

Allow the user to discover all devices connected on the MS/TP network and browse all objects exposed within these devices.

Parameter Name	Description	Default Setting
Device Name	It defines the BACnet Device Object Name	FAD0351
Device ID	It defines the BACnet Device Object Identifier	127
MAC Address	MSTP Address of FAD	127
Descriptions	BACnet Description of FAD	Field Advanced Display
Baud Rate	It defines the FAD communication speed over the BACnet local network.	38400
Max Info Frames	It defines the BACnet Device Object Max_Info_Frames	3
Adjust Priority	The Adjust priority parameter defines with which priority the display will command AV / BV / MV values.	16
Override Priority	The Override priority parameter defines with which priority the display will command AO / BO / MO values	8
Page Refresh Time	It defines the polling speed at which the FAD will refresh the values shown on the screen	30 sec
Max Master	This parameter represents the value of the Max_Master property of the node's Device object	127
APDU Time	The APDU Timeout property defines the amount of time, in seconds, the FAD waits for responses from other devices.	3

4.7.2 Display Settings Page

Parameter Name	Description	Default Setting
Backlight	It defines whether the back light remains ON or turns OFF during Standby	Stand-By ON
Homepage	It defines which page to show at power up or pressing the "Home" shortcut button	Main Menu
Service Password	Password required to enter settings page	0
User Password	Password Required to change locked values (All values are locked by default)	0
Stand By	It defines the behaviour of the display once the "Stand By Timer" has expired without interactions from the user	-
Stand By Timer	It defines the inactivity period, in minutes, required to force the display in Stand By mode and for both Service and User passwords expiration. Defining this parameter to Zero, the passwords request (if any) is prompted at any access to pages requiring them	0 min
Feedback Sound	It defines whether the device shall provide a sound feedback during user interaction	OFF
Alarm	It defines whether the device shall provide a sound feedback when receiving a new Alarm. The notification sound can be continuous (ON) or intermittent (BEEP)	OFF
Date	It adjusts settings related to the Day, Month and Year of the FAD integrated clock	
Time	It adjusts settings related to the Hour and Minute of the FAD integrated clock	
Day Of Week	It adjusts settings related to the Day of Week (1-7) of the FAD integrated clock	

ASHRAE **BACnet**

4.7.3 Select Target Device Page

Parameter Name	Description	Default Setting
Device Name	Name of the device where the object resides	
MAC Address	The MSTP address of the device where the object resides	
Device ID	The BACnet ID of the device where the object resides	
Object Type	The object type	
Object ID	The object BACnet ID	

4.7.4 View Config

Parameter Name	Description	Default Setting
Name / Description	Chooses whether objects are described by their name or description	Name
Write	Allows editing of objects	Yes
ID	This will display the BACnet ID next to all BACnet objects on the network, favourites and target pages	Yes
Function (Favourite / Lock)	This option allows objects to be added to the favourite or locked list. Once it is selected, navigate to the network page and choose which objects are required. A user password is required to change any locked object, if set. All values are unlocked by default.	None

4.8 Multiple Controllers

When accessing the Network View the FAD launches a Network Discovery function. The purpose of this function is to find other BACnet devices residing on the same MS/TP trunk. The maximum number of devices supported by the FAD discovery function is 32.

4.9 Wiring

Figure 14.

+12...24 VAC
-12...24 VAC

+BACnet
-MS/TP
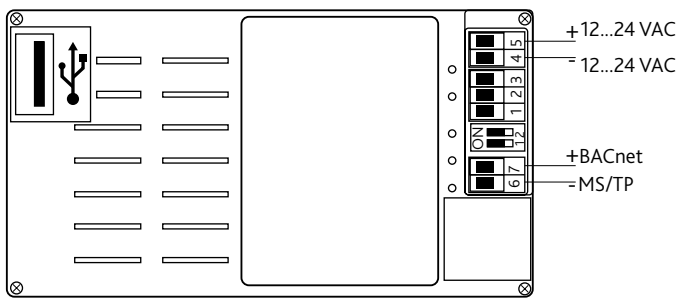
There are two ways of connecting the LCD.

• Connected to the FC bus using screwed terminals. A separate power supply is required.
• If the controller is standalone, the LCD display can be connected to the RJ12 FC bus port on the front of the FAC controller.
  This FC port will also power the LCD, so in this case, a separate power supply is not required.

One of the following cables is required to do this.

ESCO-LCD-3M	Ecosmart-Connect LCD RJ12 Connection Cable 3m
ESCO-LCD-5M	Ecosmart-Connect LCD RJ12 Connection Cable 5m
ESCO-LCD-10M	Ecosmart-Connect LCD RJ12 Connection Cable 10m
ESCO-LCD-20M	Ecosmart-Connect LCD RJ12 Connection Cable 20m
ESCO-LCD-30M	Ecosmart-Connect LCD RJ12 Connection Cable 30m

Network Page	Description
1-3	Unused
4	Power Supply (-) 12...24 VAC / VDC
5	Power Supply (+) 12...24 VAC / VDC
6	BACnet MS/TP Port (RT-)
7	BACnet MS/TP Port (RT+)
USB	Programming USB Port
DIP Switch 1	BACnet MS/TP Line Terminator (End of Network 120Ω resistor switch)
DIP Switch 2	Unused

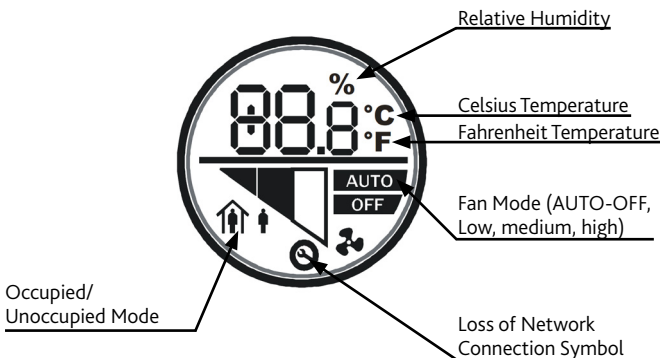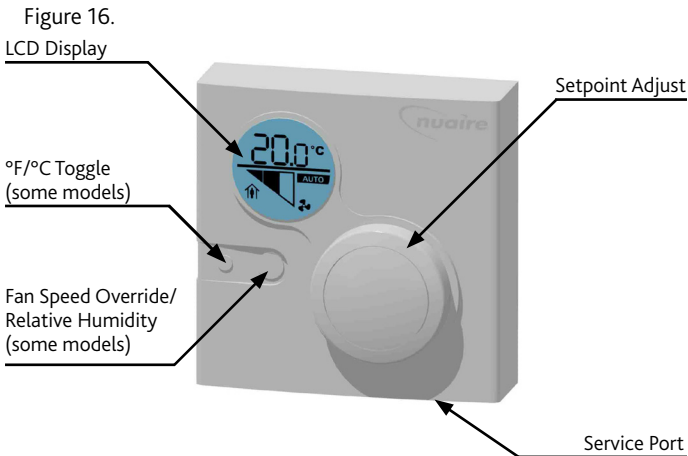# 5.0 SA BUS DEVICES

5.1 Room Module

Room Modules are electronic, wall-mountable sensors designed to work directly with the Nuaire control panel.

Figure 15.

Room modules are automatically detected and require no set-up. The majority of RM modules monitor room temperature; however, options are available to also monitor zone humidity, carbon dioxide (CO2), local temperature setpoint adjustments, PIR, and other variables. This data is transmitted to a controller on the Sensor Actuator (SA) Bus.

5.2 Features

Figure 16.
LCD Display

°F/°C Toggle
(some models)

Fan Speed Override/
Relative Humidity
(some models)

Setpoint Adjust

Service Port

Relative Humidity

Celsius Temperature
Fahrenheit Temperature

Fan Mode (AUTO-OFF,
Low, medium, high)

Occupied/
Unoccupied Mode

Loss of Network
Connection Symbol

5.2.1 Backlit LCD Display

All LCD display versions of Room Modules include a dial to adjust room setpoint. While the setpoint is being adjusted the backlight will switch on and the display will update to show the setpoint. While inactive the display will revert to display the current room temperature. The occupancy status is also displayed on the LCD. On fan speed override models the fan speed and override status is also displayed. A maintenance icon will display if there is a sensor network error.

