Titus Digital T$_3$SQ

MLM Integration with BMS

Table of Contents

MCU 2 Gateway Overview

The Master Comms Unit 2 (MCU) serves as a gateway to other BMS protocols such as Lontalk or BacNet. The MCU features four diffuser data channels with a capacity of 15 diffusers each, i.e. a total of 60 diffusers can be connected to a single MCU. It also interfaces with the MLM Tool application for setup, diagnostic and monitoring functions.

The following physical protocol interfaces are supported:

- MLM Tool application (UDP/IP) – Magnetic Ethernet
- MLM Tool application(ms/tp) – USB
- BacNet/IP – Magnetic Ethernet
- BacNet ms/tp – RS485 bus
- Lontalk - TP/FT-10 bus

The following MCU 2 hardware models are available:

MCU 2 model	Part No	Mlm Tool User Hardware Interface	BMS Protocol
Standard	BW2011-2T	Magnetic Ethernet or USB B standard	None
BACnet/IP	BW2011-2B	Magnetic Ethernet or USB B standard	BACnet/IP
BACnet ms/tp	BW2011-2M	USB B standard device	BACnet ms/tp
LON	BW2011-2L	USB B standard device	LonTalk

Please note: The Standard and BACnet/IP MCU contains a two port magnetic Ethernet switch. BACnet ms/tp and the Lon MCU only contains USB user interfaces.

The following network variables of the MLM Proprietary network are visible to other BMS network protocols:

Output from BMS

- Temperature Setpoint
    - BACnet - 0.1 °C, .5 °F resolution
    - Lon - 1°C resolution (°F not supported)

- Control Override command available in BACnet:
    - Drive Diffuser Open to pre-set limit position
    - Drive Diffuser Close to pre-set limit position
    - Emergency Activation (Disable re-heat output)
    - Emergency Open to physical limit position

- Emergency Close to physical limit position
- Activate Backoff Band control
- Set heater to maximum output
- Occupancy override occupied/unoccupied
- Occupancy external input occupied/unoccupied

- The following MCU global outputs are available on BACnet:
    - Setpoint global
    - Control override
    - Occupancy override

Input to BMS

- Space temperature, °C or °F
- Re-heater output, 0 to 100%
- Diffuser plate position, 0 to 100%
- Supply air temperature, °C or °F
- BacNet Mode
    - System Idle (in control temperature band)
    - Initializing
    - Heating mode
    - Cooling mode
    - Motor in manual drive mode
    - Occupancy state occupied/unoccupied
    - Zone air pressure
    - Zone air flow
- Averaged MCU inputs available on BACnet:
    - Average disk position
    - Average space temperature

- Lon Mode specific:
    - Data from the MCU active
    - Busy initializing
   - Heating mode
    - Cooling mode

Zone/Master/Slave Diffuser concept

The MLM Proprietary network can consist of up to 60 diffusers installed on 4 separate channels per MCU. Each channel is connected to a maximum of 15 diffusers. They can be arranged into temperature control areas, with each such area being populated with the number of diffusers required to satisfy the comfort control in that area.

Areas of control are designated 'zones' and comprise a demarked space such as a room, hallway or office area. Each such 'zone' will contain a single or multiple diffusers.

One diffuser in such a zone will be designated a 'master' diffuser and will 'host' the space temperature measurement and setpoint facility.

Other diffusers in the same control zone will be designated 'slave' or 'drone' diffusers and will follow the 'master' control outputs.
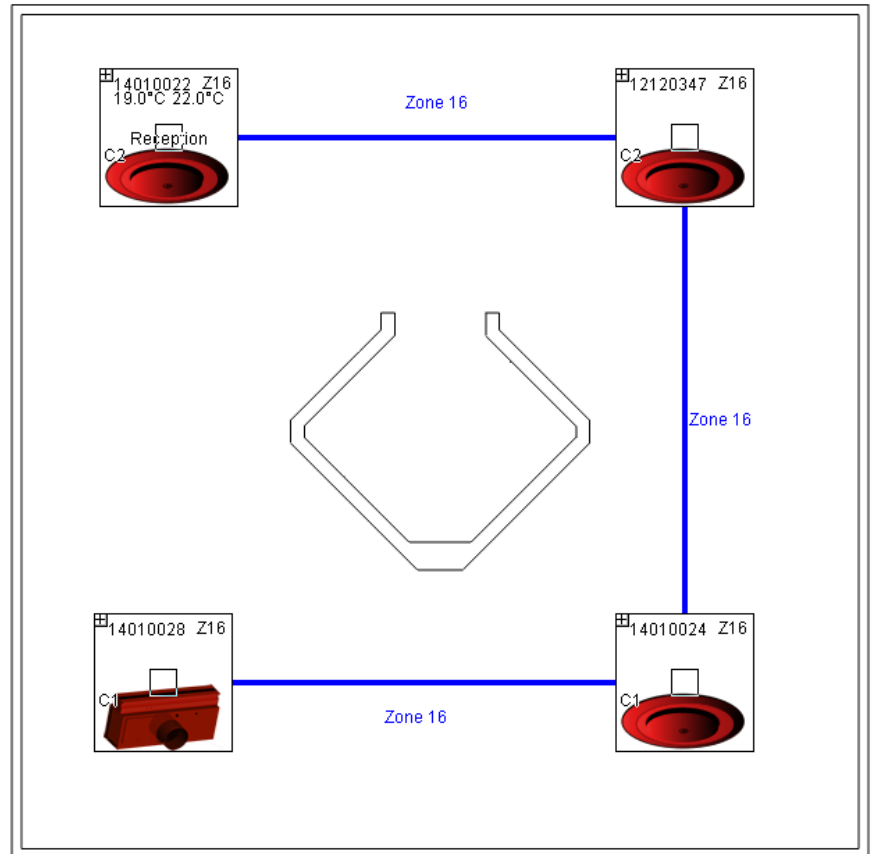
Channel and Zone designations

The Channel number corresponds to the physical (hardware) connection of the field diffusers to the MCU. From each Power Supply Unit (PSU) a RJ9 data cable connects to a numbered channel on the MCU. During commissioning, diffusers for each control area are linked (zoned) together utilising the MLM Tool application (see MLM Tool/Help/Getting Started). The number of zones could be from 1 to a maximum of 15 per channel, sequentially allocated to each master diffuser, with a maximum then of 60 zones per MCU. In practice there will be less than 60 zones as not all diffusers will be designated as master diffusers.

Information between channels can be routed across channels, with a master diffuser on one channel linked to a slave diffuser(s) on a different channel(s).

For example, the above layout is designated Zone 16:
Diffuser with serial number 14010022 is connected to channel 2, designated as zone 16 and is set as a master (temperature reading and setpoint enabled). This diffuser controls the slave diffusers with serial numbers 12120347, 14010028 and 14010024, physically connected to channels 1 and 2.

Note:

- It is important to mark the cables from a specific PSU to a specific channel. Swopping cables after commissioning will rearrange the data points on the BMS.
- The edit and save feature on the application MLM Tool is used to bind the diffusers to their respective control zones.
- Please consult the 'Making changes to a diffuser network' section in the MLM Tool rev 8.xx Help file.

During commissioning in edit mode, the user is prompted to allocate zone numbers to diffuser control groups. These numbers can be arbitrarily allocated to each control zone by the user. Once the save button is pressed, the application will automatically allocate sequential zone numbers to the project. Zone numbers will be allocated 15 per channel, with channel 1 starting with Zone 1 up to a maximum of Zone 15. Channel 2 will start with Zone 16, irrespective of channel 1 taking up 15 control zones or not. By the same token the channel 3 zone numbers will start at 31 and channel 4 starts at zone number 46.

The 3 zone numbers marked in bold in the table below corresponds to the physical connection to channel 1 (Zone 1) and channel 2 (Zones 16, 17 & 18) as depicted in the logical diffuser layout (below) in the MLM Tool.

| Channel 1	**Z1**	Z2	Z3	Z4	Z5	Z6	Z7	Z8	Z9	Z10	Z11	Z12	Z13	Z14	Z15
Channel 2	**Z16**	**Z17**	**Z18**	Z19	Z20	Z21	Z22	Z23	Z24	Z25	Z26	Z27	Z28	Z29	Z30
Channel 3	Z31	Z32	Z33	Z34	Z35	Z36	Z37	Z38	Z39	Z40	Z41	Z42	Z43	Z44	Z45
Channel 4	Z46	Z47	Z48	Z49	Z50	Z51	Z52	Z53	Z54	Z55	Z56	Z57	Z58	Z59	Z60
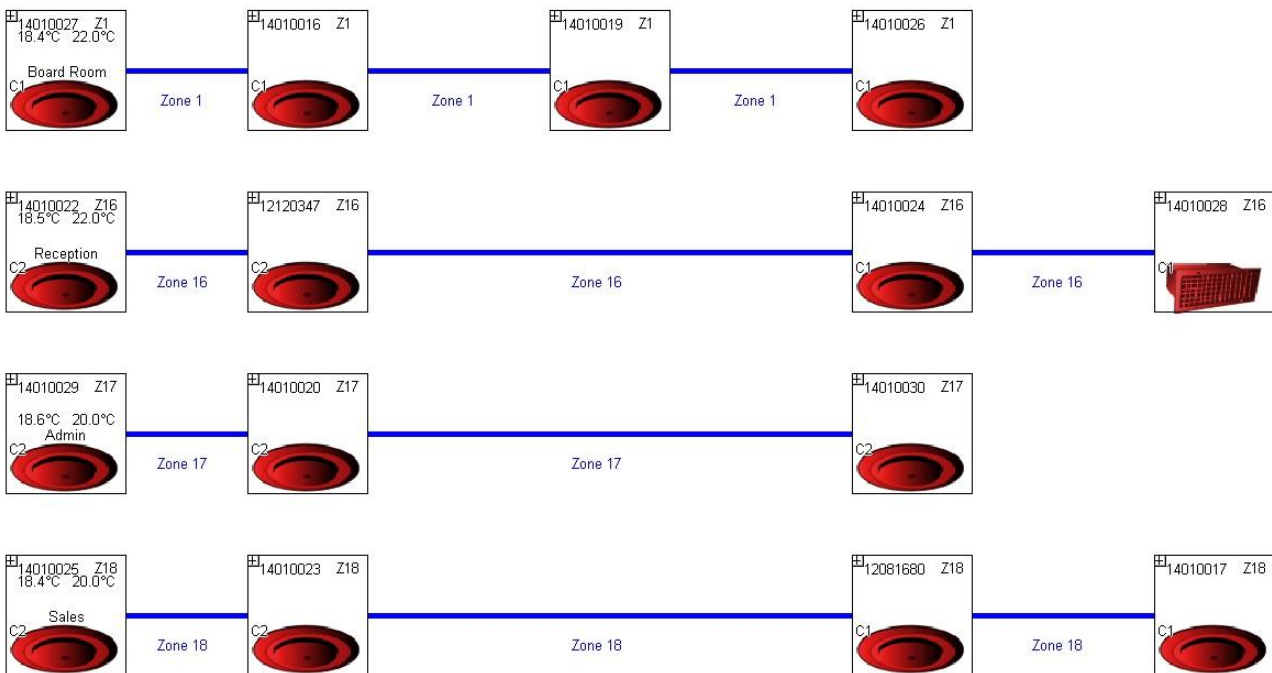
Identifying, mapping and binding of network variables to other network protocols

