# mlm24 User Manual

## Functional Interface to BMS

**Document Number: DM0070-4**

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# 1 Scope

This document gives a functional description of the mlm24 diffuser network and how it interfaces to a Building Management System (BMS).

# 2 mlm24 Diffuser Network overview

The mlm24 network comprises interlinked diffusers populated with air and temperature control nodes, a Power Supply Unit (PSU) which powers a multiple of these diffusers and also provides the communications link to a Master Comms Unit (MCU). The mlm Tool application serves as the user interface to the network on a project (multiple MCU), section (single MCU) or PSU level.

## 2.1 MCU 2 Gateway

The Master Comms Unit 2 (MCU) serves as a gateway between a diffuser network and a BMS system using the BACnet protocol.
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 program for setup, diagnostic and monitoring functions.

The following means of communication and physical interfaces are supported:

- mlm Tool application (UDP/IP) – Magnetic Ethernet
- mlm Tool application (UART) – USB B port
- BACnet/IP – Magnetic Ethernet (2 Port switch)
- BACnet ms/tp – RS485 bus


**Figure 1: MCU 2 unit**

The following MCU 2 hardware models are available:

| MCU 2 model | Part No | Mlm Tool User Hardware Interface | BMS Protocol |
|---|---|---|---|
| BACnet/IP | BW2011-2B | Magnetic Ethernet or USB B standard | BACnet/IP |
| BACnet ms/tp | BW2011-2M | USB B standard device | BACnet ms/tp |

## 2.2 mlm24 Network Variables

The following mlm24 network variables are communicated with the BMS:

### 2.2.1 Output from BMS

- Temperature Setpoint - 0.1 °C,  0.5 °F resolution
- CO2 Setpoint %
- RH (humidity) Setpoint high limit  %

- 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

### 2.2.2 MCU global outputs available on BACnet

- Setpoint global
- Control override
- Occupancy override

### 2.2.3 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
- Diffuser Zone Status
  - 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
- CO2 value %
- RH (humidity) value %
- Averaged MCU inputs available on BACnet:
  - Average disk position
  - Average space temperature

## 2.3 Zone / Master / Slave Diffuser concept

The mlm24 diffuser network is 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.

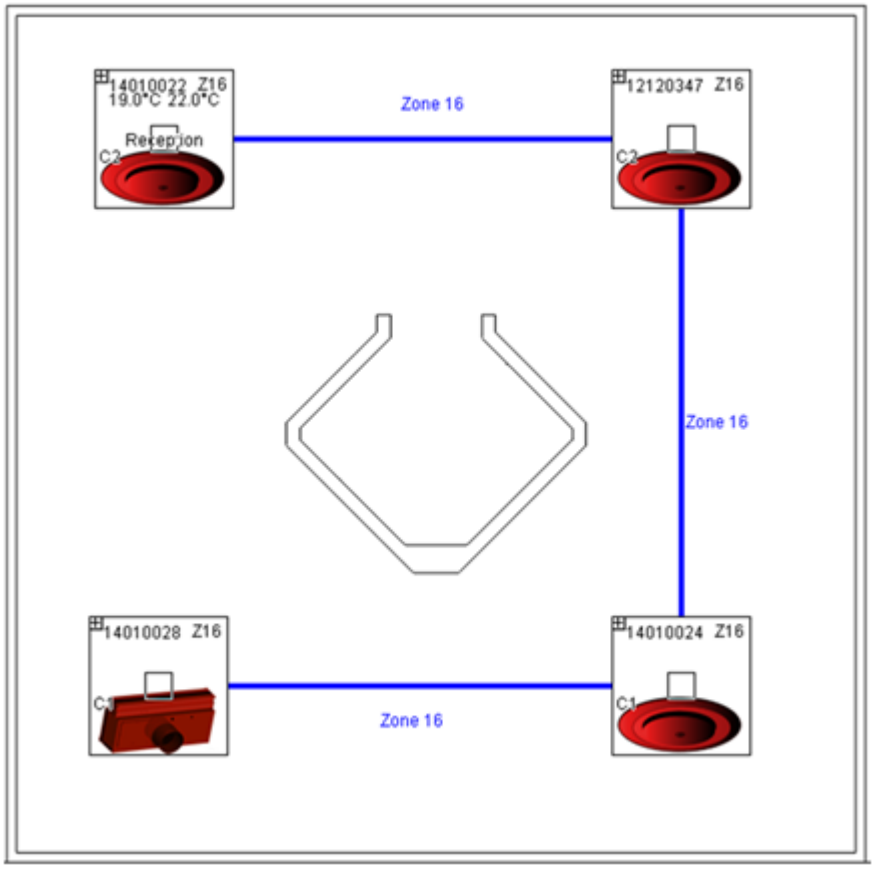



**Figure 2: Example of designated Zone 16 layout**

### 2.3.1 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 layout in Figure 2 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 mlm Tool application 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 with the mlm Tool, when 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 4 zone numbers marked in bold in Table 1 corresponds to the physical connection to channel 1 (Zone 1) and channel 2 (Zones 16, 17 & 18) as depicted in the logical diffuser layout (**Error! Reference source not ound.** below) in the mlm Tool.