5.2.3 Service Port

A RJ12 service port is provided at the base of each Room Module. This allows the temporary connection of an extra module to the sensor network.

5.2.4 Fan Speed Override/Room Humidity

This button cycles through fan speed override settings.

5.2.2 Room Humidity

The ESC-RM-2-TDH-120 model includes a push button on the face of the network sensor to allow occupants to view the temperature and relative humidity of the zone. Pressing the push button toggles between temperature and RH on the LCD. The LCD defaults to temperature 5 seconds after the push button is released. Following this procedure to permanently change the default display:

1. If the display backlight is off, press and release the push button to illuminate the backlight. If the display backlight is already on, proceed to Step 2.

2. Press and hold the push button for 5 seconds to switch to the desired default display (either temperature or RH). Note: The desired default display will flash for 5 seconds. After the display stops flashing, the new default display is in effect.

3. Release the push button; the desired display is now the new default display.

The humidity setpoint cannot change via RM sensors. This must be changed through a commissioning tool.

5.3 Installation

Location Considerations
Locate the network sensor:
- On a partitioning wall, approximately 5 ft (1.5m) above the floor in a location of average temperature.
- Away from direct sunlight, radiant heat, outside walls, outside doors, air discharge grills, or stairwells; and from behind doors.
- Away from steam or water pipes, warm air stacks, unconditioned areas (not heated or coooled), or sources of electrical interference.

5.3.1 Removing the Rear Cover

1. Use a pozi screwdriver to loosen the screw on the top of the unit.

2. Insert a coin into the slot next to the security screw location, pressing the tab that keeps the unit closed. Then carefully pry the top edge of the sensor assembly away from its mounting base and remove.

5.3.2 Modular Jack

For the modular jack, simply snap the wiring plug into the jack. A modular jack requires a straight-through, one-to-one connection (not a crossover). See interconnection section for details.
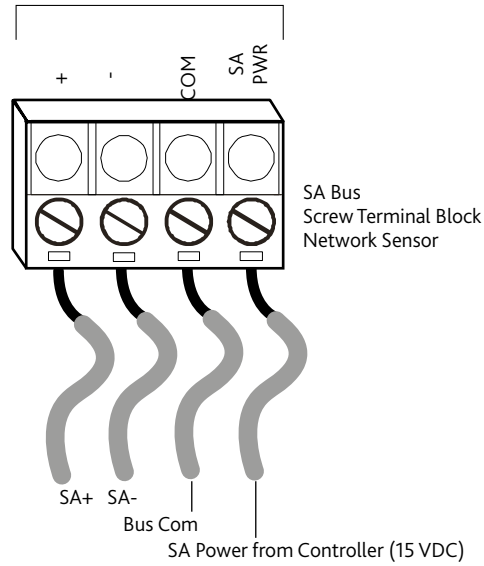
ASHRAE **BACnet**

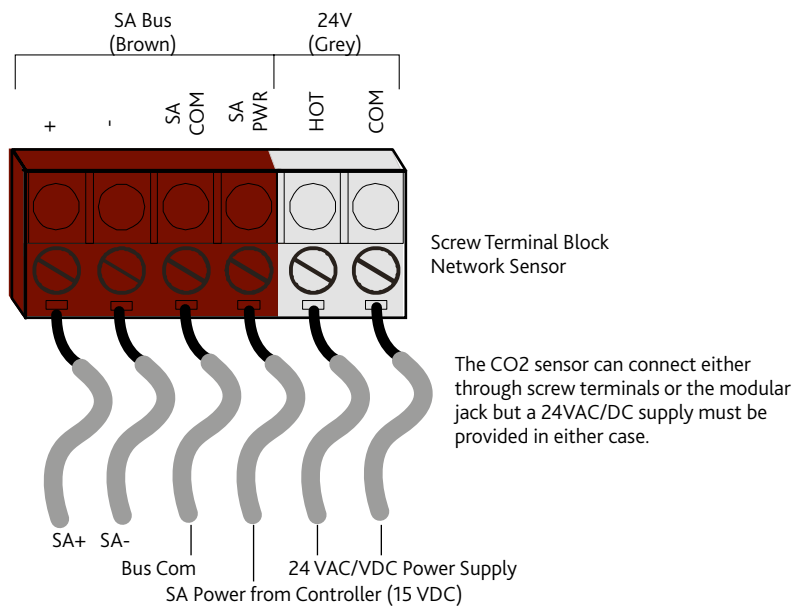## 5.4 Room Modules Wiring

Screw terminal wiring:
If RJ12 cables are not used, the screw terminal connections on the Room Modules can be used.

Figure 17.

Standard Sensor Wiring.

+   -   COM   SA PWR

SA Bus
Screw Terminal Block
Network Sensor

SA+   SA-
Bus Com
SA Power from Controller (15 VDC)

CO2 Sensor Wiring.

SA Bus
(Brown)   24V
(Grey)

+   -   SA COM   SA PWR   HOT   COM

Screw Terminal Block
Network Sensor

The CO2 sensor can connect either through screw terminals or the modular jack but a 24VAC/DC supply must be provided in either case.

SA+   SA-
Bus Com
24 VAC/VDC Power Supply
SA Power from Controller (15 VDC)