MCU to Lon Mapping

To connect with the MLM Tool to a Lon configured MCU, the USB type B hardware port on the MCU 2 is used. Either 'Basic View' or 'Project View' can be selected in the MLM Tool application.
For Basic View access press the connect button and select the MSTP tab. The diffuser network will be displayed. The MLM Tool can now be used to set up and commission the diffuser network.

By using the File/Export Setup command, a list can now be exported to a tab delimited text file of all the master diffusers in the MLM proprietary network. Note that although it is not essential to extract a 'master' list, it is a handy tool to link the zone, serial number and DeviceName (location) fields.
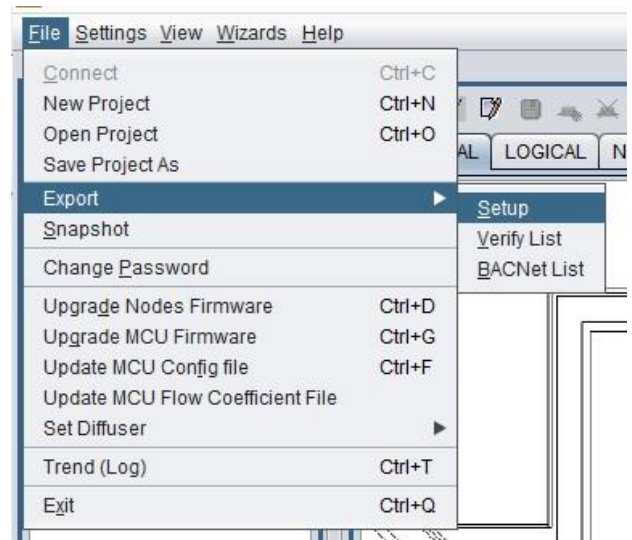
Be sure to select the 'Master Only' box to identify the point reference for the BMS.The table is exported in the following text format:

Description:
Connection Address: MSTP-USB
Exporting only masters

Channel	Type	ID	HID	Loop	ChLpMap	LonStr	Zone	Code	Serial Nr	Firmw	DeviceName
1	Diff	6	6	1	17	[1] 1	1	BT20	14010027	0608	Boardroom
2	Diff	2	2	1	33	[2] 1	16	BT20	14010022	0608	Reception
2	Diff	6	6	2	34	[2] 2	17	BT20	14010029	0608	Admin
2	Diff	4	4	3	35	[2] 3	18	BT20	14010025	0608	Sales

The fields of interest are:

- Type – 'Diff' indicates the diffuser controller hardware and in conjunction with the 'Serial Nr' field identifies the actual diffuser selected as master for that control zone.
- LonStr – Indicates the [channel][loop number] of the physical hardware point. This is legacy information and can be ignored.
- ChLpMap – Decimal presentation of the LonStr indicator. Legacy information.
- Devicename – Physical location in the building of the control zone. It is strongly recommended that this 12 character (Device name + Device name ext) identity string is implemented during commissioning.

For BMS mapping of the data points, the zone number of the master diffusers is used as the reference point. In our example Zone 1 will be the identifier surfaced to the BMS to indicate control data for Zone 1. Channel 1 has a single master controller connected, whereas channel 2 contains 3 master zone controllers.

Discovering the MCU 2 with Lon

Some concepts about the MCU Lon gateway implementation:

- The Lon configuration file (.xif) should preferably be downloaded from the MCU device during commissioning utilizing the service button. If not, the .xif program revision files 3 (standard command set) and 4 (extended command set) is available on the Rickard Trac download site http://trac.lhar.co.za/
- Pressing the service button will broadcast the Neuron ID and the program ID to the BMS system.
- Each MCU is labelled with the unique Neuron ID number for that device.
- Should the user wish to utilize the heartbeat (nciSndHrtBt) functionality, the MCU will propagate all the remaining network variables that were not propagated during the previous heartbeat period.

It is assumed the user is familiar with the standard LNS (Lon Network Service) tools and their implementation. Reference will only be made to these software tools.
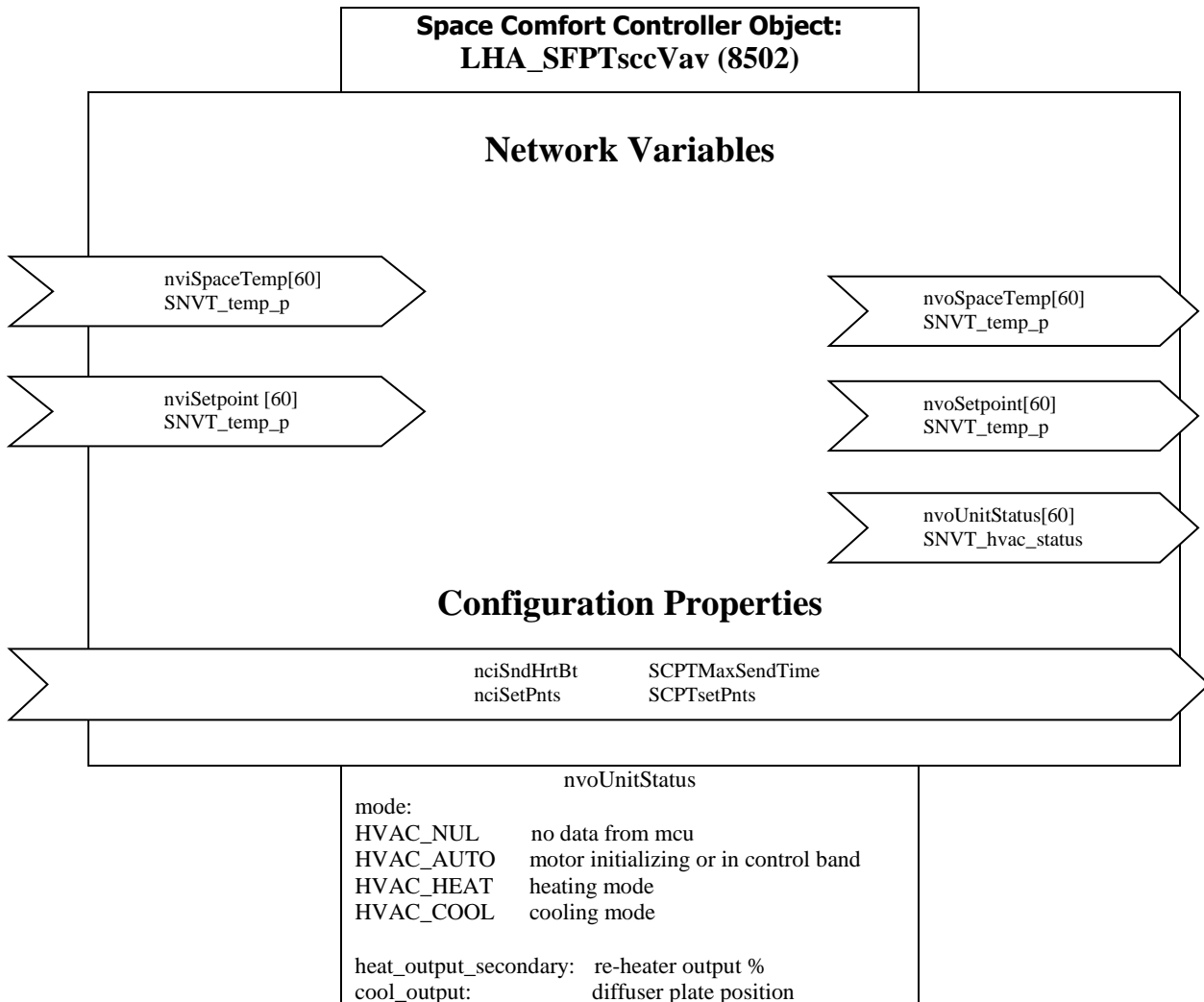
The Lon MCU device is easily discovered by the Lonmaker tool by entering a Neuron ID or using the service button.