**Table 1: Channel configuration**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **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 |

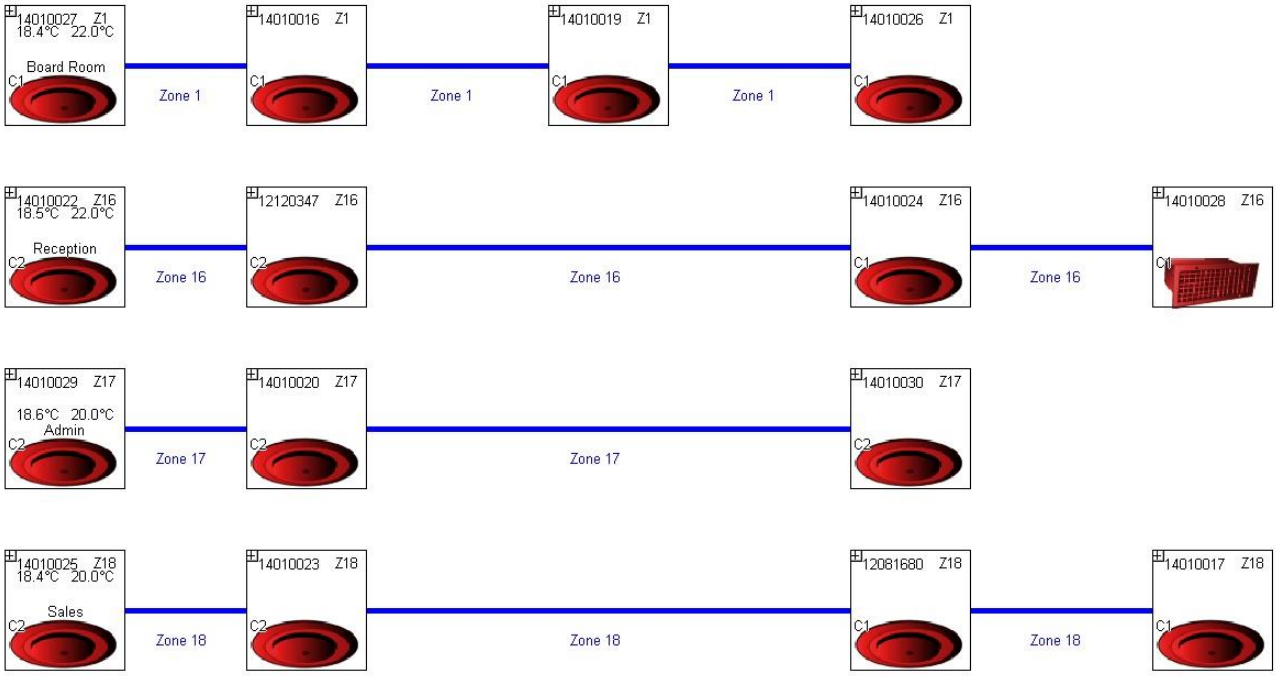



**Figure 3: Logical diffuser layout**

# 3 Identifying, mapping and binding of network variables

## 3.1 MCU 2 BACnet to BMS setup

The MCU 2 supports both the BACnet/IP or BACnet ms/tp protocols. The mlm Tool connects to the MCU 2 and is required for mapping the diffuser network to the BMS.

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 electrically isolated. For the interconnection and shielding instructions, refer to Addendum y of ANSI/ASHRAE Standard 135-2008.

A major advantage of the 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.

### 3.1.1 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 (refer Figure 4):

- 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.

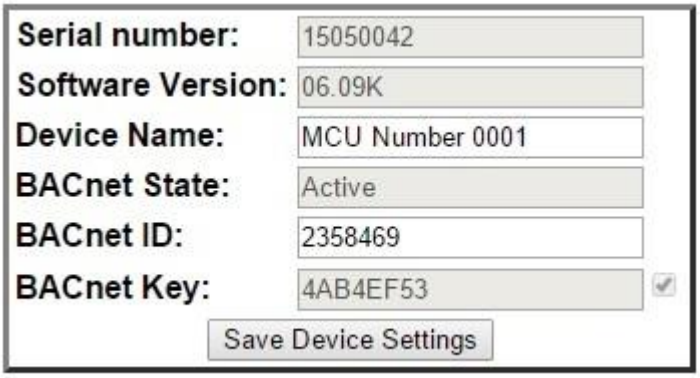



**Figure 4: BACnet/IP setup display**

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.

### 3.1.2 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 an 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.


**Figure 5: Connect to MCU**

- Select the View/Open New Terminal/USB (MSTP) tabs. Press Connect and then 'Show config' (at bottom) to verify the BACnet ID, MAC address and baud rate fields.
- The ms/tp mac address is a critical setting and each MSTP device must contain an individual mac address for correct operation. The default mac address is 25.
- Please note the ms/tp range of 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.