5.5 Dimensions Room Modules (mm)

Figure 18.
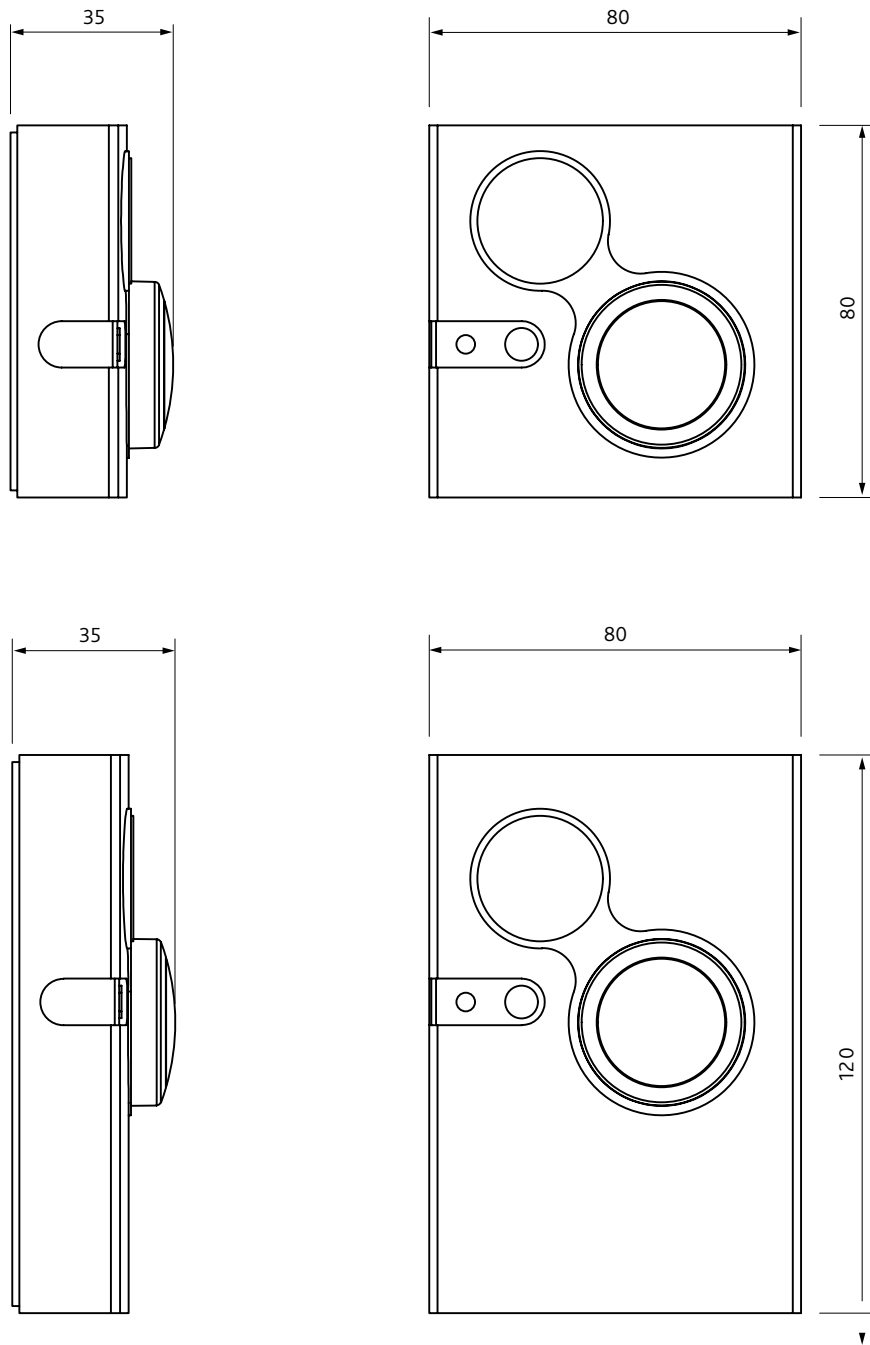
5.6 Available Room Modules

The following room modules are available.

Group	Nuaire Part Number	Size (mm)	Temperature Sensor	Humidity Sensor	LCD, Setpoint Adjust & Occupancy Display	PIR	Fan Speed Override	Fan Status Display	CO2 Sensor	Network Address Range	Notes	
Group 1 Max of 1 Per Controller	ESCO-TDFS	80x80	YES		YES		YES	YES		199 (fixed)	Max of 1 per controller	
	ESCO-TS	80x80	YES							200-203		
	ESCO-THS	80x80	YES	YES						200-203		
	ESCO-TDS	80x80	YES		YES					200-203		
	ESCO-TDHS	80x80	YES	YES	YES					200-203	Relative Humidity is not displayed	
	ESCO-TPL	80x120	YES			YES				200-203		
Group 2 Max of 4 Per Controller	ESCO-THPL	80x120	YES	YES		YES				200-203		
	ESCO-TDPL	80x120	YES		YES	YES				200-203		
	ESCO-TDHPL	80x120	YES	YES	YES	YES				200-203	Relative Humidity is not displayed	
	ESCO-TDHL	80x120	YES	YES	YES					200-203	Relative Humidity is not displayed	
	ESCO-PL	80x120				YES				200-203		
Group 3 Max of 4 Per Controller	ESCO-CL	80x120							YES	212-219	Powered via separate 24vac/dc supply	

5.7 Sensor Addressing

ESCO-TDFS has a fixed device address of 199 on the SA Bus. The address can be changed on other models via DIP switches on the PCB rear.
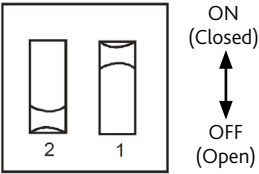
The designation of each address is shown in the following table.

Network Page	Description	Module Type
199	Fixed	Multi-function (with Fan Speed Override)
200-203	Adjustable	Multi-function
212-219	Adjustable	Room CO2 Sensor Module

Each sensor on the SA bus must have a unique address. The default controller strategy is preconfigured to automatically detect all Room Modules on the network and react accordingly.
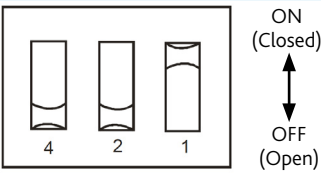
200-203 Address Switch Settings

Address		Switch 2	Switch 1
200		OFF	OFF
201		OFF	ON
202		ON	OFF
203		ON	ON

ON (Closed) ↕ OFF (Open)

2 1

200-203 Address Switch Settings

Address		Switch 4	Switch 2	Switch 1
212		OFF	OFF	OFF
213		OFF	OFF	ON
214		OFF	ON	OFF
215		OFF	ON	ON
Not Supported		ON	ANY	ANY

ON (Closed) ↕ OFF (Open)

4 2 1

5.8 Room Modules Technical Specifications

Supply Voltage	15VDC (Powered from SA bus)
Temperature Measurement Range	0 to 40°C
Humidity Measruement Range	0 to 100% (Full) 10 to 90% (Calibrated)
Temperature Sensor Type	Local 1k ohm Platinum Resistance Temerature Detector (RTD); Class A per IEC 60751
Humidity Sensor Type	Thin Film Capacitive Sensor
Temperature Resolution (Models with LCD)	±0.5°C
Default Temperature Setpoint Adjustment Range	10 to 30°C
PIR Occupancy Sensor Motion Detection	Minimum 94 Angular Degrees up to a distance of 15 ft (4.6m); Based on a clear line of sight.
Ambient Operating Conditions	10 to 30°C, 10 to 90% RH (Temp Probe -10 to 60°C)
Ambient Storage Conditions	-20 to 60°C, t to 95% RH
CO2 Sensor Warmup Time	Less than 1 Minute; less than 10 minutes for full accuracy.

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5.9 Interconnection

The sensors or other devices on the SA bus network connect either by modular RJ12 connections or by screwed terminals using plain ended cable. All sensors are fitted with both.

5.9.1 Modular Cable (Up To 30 Metres)

The Room Modules can connect using a 24AWG twisted 3-pair cable with RJ12 connections over the Sensor Actuator (SA) bus. the following items are available.

ESCO-C3M	3m Prefabricated sensor cable with modular jacks
ESCO-C5M	5m Prefabricated sensor cable with modular jacks
ESCO-C10M	10m Prefabricated sensor cable with modular jacks
ESCO-C20M	20m Prefabricated sensor cable with modular jacks
ESCO-C30M	30m Prefabricated sensor cable with modular jacks
ESCO-2WA	2-port extension adapter
ESCO-3WA	3-port extension adapter

Room Modules must not be fitted more than 30metres (cable length) from the controller when using this connection method.

5.9.2 Modular Jack Network

Figure 19.

Controller

3-way female RJ12 adaptor

3-way female RJ12 adaptor

RJ12 Sensor jack

RJ12 Plug

RJ12 Plug

Room Module

Room Module

Room Module

Sensor, SA Bus (RJ-12 Modular Jack)

Power (15 VDC) — 6
Bus and Power Common — 5
Power (15 VDC) — 4
Bus and Power Common — 3
SA Bus - — 2
SA Bus + — 1