Note the SCC functional blocks starting at SCC VAV(0) through SCC VAV(59) corresponds with Zone 1 through Zone 60 on the MCU.
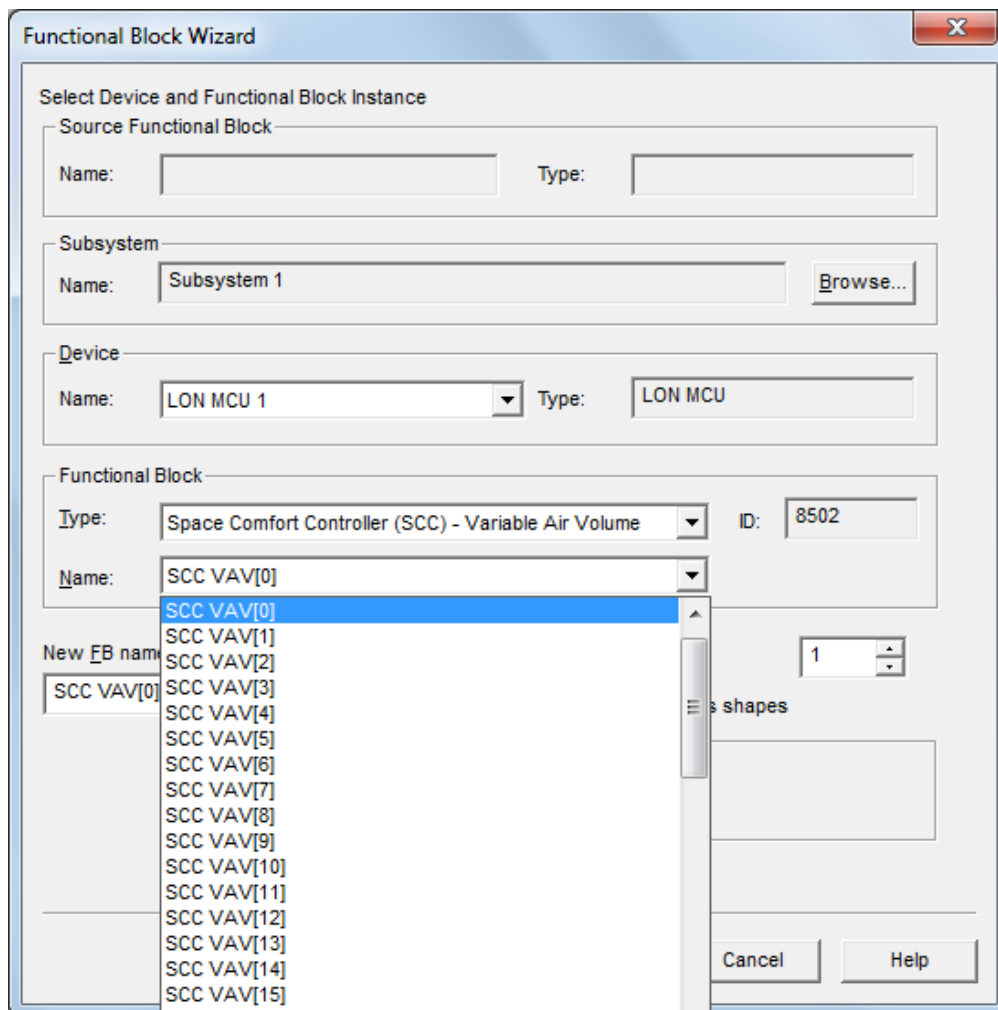
There are 62 functional blocks supported in the functional profile of the MCU Lon module. The node and virtual blocks are standard Lon implementations. The balance all utilizes the Lon 8502 Space Comfort Controller template. This in effect means each MCU serves as a gateway for a maximum of 60 master diffuser zones. Zones not populated on the MCU will reflect as null data in the corresponding functional block.

The table below shows the basic functional profile supported for each control zone:

Space Comfort Controller Object:
LHA_SFPTsccVav (8502)

Network Variables

nviSpaceTemp[60] SNVT_temp_p	nvoSpaceTemp[60] SNVT_temp_p
nviSetpoint [60] SNVT_temp_p	nvoSetpoint[60] SNVT_temp_p
	nvoUnitStatus[60] SNVT_hvac_status

Configuration Properties

nciSndHrtBt   SCPTMaxSendTime
nciSetPnts   SCPTsetPnts

nvoUnitStatus
mode:
HVAC_NUL   no data from mcu
HVAC_AUTO   motor initializing or in control band
HVAC_HEAT   heating mode
HVAC_COOL   cooling mode

heat_output_secondary: re-heater output %
cool_output: diffuser plate position

Note: More manufacturer defined network variables are available on request.

The same functional block as depicted in Lonmaker. Note the nvoHeatPrimary variable is not activated in the basic functional profile.
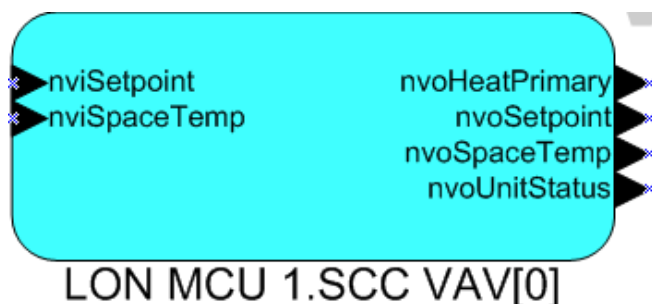
MCU 2 BACnet to BMS setup

The MCU 2 supports both BACnet/IP or BACnet ms/tp. Note MLM Tool V8.xx is required to bind the MCU 2 to other devices in a BACnet installation.

The BACnet ms/tp MCU connects via a RS485 transceiver port to the ms/tp network, whereas BACnet /IP interface to the Ethernet IP port on the MCU.

Please note the MCU ms/tp conforms electrically to the RS485 network specification as recommended by ASHRAE. The RS485 port on MCU 2 is optically isolated. For the interconnection and shielding instructions, refer to Addendum y of ANSI/ASHRAE Standard 135-2008.

A major advantage of BACnet/IP implementation is that the MLM Tool application can run simultaneously with the BMS BACnet client on the same (PC) hardware platform. This greatly simplifies system commissioning and diagnostics.

Bacnet/IP setup

To configure a MCU 2 into a BACnet/IP network, connect to the MCU web page by entering the MCU 2 IP address into an Internet browser. The default IP address is 192.168.0.251. The following information will be displayed on the web page:

- The Serial number and Software Version number - cannot be changed.
- The Device Name can be changed by the user and usually identify the physical location of the MCU.
- BACnet State indicates if the BACnet key has been activated, i.e. the BACnet/IP protocol is active on the MCU.
- The default unique BACnet device ID (instance) is derived from the Ethernet mac address. This parameter can be changed by the user (edit and press save) to comply with the BMS requirements.

- BACnet key entered to activate the BACnet protocol. This is a once-of setting normally activated during manufacture. To convert a MCU 2 Standard device to BACnet a key value can be procured from the manufacturer and entered into this field.

Note:

- The BACnet ID and Device Name fields indicated are contained in the Object Identifier and Object Name properties of the BACnet Device Object.
- To change MCU IP addresses consult the Hardware/Master Comms Unit section in the MLM Tool Help menu.
- To revert to the default IP address (192.168.0.251) press and hold the BOOT button on the MCU until the ST1 LED flashes. Release BOOT, press and release the DEF button. After a few seconds the CH1…4 LED's will flash to indicate a reset condition. The IP address is now set to default.

BACnet ms/tp setup

For an MCU to be configured into a BACnet ms/tp network the following setup is required:

Please note: To connect the MLM Tool to a ms/tp configured MCU, the USB type B hardware port is used. Either 'Basic View' or 'Project View' can be selected in the MLM Tool application.

For Basic View access press the connect button and select the MSTP tab. The diffuser network will be displayed.

Select the View/Open New Terminal/USB (MSTP) tabs. Press Connect and then 'Show config' to verify the BACnet ID, MAC address and baud rate fields.

- The ms/tp mac address is a crucial setting and each MCU must contain an individual mac address for correct operation. The default mac address is 25.
- Please note the ms/tp standard limit for mac addresses are 0 to 127.
- For optimum data throughput on ms/tp it is recommended that the mac addresses be allocated sequentially from zero. Also the MaxMaster parameter in the BACnet Device Object should be set to the highest mac address for all the devices on the network.
- The default baud rate for ms/tp on the MCU is set at 76800 bps.


Once the diffuser network has been set up with the MLM Tool, it is recommended that the same Master List as described in the MCU to Lon mapping section, now be extracted to map the diffuser network to BMS.

MCU BACnet point mapping

The MCU serves as a BACnet gateway to a maximum of 60 diffuser control zones. The point data is limited to diffuser master information and although slave diffusers generally mimic the master data, some detail information is not available through the BACnet point data. This includes specific diffuser setup as well as diagnostics information.

- The BACnet stack supports a priority array of 16 elements.
- Read/Write_property_multiple is supported.
- Segmentation is not supported.
- The maximum APDU size is 480 bytes.

A typical MCU Device Object with device properties is indicated on a BMS front-end below, in this case Workplace AX running on a Niagara platform:
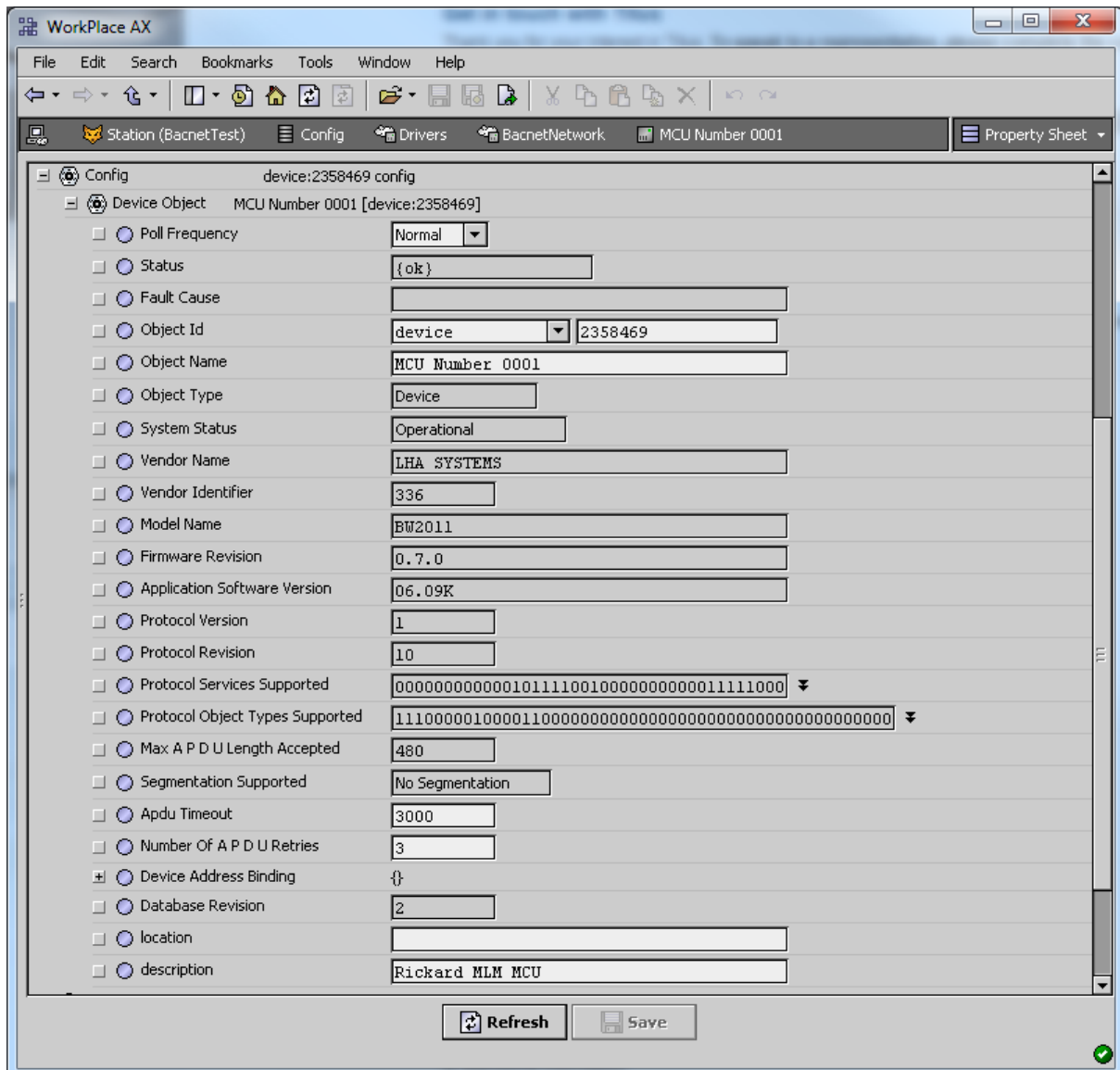
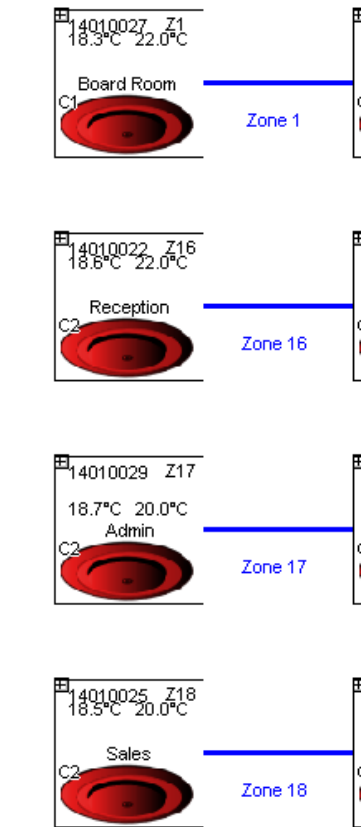The BACnet point list table can be browsed from the main web page as indicated below (BACnet/IP only):

The zone numbers of the diffuser network as set-up with the MLM Tool corresponds to the zone table on the Point List web page.

Zone		Room Temp		
Num	Serial	Type	Instance	T
1	14010027	AV	0	A
2	-	AV	1	A
3	-	AV	2	A
4	-	AV	3	A
5	-	AV	4	A
6	-	AV	5	A
7	-	AV	6	A
8	-	AV	7	A
9	-	AV	8	A
10	-	AV	9	A
11	-	AV	10	A
12	-	AV	11	A
13	-	AV	12	A
14	-	AV	13	A
15	-	AV	14	A
16	14010022	AV	15	A
17	14010029	AV	16	A
18	14010025	AV	17	A
19	-	AV	18	A

MCU
BACnet Points

Device Name:	MCU Number 0001
BACnet ID:	2358469
IP address:	192.168.0.160
BACnet Port:	0xBAC0

◉ °C ○ °F

Save

At the top of the Point List page is displayed some configuration parameters. Note the Device Name and BACnet ID is editable on the main page. The IP address can be changed in the 'Configure LAN interface'.

BACnet port address and deg °C/°F selection is updated on this page by entering and then pressing the 'Save' button.

Global Points

Name	Type	Instance
Disk Avg	AI	120
Room Temp Avg	AI	121
Setpoint Global	AO	60
Control override Global	MSO	120
Occupancy override Global	MSO	121

At the bottom of the page is listed the point positions for global parameters available on the MCU. Averaged inputs for disk position and room temperature and the global outputs for setpoint, control override and occupancy override. Note these parameters are applied to all the control zones available on the MCU.

Go back to menu page

To confirm live BACnet data, a MCU BACnet (client) reader can be downloaded from the Rickard Trac download site http://trac.lhar.co.za/ . Enter either the MCU IP address or BACnet ID for the device to be discovered. Note the BACnet reader display all data points in sequence, whether that point contains data or not.

MCU BACnet Reader v1.03

MCU IP Address: 192.168.0.160 | Get BACnet ID | BACnet ID: 2358469 | Get values

Zones	Serial	Room Temp	CO Temp	Disk pos	Heat	Disk min	Disk max	Heat max	Setpoint
Zone-1	14010027	AV-0: 17,79...	AV-60: 0	AV-120: 30	AV-180: 100	AV-240: 30	AV-300: 100	AV-360: 100	AO-0: 22
Zone-2	-	AV-1: 0	AV-61: 0	AV-121: 0	AV-181: 0	AV-241: 0	AV-301: 0	AV-361: 0	AO-1: 22
Zone-3	-	AV-2: 0	AV-62: 0	AV-122: 0	AV-182: 0	AV-242: 0	AV-302: 0	AV-362: 0	AO-2: 22
Zone-4	-	AV-3: 0	AV-63: 0	AV-123: 0	AV-183: 0	AV-243: 0	AV-303: 0	AV-363: 0	AO-3: 22
Zone-5	-	AV-4: 0	AV-64: 0	AV-124: 0	AV-184: 0	AV-244: 0	AV-304: 0	AV-364: 0	AO-4: 22
Zone-6	-	AV-5: 0	AV-65: 0	AV-125: 0	AV-185: 0	AV-245: 0	AV-305: 0	AV-365: 0	AO-5: 22
Zone-7	-	AV-6: 0	AV-66: 0	AV-126: 0	AV-186: 0	AV-246: 0	AV-306: 0	AV-366: 0	AO-6: 22
Zone-8	-	AV-7: 0	AV-67: 0	AV-127: 0	AV-187: 0	AV-247: 0	AV-307: 0	AV-367: 0	AO-7: 22
Zone-9	-	AV-8: 0	AV-68: 0	AV-128: 0	AV-188: 0	AV-248: 0	AV-308: 0	AV-368: 0	AO-8: 22
Zone-10	-	AV-9: 0	AV-69: 0	AV-129: 0	AV-189: 0	AV-249: 0	AV-309: 0	AV-369: 0	AO-9: 22
Zone-11	-	AV-10: 0	AV-70: 0	AV-130: 0	AV-190: 0	AV-250: 0	AV-310: 0	AV-370: 0	AO-10: 22
Zone-12	-	AV-11: 0	AV-71: 0	AV-131: 0	AV-191: 0	AV-251: 0	AV-311: 0	AV-371: 0	AO-11: 22
Zone-13	-	AV-12: 0	AV-72: 0	AV-132: 0	AV-192: 0	AV-252: 0	AV-312: 0	AV-372: 0	AO-12: 22
Zone-14	-	AV-13: 0	AV-73: 0	AV-133: 0	AV-193: 0	AV-253: 0	AV-313: 0	AV-373: 0	AO-13: 22
Zone-15	-	AV-14: 0	AV-74: 0	AV-134: 0	AV-194: 0	AV-254: 0	AV-314: 0	AV-374: 0	AO-14: 22
Zone-16	14010022	AV-15: 18,1	AV-75: 0	AV-135: 30	AV-195: 100	AV-255: 30	AV-315: 100	AV-375: 100	AO-15: 22
Zone-17	14010029	AV-16: 19,2...	AV-76: 0	AV-136: 30	AV-196: 0	AV-256: 30	AV-316: 100	AV-376: 100	AO-16: 17
Zone-18	14010025	AV-17: 18,2...	AV-77: 0	AV-137: 30	AV-197: 100	AV-257: 30	AV-317: 100	AV-377: 100	AO-17: 20

Disc Position Avg-AI-120: 30   Room temp Avg-AI-121: 14,6   Global Setpoint-AO-60: 22   Controll

The BACnet object types supported are Analog Value, Analog Output, Multi-State Input, Multi-State Output and Analog Input. For every object type there are 60 BACnet points available. BACnet points are distributed as follows:

Instance #	Object(s)	VAV Parameter	Value
Bacnet Device ID	Device	Device Object	NA
AV:0..59	Analog Value	Space Temp 1..60	0..40°C
AV:60..119	Analog Value	Supply Temp 1..60	0..40°C
AV:120..179	Analog Value	Control Disk pos 1..60	0..100%
AV:180..239	Analog Value	Heater output 1..60	0..100%
AV:240..299	Analog Value	Disk Min Pos 1..60	0..100%
AV:300..359	Analog Value	Disk Max Pos 1..60	0..100%
AV:360..419	Analog Value	Heat Max 1..60	0..100%
AO:0..59	Analog Outputs	Setpoint 1..60	0..40°C
MSI:0..59	Multi-State Inputs	Mode 1..60	See table
MSI:60..119	Multi-State Inputs	Occupancy 1..60	See table
MSO:0..59	Multi-State Outputs	Control override 1..60	See table
MSO:60..119	Multi-State Outputs	Occupancy override 1..60	See table
AI:0..59	Analog Input	Pressure 1..60	0..200 Pa
AI:60..119	Analog Input	Flow 1..60	0..200 l/s

Diffuser Mode (status) - multi-state input 0-59

The following table contains the diffuser mode inputs. Please note these integer values are presented in decimal format on the BMS front end. The string value can be read at the state_text_property for the specific point.