Cable Type: Pre-fabricated 3 twisted pair with RJ12 Plugs, 26AWG
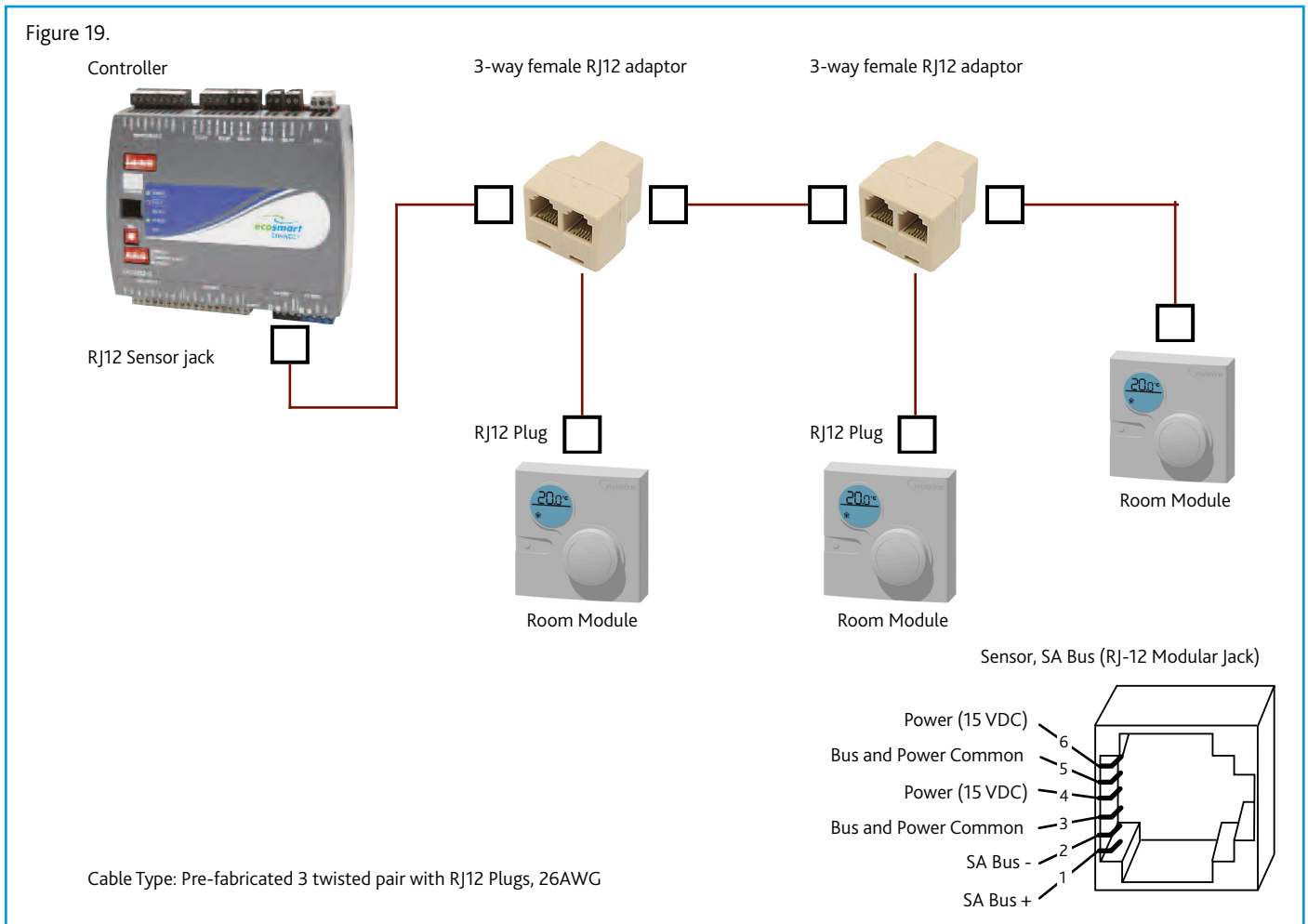
5.9.3 Plain Cable (30 To 150 Metres)

If a Room Module is to be fitted more than 30metres (cable length) from a controller, the following cable is recommended.

ESCO-MSTPC30M	Ecosmart Connect MSTP cable reel 30m
ESCO-MSTPC150M	Ecosmart Connect MSTP cable reel 150M

Note: On the SA Bus, the + and - wire are one twisted pair, and the COM and SA PWR are the second twisted pair of wires.

These cannot be used with RJ12 connections and must be stripped and connected using screwed terminals. The shield must be earthed at the control panel end only and be made continuous along the bus length.

Room Modules must not be fitted more than 150metres (cable length) from the controller.

Figure 20.

Controller

SA Bus Screwed
Terminal (Brown)

Screwed Terminal

Room Module

Screwed Terminal

Room Module

Screwed Terminal

Room Module
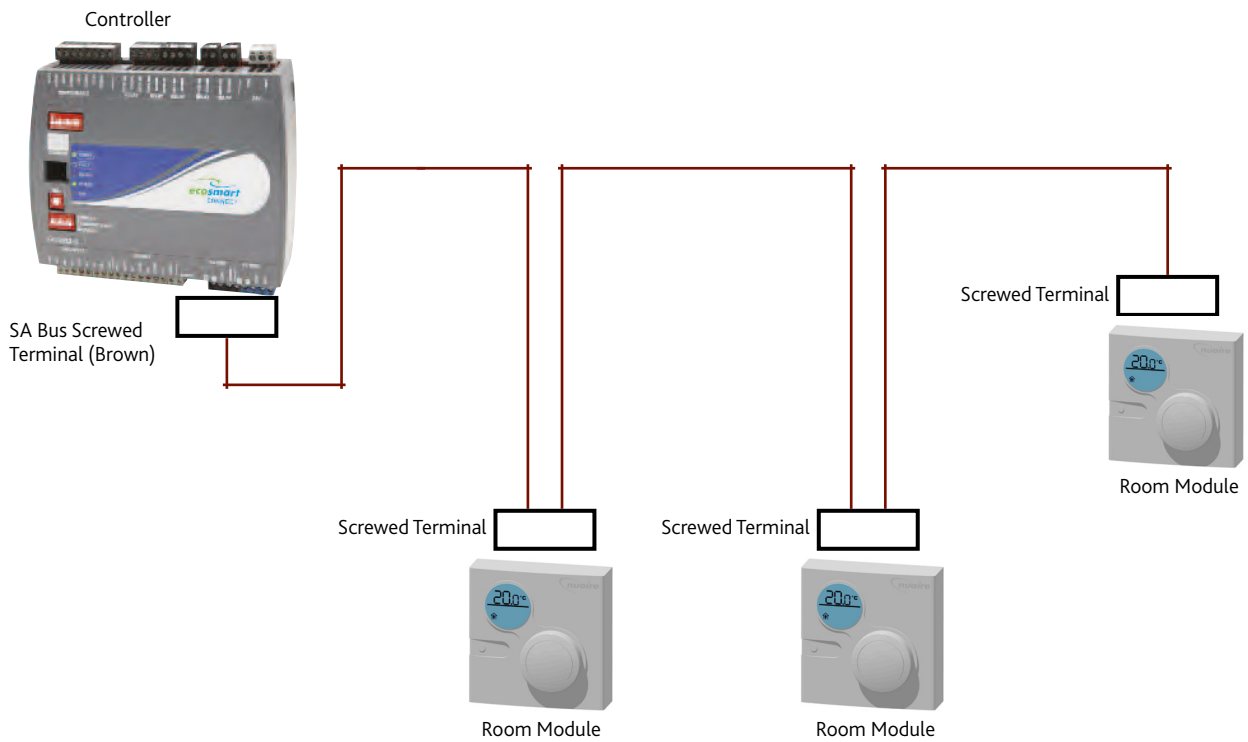
Cable Type: Plain-eded shielded 2 twisted pair 22AWG

6.0 APPENDIX TO SOFTWARE STRATEGY

6.1 BACnet Object List (By Instance Number)

Please note: The numbers in parentheses before each multi state object is the enumerated object value for use with BACnet browers.

LCD Browser Page	Name	Description	Type	BACnet Object Instance Number	Units	Default Value
1	Supply Air Temp (B)	The supply air temperature	AI	10005	Degrees-Celsius	N/A
1	Fresh Air Temp (H)	The fresh air temperature	AI	10008	Degrees-Celsius	N/A
1	Extract Air Temp (C)	The extract air temperature	AI	10011	Degrees-Celsius	N/A
2	RM199 Humidity	The Humidity at RM address 199	AI	10017	Percent-Relative-Humidity	N/A
2	RM199 Temp	The temperature at RM address 199	AI	10029	Degrees-Celsius	N/A
2	IN4	The 0-10 voltage at input 4	AI	10032	volts	N/A
2	IN5	The 0-10 voltage at input 5	AI	10035	volts	N/A
3	RM200 Temp	The temperature at RM address 200	AI	10050	Degrees-Celsius	N/A
3	RM200 Humidity	The Humidity at RM address 200	AI	10053	Percent-Relative-Humidity	N/A
3	RM201 Temp	The temperature at RM address 201	AI	10065	Degrees-Celsius	N/A
3	RM202 Temp	The temperature at RM address 202	AI	10068	Degrees-Celsius	N/A
4	RM203 Temp	The temperature at RM address 203	AI	10071	Degrees-Celsius	N/A
4	RM201 Humidity	The Humidity at RM address 201	AI	10077	Percent-Relative-Humidity	N/A
4	RM202 Humidity	The Humidity at RM address 202	AI	10092	Percent-Relative-Humidity	N/A
4	RM203 Humidity	The Humidity at RM address 203	AI	10107	Percent-Relative-Humidity	N/A
5	RM212 CO2	The CO2 at RM address 212	AI	10137	Parts-Per-Million	N/A
5	RM213 CO2	The CO2 at RM address 213	AI	10140	Parts-Per-Million	N/A
5	RM214 CO2	The CO2 at RM address 214	AI	10143	Parts-Per-Million	N/A
5	RM215 CO2	The CO2 at RM address 215	AI	10146	Parts-Per-Million	N/A
6	Output 4	Configurable output 4 (OUT4)	AO	10173	Percent	N/A
6	Extract Fan Output	The 0-10v signal to the extract fan	AO	10176	volts	N/A
6	Heating Output	The 0-10v signal to the heating output	AO	10179	Percent	N/A
6	Supply Fan Output	The 0-10v signal to the supply fan	AO	10182	volts	N/A
7	RM199 Setpoint	The setpoint at RM address 199	AV	10023	Degrees-Celsius	N/A
7	RM200 Setpoint	The setpoint at RM address 200	AV	10074	Degrees-Celsius	N/A
7	RM201 Setpoint	The setpoint at RM address 201	AV	10083	Degrees-Celsius	N/A
7	RM202 Setpoint	The setpoint at RM address 202	AV	10098	Degrees-Celsius	N/A
8	RM203 Setpoint	The setpoint at RM address 203	AV	10113	Degrees-Celsius	N/A
8	Alarm Delay	Alarm hold off period	AV	10262	Seconds	10
8	Auto-Run on Max-Time	Maximum Run-on Max Time	AV	10263	Seconds	900
8	Auto-run-on Scale Factor	Scale Factor for automatic run-on time	AV	10264	No units	2
9	CO2 Target	Target CO2 Value	AV	10265	Parts-per-million	650
9	Deadband	Dead band for temp control	AV	10266	Degrees-Celsius	3
9	Run-on (Enable)	Run-on timer value	AV	10267	Seconds	0
9	Extract Fan Max	Individual fan maximum speed setting	AV	10268	Percent	100
10	Extract Fan Min	Individual fan minimum speed setting	AV	10270	Percent	20
10	Run-on (Boost)	Boost run-on time	AV	10272	Seconds	0
10	Supply Fan Boost Speed	Supply Fan boost speed	AV	10273	Percent	100
10	Frost Prot. Fan Off	Minimum time the supply fan will stop in a frost protection state	AV	10274	Seconds	300
11	Frost Prot. Temp	Supply temperature at which frost protection becomes active	AV	10275	Degrees-Celsius	4
11	Heat Boost Setpoint	Heater Boost Setpoint	AV	10276	Degrees-Celsius	35
11	High Temp Alarm	Supply temp which will trip the high supply alarm	AV	10277	Degrees-Celsius	50
11	Humidity Target	Relative Humidity Target	AV	10278	Percent-Relative-Humidity	50

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BOXER BPS ECOSMART CONNECT CONTROL (CO)

LCD Browser Page	Name	Description	Type	BACnet Object Instance Number	Units	Default Value
12	IO Damper Delay	Delay between starting the fan relay and the fan output.	AV	10279	Seconds	0
12	Low Temp Alarm	Supply temp which will trip the low supply alarm	AV	10280	Degrees-Celsius	8
12	Night C Fan Speed	The night cool fan speed	AV	10281	Percent	60
12	Nigh C Min Temp	The minimum temperature that will stop night cooling	AV	10302	Degrees-Celsius	12
13	Pressure Target	Target pressure value	AV	10303	Pascals	400
13	Purge Fan Speed	Purge Fan Speed	AV	10304	Percent	60
13	Purge Min Temp	The minimum temperature that will stop night cooling	AV	10305	Degrees-Celsius	12
13	RTC Boost Band	The Return Temperature Control Boost Band	AV	10306	Degrees-Celsius	15
14	RTC Max Supply Temp	Maximum supply temp when in RTC mode	AV	10307	Degrees-Celsius	35
14	RTC Min Supply Temp	Minimum supply temp when in RTC mode	AV	10308	Degrees-Celsius	12
14	Software Setpoint	Software Setpoint	AV	10309	Degrees-Celsius	22
14	STC H/C Pref	STC Heat/Cool Pref	AV	10310	No units	50
15	STC HX Efficiency	STC HX Efficiency	AV	10311	No units	0.8
15	Supply Fan Max	Individual fan maximum speed setting	AV	10312	Percent	100
15	Supply Fan Min	Individual fan minimum speed setting	AV	10314	Percent	20
15	Trickle Deadband	Setpoint deadband used when trickling with no enable signal.	AV	10316	Degrees-Celsius	5
16	Room Air Temp	The room air temperature	AV	11296	Degrees-Celsius	N/A
16	CO2 Level	The CO2 Level	AV	13980	Parts-Per-Million	N/A
16	Humidity	The Humidity Level	AV	14297	Percent-Relative-Humidity	N/A
16	Active Setpoint	The setpoint currently used	AV	14534	Degrees-Celsius	N/A
17	EF Max Volt	The upper voltage for the extract fan	AV	17273	Volts	10
17	EF Start Volt	The voltage required to start the extract fan	AV	17274	Volts	1
17	SF Max Volt	The upper voltage for the supply fan	AV	17275	Volts	10
17	SF Start Volt	The voltage required to start the extract fan	AV	17276	Volts	1
18	Extract Boost Speed	The extract fan boost speed	AV	17419	Percent	100
18	Fan Speed Demand	A user entered fan speed demand. 0% = trickle speed	AV	17761	Percent	0
18	BMS 0-10v Input	A virtual BMS voltage input using an ESClassic BMS table	AV	17773	Volts	0
18	Fan Speed Schedule	Current state of the Fan Speed Demand Schedule object.	AV	17830	Percent	0
19	Setpoint Timeout	The time before reverting to software setpoint when last changed with timeout is selected.	AV	17971	seconds	3600
19	Fan Override Timeout	The time before reverting to auto fan speed when revert to auto with timeout is selected.	AV	17977	seconds	3600
19	Setpoint Schedule	Current state of the Setpoint Schedule object.	AV	18215-	Degrees-Celsius	22
19	Recirc Offset	Difference in setpoint and room temperature for which recirculation is required.	AV	18327	Degrees-Celsius	5
20	Extract Setback Speed	The extract fan speed when Extract Setback is enabled.	AV	18258	Percent	30
20	SL Enable	The state of the enable input (IN8)	BI	10161	(1)Off (2)On	N/A
20	SL2 Input	The state of the configurable input (IN9)	BI	10164	(1)Off (2)On	N/A
20	Alarm Circuit 1	The state of Alarm Circuit 1	BI	10167	(1)Alarm (2)Normal	N/A