Decimal Value	Mode Description
1	System Idle (in control temperature band)
2	Initializing
3	Heating mode
4	Cooling mode
5	Actuator in manual operate mode
6	BMS control override mode

Occupancy Mode (status) - multi-state input 60-119

The following table contains the occupancy mode inputs. These integer values are presented in decimal format on the BMS front end. The string value can be read at the state_text_property for the specific point.

Decimal Value	Mode Description
1	Occupied
2	Unoccupied

BMS control override - multi-state output 0-59

The MLM 24 system contains some BMS commands to force certain diffuser behaviour. These commands are typically used for zone flush or emergency operations. The following table indicates the command (decimal) values:

| Function	Command	Description
Normal	1	No BMS command active
Open	2	Drive Diffuser Open to pre-set limit position, heater off
Close	3	Drive Diffuser Close to pre-set limit position, heater off
Emergency	4	Emergency, this command will disable the heater output
Emergency Open	5	Disable heater output and drive diffuser completely open
Emergency Close	6	Disable heater output and drive diffuser completely closed
Backoff Active	7	Activate backoff dead-band control
Max Heat	8	Drive diffuser to supply air max heat position and switch heater max on

Occupancy override - multi-state output 60-119

The following table contains occupancy override functions as set by the BMS.

| Decimal Value	Mode Description
1	Occupancy normal (no override from BMS)
2	Override occupied
3	Override unoccupied

Note: To enable any control override feature, including the occupancy override, the Control override (Enable) function must be selected on the master controller of that zone.

To activate using the MLM Tool, expand the master diffuser icon, select Process/Master Command and tick the Control Override box. Press 'Write'. The functions contained in the two tabs below the Master Command tab, BMS Command and Occupancy override now becomes enabled. This is a non-volatile parameter. Also see the next section about control override procedure.
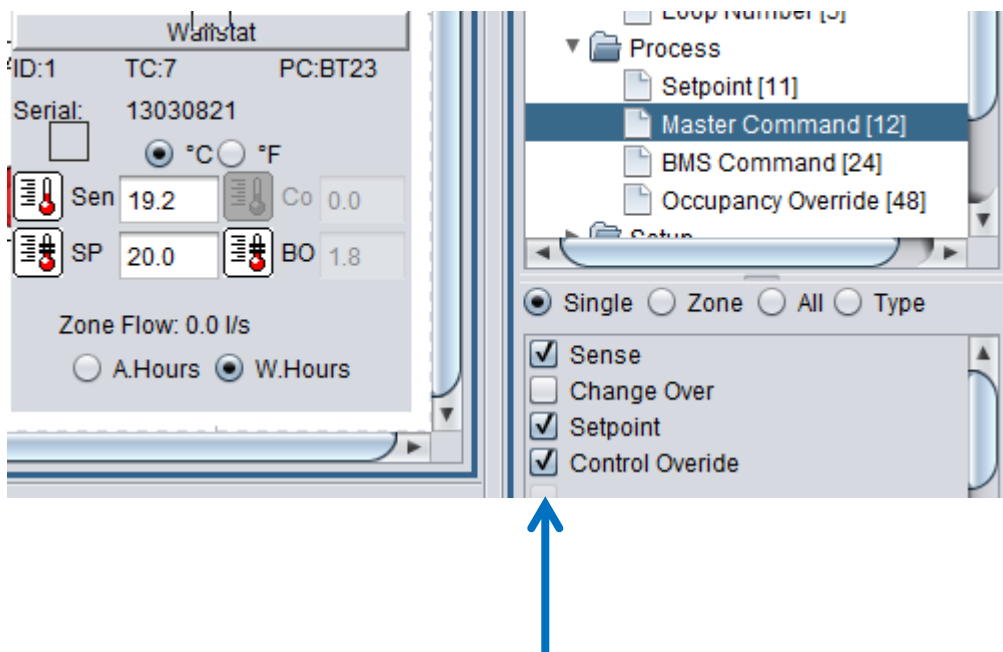
Mapped MCU on a BMS Front-end

The following picture shows a typical MCU mapped on a BMS front-end, herewith Workplace AX running on a Niagara platform showing data for Zone 1.
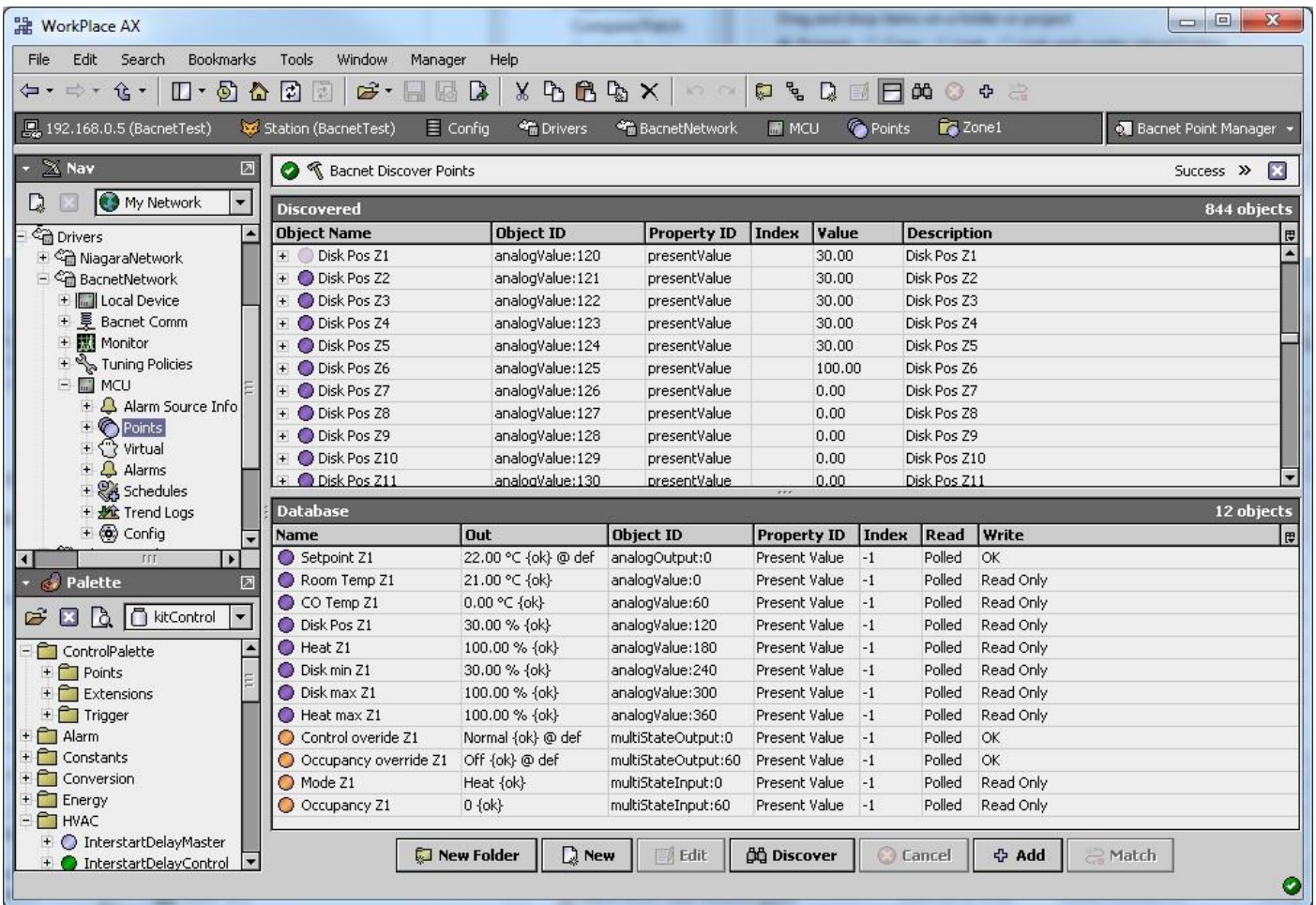
Please note the Read Only fields indicated in the Write (right hand) column.

MLM Control Override Handling Procedure

The MLM24 system contains three internal processes for activating system **control override**, or **back-off** from normal control. There is a **manual control override** command entered through the MLM Tool application, a **Real Time Clock operation for after-hours** detection and operation and an **Occupancy sense** feature. Any external BMS process such as BACnet connected to the MLM24 system will take precedence over an internal back-off/override process currently in operation.

- Please note that these control override features are enabled per control zone, i.e. each individual master controller unit must be activated, either zone specific or global (All) commands by the MLM Tool. Note that after selection the 'Write' button must be pressed to activate a command.
- The following explanation makes use of the MLM Tool revision 8.14 or above. During the setup procedure it is assumed the MLM Tool is actively communicating to a field diffuser system and the system is synchronised.
- Conventionally an external 'BMS (Building Management System) command' would force a specific 'control override' action on the MLM24 system. These same control override actions can also be generated by the MLM24 internal processes and are therefore indicated under the same naming tabs.
- Most of the control override commands require the Diffuser controller to set the actuator and heater drivers into a manual operation mode, with the diffuser icons then displayed in yellow.

Manual control override activation

The manual control override feature allows the user to enter specific control override commands by using the MLM Tool.

Manual control override can be commanded by accessing either a Wallstat or an On-board master unit:

- Expand the Wallstat or the on-board master host diffuser icon in the Logical screen. On type 7 (WS) or 8 (On-Board) click on Process/BMS command and select the action required during control override. Press Write. See the BMS Command table below. Note these flags also double as status indicators should an external BMS command be active, e.g. a BACnet BMS command received via the MCU.
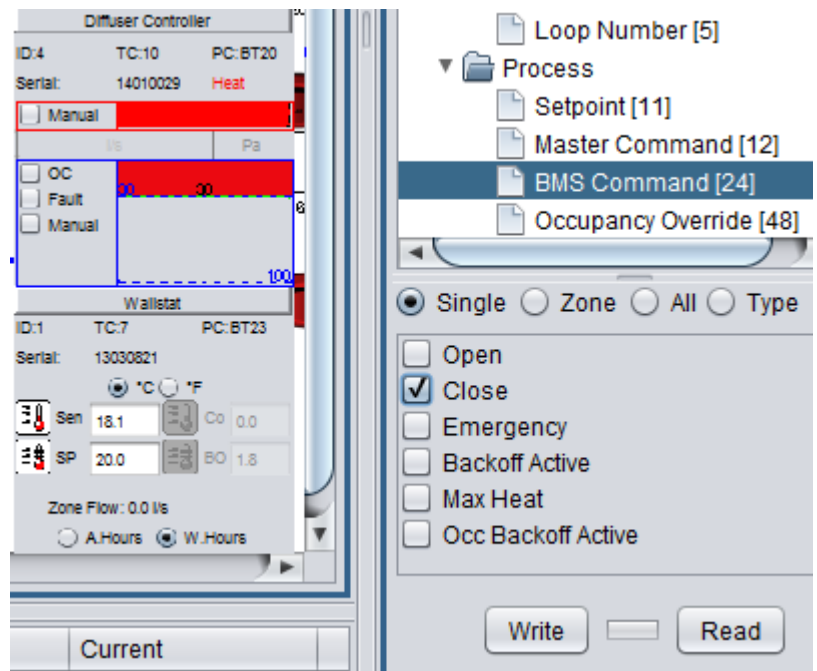
- To immediately activate a BMS command, select the Process/Master Command tab and select control override. Press Write. The control override function selected in the BMS command tab will now be activated.
- Note that selecting the Backoff Active box will force the diffuser to control to the dead-band value contained in the Backoff-band field.
- For normal control operation again, uncheck the control override box under the Process/Master Command tab and press Write.

RTC control override activation

The MLM24 Wall thermostat (part no BT2311-5) contains a Real-Time-Clock used to activate a control override timer. This feature is not currently available on the On-board master unit. To use the control override time feature:

- Ensure the RTC time is correctly set. Expand the Wallstat host diffuser in the Logical screen. On type 7 (WS) click on Setup/RTC and press the read button. If the time displayed is incorrect edit the value and press write.
- Expand the Backoff/Days tab and check the boxes where a day/night control override is required.
- Where a 24 hour control override is required, typically over weekends, it can be checked under the 24H column.
- Expand the Start time tab and enter the time required for the control override action to start.
- Expand the End time tab and enter the time required for the control override to end.
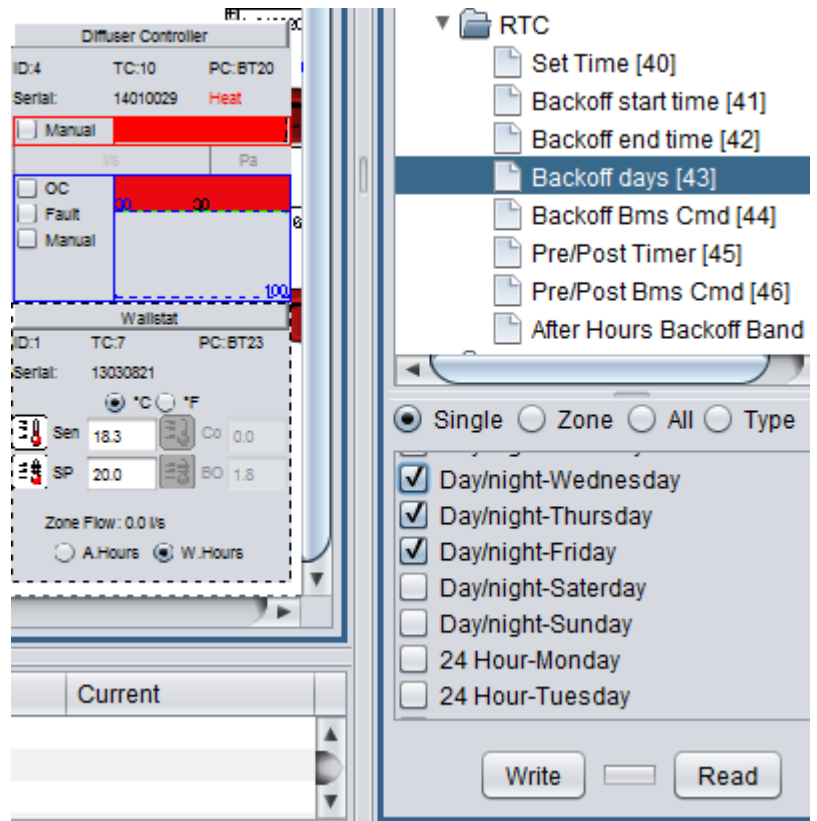
- Expand the Pre/Post timer tab and enter the pre-and/or post timer period (in minutes) if required. A value of zero will disable the pre/post BMS command.
- Expand the Pre/Post BMS Command tab and select the Pre/Post control override action required. This command will typically be used to heat/cool a building after an extended control override period.
- Expand the Backoff BMS Cmd tab. The BMS command selects the control override action required for afterhours back-off.
- The final step is to expand the Process/Master Command tab and check (and Write) the control override box. Activating this box will enable either an external BMS command or internal control override.

Note:

- It is important to distinguish between the three 'BMS command' tabs indicated. The 'Process/BMS' tab is for selecting manual or external BMS commands. The 'RTC/Backoff BMS' tab is exclusively for RTC driven operations. 'RTC/ Pre_Post BMS Cmd' tab is for RTC functions where a pre/post timer period is required.
- For any control override command to execute, the Master Command/Control override flag must be enabled.
- If a system is required to execute a control override command after hours only, the 'Process/BMS command' check boxes should all be cleared.

RTC control override operation

Once the control override start time is reached, typically after working hours, the MLM24 system will check if a pre-timer period was set. If so, the pre-BMS selection will be executed. In conjunction the indicator button at the bottom of the Wallstat screen will switch from WH (working hours) to AH (after hours).
Once the pre-timer period has lapsed or if it is set to zero, the system will execute the control override BMS selection.

On conclusion the post-BMS action will be activated if the post timer was set. The pre- and post-timer periods are implemented if there is a requirement to condition an area prior to back-off or back-on. Following this optional period the system will revert to normal control and the indicator will switch back from AH to WH.

RTC control override Command Table:

Function	Description
Open	Drive Diffuser Open to pre-set limit position, heater off
Close	Drive Diffuser Close to pre-set limit position, heater off
Emergency	Emergency, this command will disable the heater output
Emergency & Open	Disable heater output and drive diffuser completely open
Emergency & Close	Disable heater output and drive diffuser completely closed
Backoff Active	Activate WH or AH dead band back-off control, whichever is applicable
Max Heat	Drive diffuser to supply air maximum heat position and switch heater 100% on
Occ Backoff Active	Status flag to indicate the system is in unoccupied control mode

Occupancy sensor description

The MLM24 system makes use of PIR (Passive Infra-Red) technology to detect an occupied/unoccupied state. The PIR sensors are mounted unobtrusively on the diffuser trim disk to cover the normal diffuser 'throw' area. These sensors are also fitted to Wall thermostats as an additional option for occupancy detection.

The number of sensors mounted per control zone is determined by the detection area, and ranges from one per control zone to one per diffuser and Wallstat units. The sensor signals are combined in an 'or' function, which means that detection picked up by any sensor in a control zone will flag that zone as occupied.

Occupancy control override operation

- Working Hours

When the room is vacant for a specific period, the diffuser(s) in that particular zone will drive to the minimum closed position. This period is user adjustable as 'delay 1' in the MLM Tool application. Should a second vacant period, as set in 'delay 2' elapse, the diffuser(s) will drive to the fully closed position. The factory default on both these timers is set to 15 minutes.

If the room temperature drifts outside the temperature band during this state (set in Process/Setpoint/Backoff Band), the diffuser(s) will revert to the minimum closed position.

If occupancy is detected during this control override operation, the diffuser(s) will revert to normal operation.

- After hours

After hours operation is basically the same as for working hours. Delays 1 & 2 are the same for both. The only difference is the 'After hours backoff band' is used for phase two of the unoccupied control. The RTC operation for after hour detection is described in the RTC control override section.

Note: If an On-board master unit is used to control a zone, no distinction is made between working hours and after hours and only the 'Backoff-band' parameter is applicable, as the On-board master does not contain a Real Time Clock.

System set-up for Occupancy Sense

The user can adjust the unoccupied period before the system reverts to a control override state. The following procedure needs to be followed to set the system up:

- Diffuser controller
  - Ensure an Occupancy sensor is fitted to the Diffuser controller hardware or to the Wallstat hardware.
  - Select the Diffuser controller (type code 10), go to Setup menu, Occupancy present and check the Occupancy present box. By setting this parameter that particular diffuser is enabled for occupancy sense.
  - A Wallstat unit containing an occupancy sensor does not require an occupancy present setup and is always enabled for that zone.
  - The sensor sensitivity can be changed for a value between 1 and 10 to offset false or no triggers. The default setting ranges between 6 and 8.
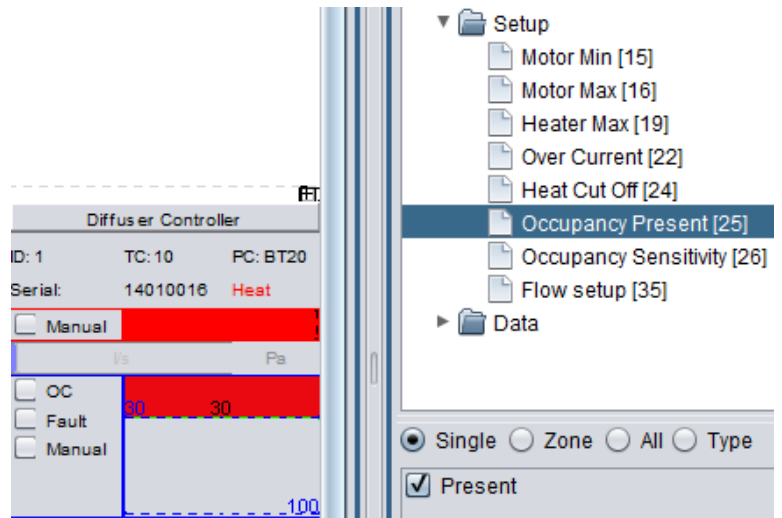
Note: Occupancy present will be selected on all Diffuser controllers that are factory fitted with occupancy sensors.