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LCD Browser Page	Name	Description	Type	BACnet Object Instance Number	Units	Default Value
21	Alarm Circuit 2	The state of Alarm Circuit 2	BI	10170	(1)Alarm (2)Normal	N/A
21	Bypass Damper Cmd	The controller's signal to the HX bypass. (Active = Bypass, Inactive = Heat Exchange)	BO	10185	(1)Inactive (2)Active	N/A
21	Fault Relay Cmd	The state of the fault relay. (Fault = De-energised)	BO	10188	(1)Alarm (2)Normal	N/A
21	Fan Enabled Cmd	The state of the fan enabled relay.	BO	10191	(1)Off (2)On	N/A
22	Cooling Demand Cmd	The state of the cooling demand relay.	BO	10194	(1)Off (2)On	N/A
22	Rcirc Relay	The state of the recirculation damper relay	BO	10197	(1)Close (2)Open	N/A
22	RM199 Occupancy Status	The occupancy status at RM address 199	BV	10020	(1)Occupied (2)Unoccupied	N/A
22	RM200 Occupancy Status	The occupancy status at RM address 200	BV	10056	(1)Occupied (2)Unoccupied	N/A
23	RM201 Occupancy Status	The occupancy status at RM address 201	BV	10080	(1)Occupied (2)Unoccupied	N/A
23	RM202 Occupancy Status	The occupancy status at RM address 202	BV	10095	(1)Occupied (2)Unoccupied	N/A
23	RM203 Occupancy Status	The occupancy status at RM address 203	BV	10110	(1)Occupied (2)Unoccupied	N/A
23	Reset Alarms	Changing this value will reset any latched alarms	BV	10332	(1)False (2)True	FALSE
24	Tuning Reset	Resets the PID auto tuning loops	BV	12880	(1)False (2)True	FALSE
24	Local Calendar		CAL	10496		N/A
24	8-1/Boot	8-1/Boot	-			N/A
24	8-1/Main	8-1/Main	-			N/A
25	8-1/Archive	8-1/Archive	-			N/A
25	8-1/Static	8-1/Static	-			N/A
25	8-1/Dynamic	8-1/Dynamic	-			N/A
25	8-1/Flash_Memory	8-1/Flash_Memory	-			N/A
26	Notification	Notification	-			N/A
26	Time Schedule	Local Time Schedule	SCH	10496		N/A
26	Purge Time Schedule	Purge Time Schedule	SCH	10499		N/A
26	Night C Sample	Daytime schedule for winter or summer decision making	SCH	15875		N/A
27	Night C Schedule	Night Cooling Schedule	SCH	16014		N/A
27	Fan Speed Schedule	A schedule for fan speed demand (0% = Trickle speed)	SCH	17798		N/A
27	Setpoint Schedule	A schedule for setpoint adjustment.	SCH	18215		N/A
27	Reverse Cycle backup Heating	Schedule for running electric/LPHW heating over reverse cycle heating. On = Electric/LPHW, Off = Reverse Cycle Heating	SCH	18330		N/A
28	RM199 Fan Speed	Fan Speed Override Status of RM199	MSV	10014	(1)Auto (2)Off (3)Low (4)Medium (5)High	N/A
28	RM199 Occ Display	Occupancy Display at RM address 199	MSV	10044	(1)Occupied (2)Unoccupied (3)Bypass (4)Standby	N/A
28	RM200 Occ Display	Occupancy Display at RM address 200	MSV	10062	(1)Occupied (2)Unoccupied (3)Bypass (4)Standby	N/A
28	RM201 Occ Display	Occupancy Display at RM address 201	MSV	10089	(1)Occupied (2)Unoccupied (3)Bypass (4)Standby	N/A
29	RM202 Occ Display	Occupancy Display at RM address 202	MSV	10104	(1)Occupied (2)Unoccupied (3)Bypass (4)Standby	N/A
29	RM203 Occ Display	Occupancy Display at RM address 203	MSV	10119	(1)Occupied (2)Unoccupied (3)Bypass (4)Standby	N/A
29	0-10 v CO2 Range	CO2 sensor output range	MSV	10200	(1)0-2,000ppm (2)0-4,000ppm (3)0-5,000ppm (4)0-10,000ppm (5)0-20,000ppm	N/A
29	CO2 Sensor Op	CO2 sensor operation	MSV	10201	(1)Average CO2 (2)Max CO2 (3)Ignore CO2	N/A

LCD Browser Page	Name	Description	Type	BACnet Object Instance Number	Units	Default Value
30	SL2 Mode	Set the function of switched live 2	MSV	10202	(1)None (2)Fan Boost (3)Heater Boost (4)Extract Setback	Fan Boost
30	Cooling Type	Set the type of cooling fitted.	MSV	10203	(1)None (2)Chilled Water (3)3rd-Party (4)Reverse Cycle DX	None
30	Damper Override	Override bypass damper position	MSV	10204	(1)Auto (2)Heat Exchange (3)Bypass	Auto
30	Heat Boost	Software enabled Heater boost	MSV	10205	(1)Off (2)On	Off
31	Heating Type	Set the type of heating fitted.	MSV	10206	(1)None (2)LPHW (3)Electric (4)3rd-Party	As per Build
31	H Sensor Op	Humidity Sensor Operation	MSV	10207	(1)Average RH% (2)Max RH% (3)Ignore RH%	Average RH%
31	Ignore PIR Sensors	Ignore all MSTP network PIR sensors	MSV	10208	(1)No (2)Yes	No
31	IN4 Function	Function of the UI4 input	MSV	10209	(1)None (2)N/A (3)N/A (4)0-10V CO2 Sensor (5)0-10V Temperature Sensor (6)0-10V Humidity Sensor (7)0-10V Pressure Sensor	None
32	IN5 Function	Function of the UI5 input	MSV	10210	(1)None (2)Fan Speed Control (3)0-10v BMS (4)0-10V CO2 Sensor (5)0-10V Temperature Sensor (6)0-10V Humidity Sensor (7)0-10V Pressure Sensor	None
32	Low Temp Action	Action taken when the low supply alarm is engaged.	MSV	10211	(1)Alarm only (2)Alarm and stop fans	Alarm Only
32	0-10v Press. Range	Pressure sensor range	MSV	10212	(1)0-25Pa (2)0-50Pa (3)0-100Pa (4)0-300Pa (5)0-500Pa (6)0-1000Pa (7)0-1600Pa (8)0-2500Pa (9)0-3000Pa	0 to 1000Pa
32	P sens. Op	Pressure sensor operation	MSV	10213	(1)Average (2)Max (3)Ignore	Average Value
33	SetPoint Op	Setpoint operation	MSV	10214	(1)Last Changed (2)Software Only (3)Last Changed with Timeout	Software Only
33	T Sens. Op	Temperature sensor operation	MSV	10215	(1)NS Average (2)Return Air Only (3)NS & Return Average	NS Average
33	0-10v Temp Range	Temperature sensor range	MSV	10216	(1)0 to 50°C (2)0 to 40°C (3)0 to 100°C (4)0 to 80°C (5)0 to 90°C	0 to 50°C
33	Auto Run-on	Auto-run on mode	MSV	10217	(1)Off (2)On	Off
34	Enable	Software enable switch	MSV	10218	(1)Off (2)On	On
34	Enable via Schedule	Enabled via Schedule	MSV	10219	(1)Off (2)On	N/A
34	Fan Boost	Software enabled Fan boost	MSV	10240	(1)Off (2)On	Off
34	Hibernate Mode	Unit is ready for hibernation	MSV	10241	(1)Off (2)On	Off
35	Night C Mode	This input will enable night cool mode.	MSV	10242	(1)Off (2)On	Off
35	Purge Active	This input will enable purge mode	MSV	10243	(1)Off (2)On	Off
35	Tacho PCB Fitted	Is a "Taco Bell" PCB fitted.	MSV	10244	(1)No (2)Yes	As per Build
35	Temp Control Mode	Temperature control mode	MSV	10245	(1)Supply Temp (2)Room Temp	Supply Temp
36	Test (Fan)	Fan Test (Factory Use Only)	MSV	10246	(1)Off (2)On	N/A
36	Test (Heater)	Heater Test (Factory Use Only)	MSV	10247	(1)Off (2)On	N/A
36	Test (Override Fan)	Overtemp Test (Factory Use Only)	MSV	10248	(1)Off (2)On	N/A