- On-board master
  - Expand the diffuser icon in the Logical screen and select the On-board master (type code 8).
  - Under Setup/Unoccupied delays, verify and edit the delay 1 & delay 2 periods. Note the default of 900 seconds for a 15 minute delay.
  - Check and edit the BackoffBand setting under Setpoint. The default is 1.8 °C.
 - Under Master Command, check and write the control override parameter.
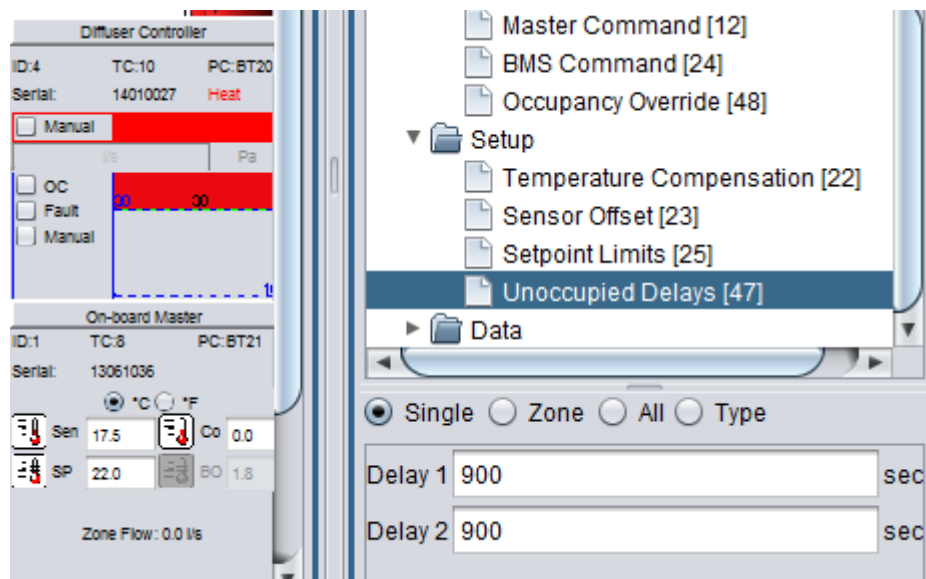
- Wallstat
  - Expand the diffuser icon in the Logical screen and select the Wallstat (type code 7).
  - Under Setup/Unoccupied delays, verify and edit the delay 1 & delay 2 periods. Note the default of 900 seconds for a 15 minute delay.
  - Check and edit the Process/Setpoint/BackoffBand setting. The default is 1.8 °C.
  - Check and edit the RTC/Afterhours Backoff Band setting. The default is 1.8 °C.
  - Under Master Command, check and write the control override parameter.
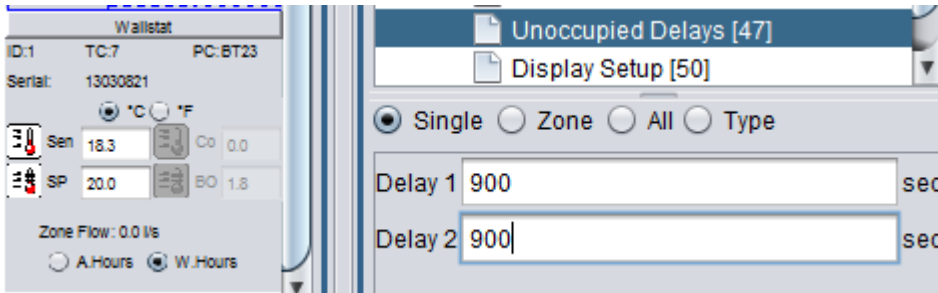
Note: The three parameters of interest in setting up occupancy sense are:

- Occupancy present as set on the Diffuser controller – this enables/arms that particular sensor to be active.
- Unoccupied delays – setting these timers to zero will stop the timers and the controller unit (Wallstat or On-board) will always indicate the zone as occupied.
- Control override – by unchecking this box, the controller unit will still show the occupied status, but will not command the Diffuser controllers into a back-off state.

MLM Tool occupancy wizard

The MLM Tool rev 8.xx contains a setup wizard (Wizards/Occupancy) that assists the installer to easily set-up or de-activate occupancy sensing on a zone by zone basis.
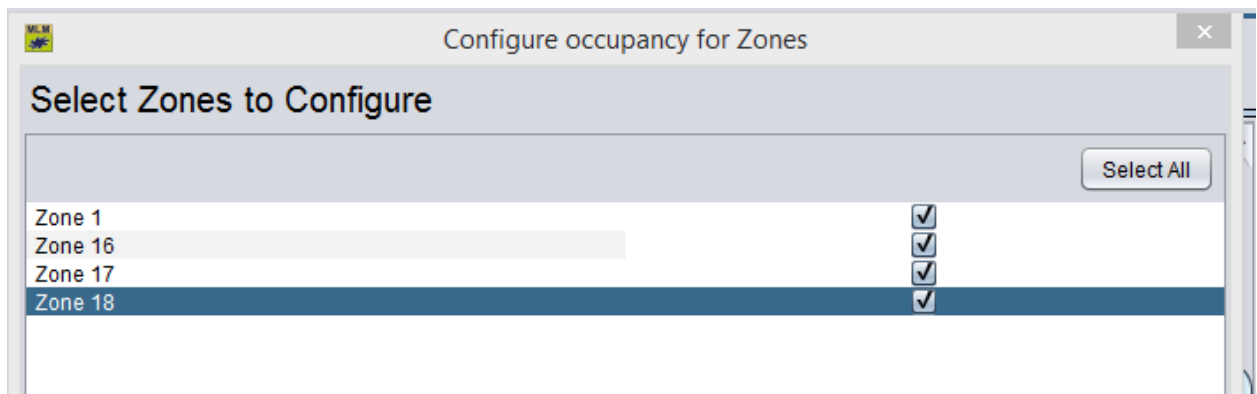
MLM24 Tool Occupancy display

The Wallstat and On-board master units each contain an Occupied button to indicate status – green for occupied and red for unoccupied.

The progress bar next to the button is divided into the 'delay 1' and 'delay 2' areas. As the delay timers run down, the progress bar will decrement from right to left. Once an unoccupied condition is detected, the bar display will change from green to red.

The adjacent picture indicates a Wallstat master unit entering the second delay period, with the control disk moving towards the pre-set minimum of 30%. Once the second delay period has expired, the control disk will move to 0% position. This position will be maintained until either:

- Occupancy is detected and control reverts to normal or..
- The room temperature drifts outside the Backoff band setting with the control disk then moving back to the 30% position.
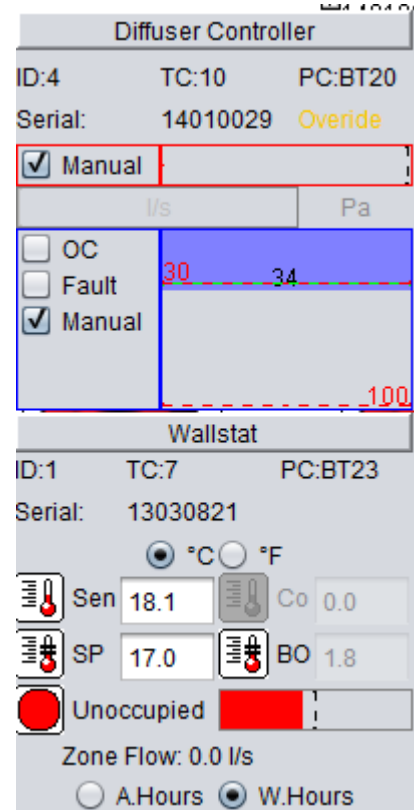
Occupancy override

The MLM24 system contains an internal occupancy override feature shared with an external BMS. See the BMS (BACnet) table for Multi-state Output 60-119.

The system can be forced into an occupied or unoccupied state. The default is for normal operation. Again the Master Command/Control override need to be set:
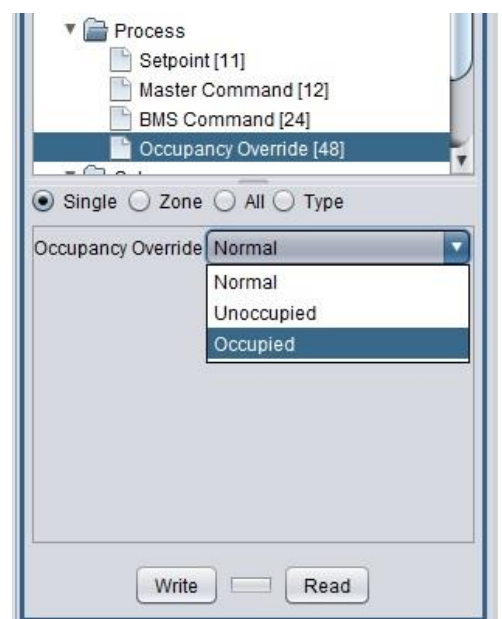
Light Switch operation