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LCD Browser Page	Name	Description	Type	BACnet Object Instance Number	Units	Default Value
36	Test (Wiring)	Wiring Test (Factory Use Only)	MSV	10249	(1)Off (2)On	N/A
37	Trickle Mode	Enable trickle mode	MSV	10250	(1)No Status (2)Off (3)Low (4) Medium (5)High (6)Auto-Off (7) Auto-Low (8)Auto-Medium (9) Auto-High	N/A
37	Purge Time Schedule	State of the Purge Time Schedule	MSV	10512	(1)Normal (2)Alarm	N/A
37	RM199 Fan Display	Fan Speed Override Display at RM address 199	MSV	14703	(1)Normal (2)Alarm	N/A
37	Critical Alarm	Unit is latched in critical alarm	MSV	15309	(1)Off (2)On	N/A
38	Maint. Alarm	Maintenance Alarm	MSV	15310	(1)Off (2)On	N/A
38	Night C Sample	Night Cooling Sample Schedule	MSV	16008	(1)Normal (2)Alarm	N/A
38	Night C Schedule	Night Cooling Running Schedule	MSV	16014	(1)Normal (2)Alarm	N/A
38	XBC Sensor Alarm	XBC Sensor Out of Range	MSV	17009	(1)Normal (2)Alarm	N/A
39	Low SA-T Alarm	Low Supply Air Alarm	MSV	17011	(1)Normal (2)Alarm	N/A
39	High SA-T Alarm	High Supply Air Alarm	MSV	17012	(1)Normal (2)Alarm	N/A
39	Frost Alarm	Frost Alarm	MSV	17013	(1)Normal (2)Alarm	N/A
39	Ala (A Cir 1)	For LCD Event Signal Only	MSV	17281	(1)Normal (2)Alarm	N/A
40	Norm (A Cir 1)	For LCD Event Signal Only	MSV	17282	(1)Normal (2)Alarm	N/A
40	Ala (Low Supply Temp)	For LCD Event Signal Only	MSV	17285	(1)Normal (2)Alarm	N/A
40	Norm (Low Supply Temp)	For LCD Event Signal Only	MSV	17286	(1)Normal (2)Alarm	N/A
40	Norm (High Supply Temp)	For LCD Event Signal Only	MSV	17289	(1)Normal (2)Alarm	N/A
41	Ala (High Supply Temp)	For LCD Event Signal Only	MSV	17290	(1)Normal (2)Alarm	N/A
41	Ala (A Cir 2)	For LCD Event Signal Only	MSV	17293	(1)Normal (2)Alarm	N/A
41	Norm (A Cir 2)	For LCD Event Signal Only	MSV	17294	(1)Normal (2)Alarm	N/A
41	Ala (Frost)	For LCD Event Signal Only	MSV	17316	(1)Normal (2)Alarm	N/A
42	Norm (Frost)	For LCD Event Signal Only	MSV	17317	(1)Normal (2)Alarm	N/A
42	Ala (XBC Sensor Fault)	For LCD Event Signal Only	MSV	17320	(1)Off (2)On	Off
42	Norm (XBC Sensor Fault)	For LCD Event Signal Only	MSV	17321	(1)Normal (2)Alarm	N/A
42	SW-FAC2612-2-9A	Strategy Version	MSV	17340	(1)Normal (2)Alarm	N/A
43	Fire Alarm	Engage Fire Alarm Mode	MSV	17365	(1)Normal (2)Alarm	N/A
43	Ala (Fire Alarm)	For LCD Event Signal Only	MSV	17409	(1)Cooling Demand (2)ESClassic BMS Mode	Cooling Demand
43	Norm (Fire Alarm)	For LCD Event Signal Only	MSV	17411	(1)Auto (2)None (3)Heating (4) Cooling	Auto
43	OUT4 Mode	Chooses the mode of Analogue Output 4	MSV	17608	(1)No (2)Yes	No
44	ESC BMS Thermic Output	Chooses whether to demand thermal output in 0-10v ESClassic BMS mode	MSV	17610	(1)Off (2)On	Off
44	IO Damper Fitted	Selects whether IO dampers are fitted on alarm circuit 2	MSV	17669	(1)Override Has Priority (2)Revert to Auto after Timeout	Override Has Priority
44	Extract Setback	Puts the extract fan to setback speed	MSV	17769	(1)Off (2)On	Off
44	Fan Override Operation	Chooses the operation of the 3-speed fan override.	MSV	17975	(1)Override Has Priority (2)Revert to Auto after Timeout	Override Has Priority
45	Recirc Override	Override the Recirc Damper position	MSV	18329	(1)Auto (2)Open (3)Close	N/A
45	Recirc Cycle Backup Heating	Current state of the reverse cycle schedule	MSV	18330	(1)Normal (2)Alarm	N/A

6.2 BACnet Overview

BACnet is a data communication protocol for Building Automation and Control Networks. It allows compatibility between devices of different manufacturers.

In BACnet, any device on the network has the ability to browse the network and discover devices

6.3 Writing Values

It is best practice to only write to AV, BV & MSV (Analogue Variables, Binary Variables, and Multistate Variables). When writing to these, it is best to write at priority level 16.

6.4 Typical Basic Commissioning

- Set the analogue variables "Extract Fan Min Speed" "Supply Fan Min Speed" "Extract Fan Max Speed" "Supply Fan Max Speed" during commissioning.
- If flow measurements are required enable the unit using the "Enable" MSV and boost the unit using the "Fan Boost" MSV.

6.5 Typical Basic Operation

- Enable the unit using the MSV "Enable" object. The fan runs at min speed.
- Increase the fan speeds using the AV "Fan Speed Demand" 0-100% (0% = Min Commissioned Speed, 100%= Max Commissioned Speed).
- Adjust setpoint using the AV "Software Setpoint".

6.6 Writing Directly To Outputs

- It is not recommended to write directly to outputs since the internal logic of the control will be bypassed and some features will not function. The unit may also start without an enable signal.
- However, if this is required for test purposes (or otherwise), priority level 8 must be used.
- The internal control logic writes at priority level 16 so any data written to the outputs at this level is at risk of being overwritten.
- These values must be relinquished or nulled once used otherwise the outputs will be locked at that value. Even if the value is "0".

6.7 Priority Array Storage

Priority levels 8 & 16 are stored in the controller following a power cycle. All other levels are reset to null.
Level 16 is not to be used for controller outputs since it will be overridden by the internal logic during operation.

6.8 Devices

A BACnet network can consist of a number of *device objects*. Each device is given a unique *Device Instance Number.* A typical example of a device is a controller or BACnet compatible LCD. EcoSmart Connect controllers are assigned a random device instance number at the factory and do not need to be changed. The instance number range is 1 - 4,194,303 (2^{22}).

Note: EcoSmart Connect controllers use a MSTP network for communication and are assigned a MSTP address (4 -127) by the dip switch located on the front of the controller. The *MSTP address* must not be confused with the *Device Instance Number.*

Most network browsers can identify a device by the *Device Instance Number* or the *MSTP address*.

6.9 Objects

In BACnet, information is stored within devices as a number of 'virtual' objects. Some examples of these are Fresh Air Temperature, Extract Fan Speed, CO2 Target, etc.
Each object has a number of properties but the most important are shown in the table below.

Object Name	The name of the object. E.g. Setpoint
Object Instance Number	A unique number which represents the object within the device. E.g. 12544
Object Type	The type of object. E.g. Analogue Variable (AV)
Description	A short description of the object. E.g. The room setpoint
Present Value	The current value of the object. E.g. 20
Units	The units of the present value. E.g. °C

The maximum number of objects in a device is 4,194,303 (2^{22}) of each type.

6.10 Types Of Objects

The following is a list of some typical object types.

AI	Analogue Input	An analogue object which is a physical input to a device.
AO	Analogue Output	An analogue object which is a physical output from a device.
AV	Analogue Variable	An analogue object which exists within a device.
BI	Binary Input	A true/false object which is a physical input to a device.
BO	Binary Ouput	A true/false object which is a physical output from a device.
BV	Binary Variable	A true/false object which exists within a device.
MSV	Multi-State Variable	This is an enumerated object which can have a number of states, each represented by a number. This is similar to a dropdown menu in windows forms. The State_Text property is an array containing the text for each value. Some browsers may not be able to read the text values so both are provided in this manual. E.g. 1=Off, 2=Low, 3=High, 4=Auto
SCH	Schedule Object	This is a special object with the ability to have a changing value depending on the time of date or day of the week.

6.11 Writing Of Values (Priority Array)

Any device on the BACnet network has the ability to write values to other device objects.

To resolve conflicts, BACnet uses a 16 position priority array to work out who gets priority. Any request it change the present value is stored in the priority array at the priority level of the received request. The object then chooses the highest priority value to become the present value.

Shown below are examples of priority array decision making.

ASHRAE **BACnet**

Case 1	
Priority 1	null
Priority 2	null
Priority 3	null
Priority 4	null
Priority 5	null
Priority 6	null
Priority 7	null
Priority 8	null
Priority 9	null
Priority 10	null
Priority 11	null
Priority 12	null
Priority 13	null
Priority 14	null
Priority 15	null
Priority 16	null
Relinquish Default	0
Present Value	**0**

Case 2	
Priority 1	null
Priority 2	null
Priority 3	null
Priority 4	null
Priority 5	null
Priority 6	null
Priority 7	null
Priority 8	null
Priority 9	null
Priority 10	null
Priority 11	null
Priority 12	null
Priority 13	null
Priority 14	null
Priority 15	null
Priority 16	5
Relinquish Default	0
Present Value	**5**

Case 3	
Priority 1	null
Priority 2	null
Priority 3	null
Priority 4	null
Priority 5	null
Priority 6	null
Priority 7	null
Priority 8	null
Priority 9	7
Priority 10	null
Priority 11	null
Priority 12	null
Priority 13	null
Priority 14	null
Priority 15	null
Priority 16	5
Relinquish Default	0
Present Value	**7**

Case 4	
Priority 1	null
Priority 2	null
Priority 3	null
Priority 4	null
Priority 5	null
Priority 6	null
Priority 7	null
Priority 8	null
Priority 9	7
Priority 10	null
Priority 11	null
Priority 12	null
Priority 13	null
Priority 14	null
Priority 15	null
Priority 16	0
Relinquish Default	0
Present Value	**7**

Case 5	
Priority 1	null
Priority 2	null
Priority 3	null
Priority 4	null
Priority 5	null
Priority 6	null
Priority 7	null
Priority 8	null
Priority 9	null
Priority 10	null
Priority 11	null
Priority 12	null
Priority 13	null
Priority 14	null
Priority 15	null
Priority 16	0
Relinquish Default	0
Present Value	**0**

Priority	Application
1	Manual Life Safety
2	Automatic Life Safety
3	Available
4	Available
5	Criticial Equipment Control
6	Minimum On/Off
7	Available
8	Manual Operator
9	Available
10	Available
11	Available
12	Available
13	Available
14	Available
15	Available
16	Available

6.12 Inter-networking

Inter-networking is used to connect two BACnet networks operating on different physical mediums (e.g. MSTP & IP). This is possible because no matter the physical medium, BACnet messages are always the same. A router can be fitted to the network to translate BACnet between different physical media.

6.13 Example BACnet Network

MSTP Connection

Controller (MSTP address 4)

Device Properties

Object Name: Office 1 Controller
Object Instance: 12222
Description: Office 1 Controller
Location: Office 1

Object Properties
Object Name: Room Air Temp
Object Instance: 10008
Object Type: AI
Present Value: 20.2
Units: °C

Object Properties
Object Name: Enable
Object Instance: 10288
Object Type: MSV
Present Value: On
State Text: Off, On

Object Properties
Object Name: Alarm
Object Instance: 17013
Object Type: MSV
Present Value: Normal
State Text: Normal, Alarm

Object Properties
Object Name: Fan Output
Object Instance: 10182
Object Type: AO
Present Value: 2.8
State Text: Volts

Controller (MSTP address 5)

Device Properties

Object Name: Office 2 Controller
Object Instance: 12226 Description: Office 2 Controller
Location: Office 2

Object Properties
Object Name: Humidity
Object Instance: 10104
Object Type: AI
Present Value: 56
Units: Percent

Object Properties
Object Name: Humidity Setpoint
Object Instance: 10104
Object Type: AV
Present Value: 60
State Text: Percent

Object Properties
Object Name: Fan Output
Object Instance: 10185
Object Type: AO
Present Value: 0
State Text: Volts

This is a typical example of a BACnet network.
Not all objecs or properties are shown for clarity.

Case 1
The object looks down the list until it gets to the first non-null value. In this case, all priority levels are empty so the (relinquish) default value of 0 is used as the present value.

Case 2
Priority 16 is now 5 so the present value becomes 5.

Case 3
Priority 9 is now 7. Priority 9 overrules priority 16 so the present value becomes 7. Note that priority 16 is still calling for 5 but it is being ignored.

Case 4
Priority 16 is changed to 0 but this has no effect on the present value. It is still at 7 because of priority 9.

Case 5
Priority 9 is relinquished back to null. This allows priority 16 to take priority again and the present value becomes 0.

The priority array is stored inside the device itself. This means that an external device can write to a priority position and the value will stay there even if the device is disconnected.

AI and BI object types are read only and therefore do not have a priority array. AO & BO values are typically changed by the strategy at priority level 16. Any override must occur above this level and is not recommend. Be sure to relinquish all overrides once finished to minimise confusion and undesirable operation. AV, BV & MSV values are generally not changed by the strategy so an external command at priority level 16 is sufficient to change the value permanently.
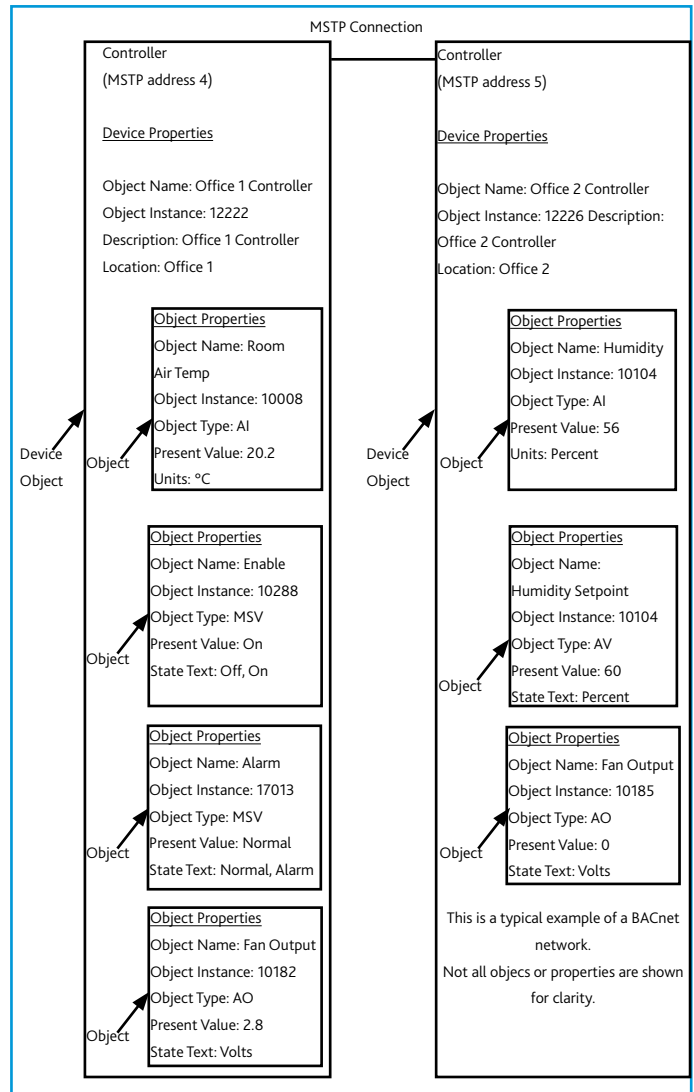
The following table shows the standard use of the priority array.

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