- The light switch is designed to operate in conjunction with occupancy sensors, with one light switch unit installed for each control zone.
- The unit contains two output channels, Switch A and Switch B to power two separate lighting arrays (See hardware specification).
- Each channel can be configured for manual on, manual off or to switch following occupancy sense delay 1 or delay 2.
- Manual on/off does not require the control override enable to be selected.
- Each channel contains a Normally Closed relay output, i.e. power to the lighting arrays stays connected by default.
- If Delay 1 is selected, the relay contact for Switch A or Switch B will open when Delay 1 expires. This contact will remain open until the status changes from unoccupied to occupy again. The same operation goes for Delay 2.
- The user has the option to select both Switch channels to operate off the same timer.
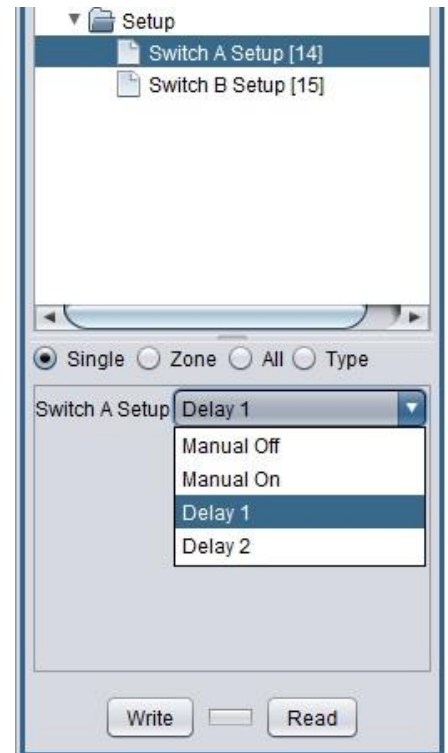
The Light Switch icon in the MLM Tools shows the current selection as well as the status of the Light Switch node.
A channel block coloured in green will indicate the switch is activated (closed).
The adjacent picture shows the occupied Delay period 1 has timed out, which caused the Switch A channel to disconnect. The Switch B channel is still connected.
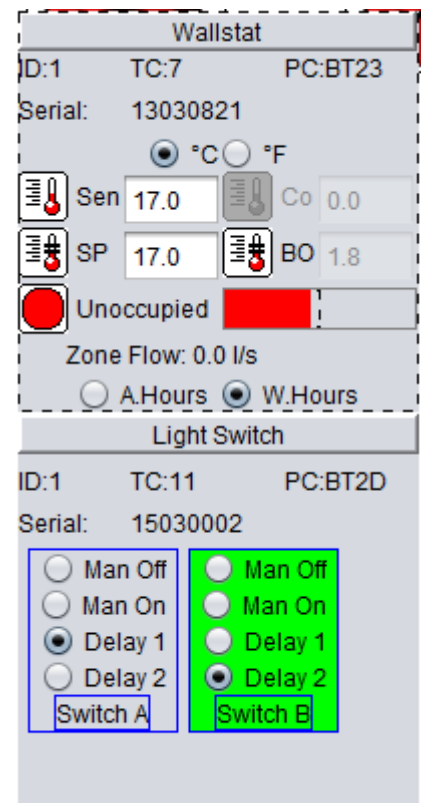
Airflow sense setup and operation

This section describes how to set up the flow sense operation in the MLM Tool for a single diffuser and then the zone for that diffuser. Once the basic flow operation is understood, the user is advised to follow the procedure in the MLM Help file, Main Menu/Wizards. It deals extensively on how to set the flow min/max control on a MCU (segment) scale, including import and export functions.

A few basic checks to ensure the correct operation:

- Ensure the correct firmware revisions are loaded for the Diffuser controller, On-Board Master and Wallstat nodes. Check the release notes on the Trac download site http://trac.lhar.co.za/ .
- Ensure that firmware revision 6.08 or higher is loaded onto the MCU 2 unit.
- Ensure the MCU Flow coefficient file is up to date (File/Update MCU Flow Coefficients).
- Ensure MLM Tool rev 8.14 u3 or higher.
- Verify that the diffuser Type and Neck Size is correctly set on the Diffuser controller node (see picture).
- Ensure a flow sensor is correctly fitted to the diffuser neck.
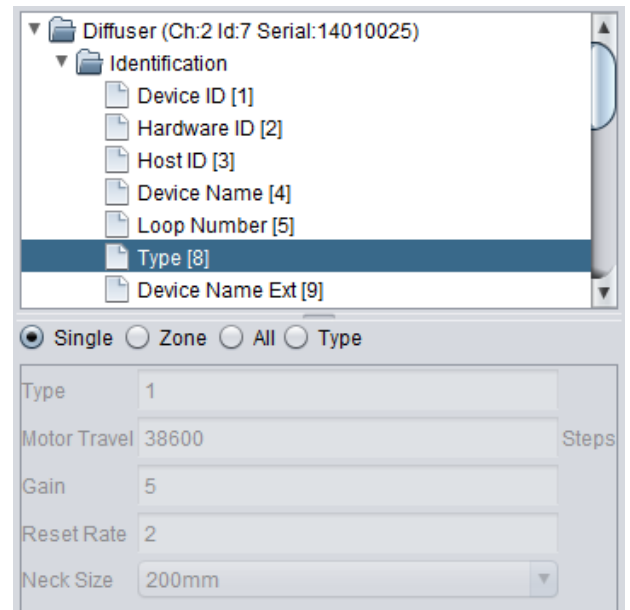
Once this check list is confirmed, the user must select Pressure present under the 'Flow setup' tab on the Diffuser controller node.

If the air handling unit is in operation, the flow and pressure values will now be displayed on the Diffuser controller icon on a horizontal bar just below the heater demand output.
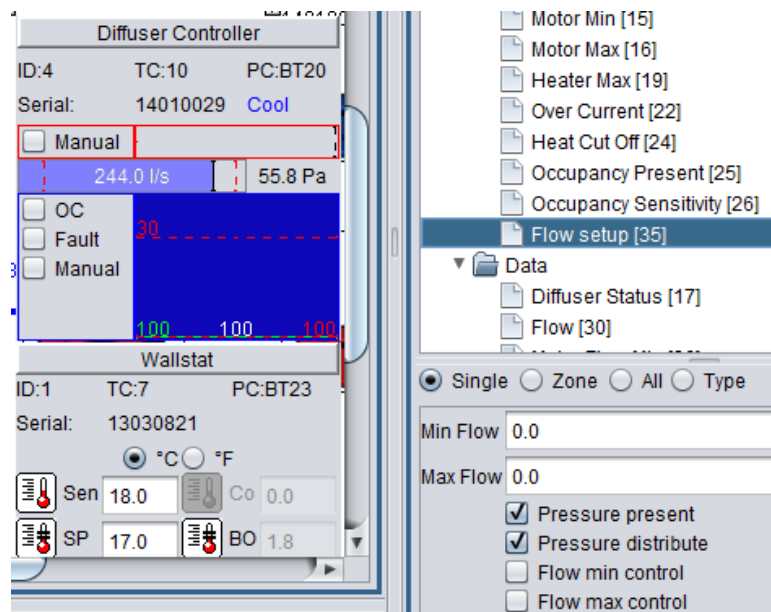
The airflow data can also be monitored under the Data/Flow tab on the Diffuser controller.
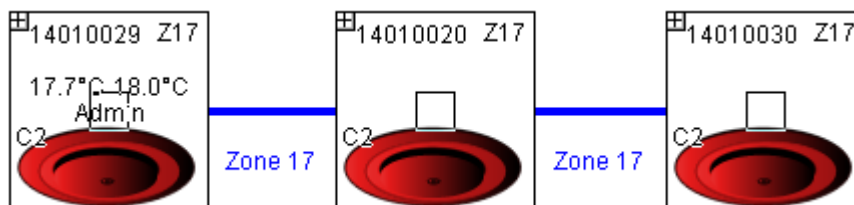
- Valid – indicates the MCU had all the necessary information to do a valid airflow calculation.
- Distribute – if a single airflow sensor is installed per control zone, the 'distribute' function should be activated in Flow setup. The measured pressure is then distributed to all the other diffusers in that zone for a total zone airflow calculation. Should each diffuser in the zone have airflow sensors fitted, this function should not be selected. Note if more than one, but not all diffusers in a zone are fitted with airflow sensors, the distribute function for the zone will only work off one pressure sensor.
- No constants found – update the MCU Flow coefficients or check the diffuser type.
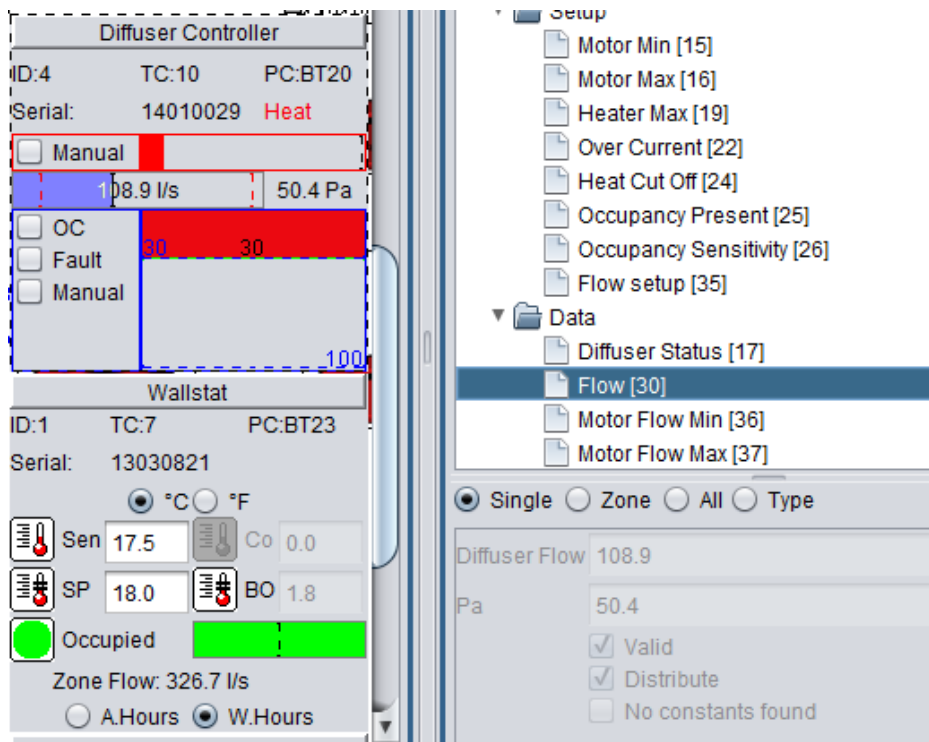
Notice how the airflow volume decreased with a change in control disk position.

The total airflow volume for the zone is displayed on the master controller for that zone, in this instance the Wallstat. For this zone (17) only the master controller was fitted with an airflow sensor, hence the distribute function was selected. The zone consists of three equal size diffusers.

For a BACnet BMS system this total flow value is found in BACnet point variables AI: 60...119.

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