**Figure 6: ms/tp Configuration display**

Once the diffuser network has been set up with the mlm Tool, the **File/Export/BACnet List function** can now be run to extract the diffuser map info to set up the BMS.

## 3.2 MCU BACnet point mapping

The BACnet instance (point) data is limited to diffuser master information and although slave diffusers generally follow 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 following apply:

- 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.

Figure 7 shows a typical MCU Device Object with device properties is indicated on a BMS front-end, in this case Workplace AX running on a Niagara platform:

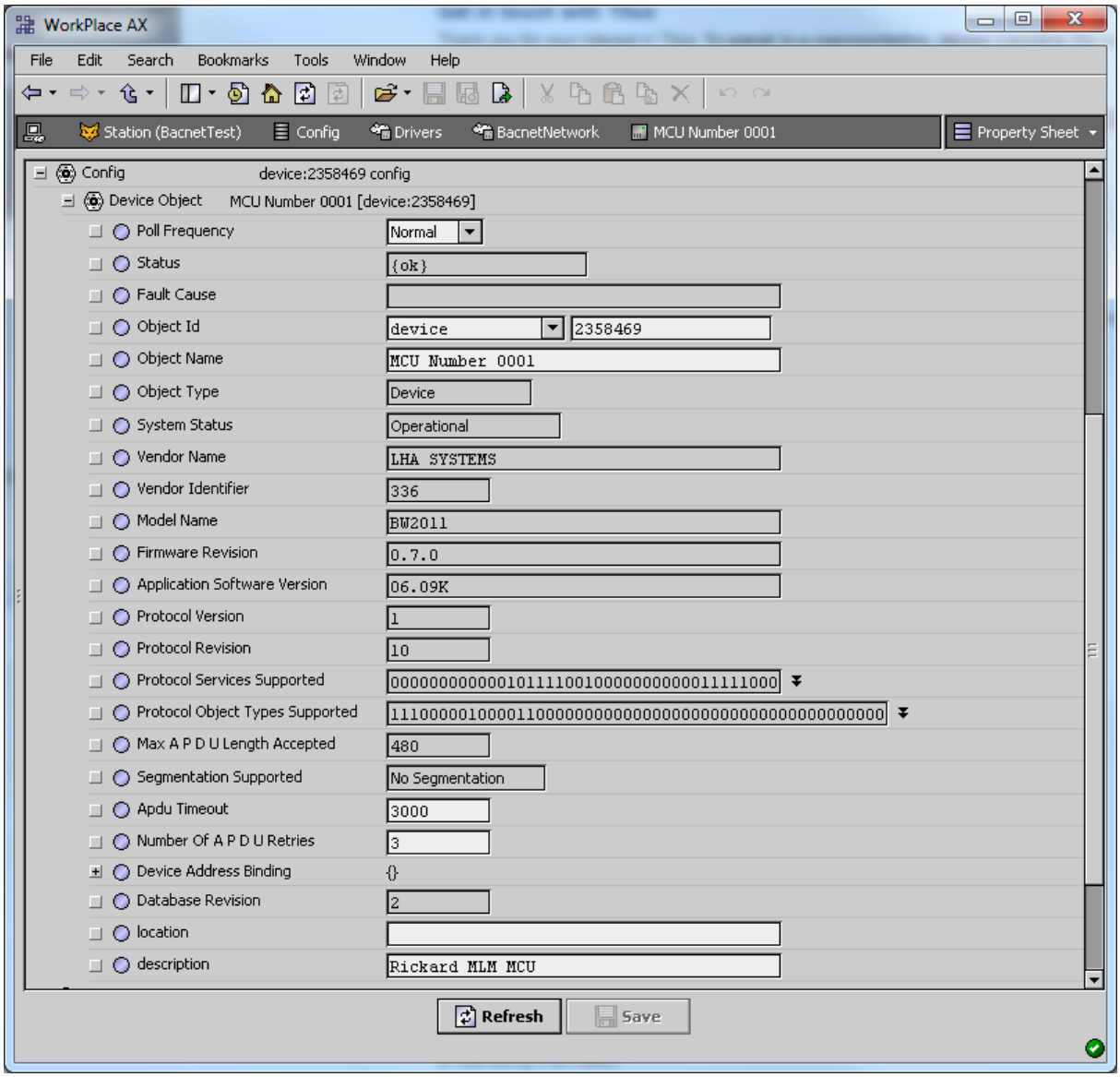



**Figure 7: BMS front-end**

The BACnet point list table can be browsed from the main web page as indicated in Figure 8 below **(BACnet/IP only)**:

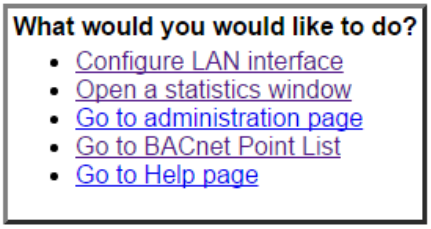
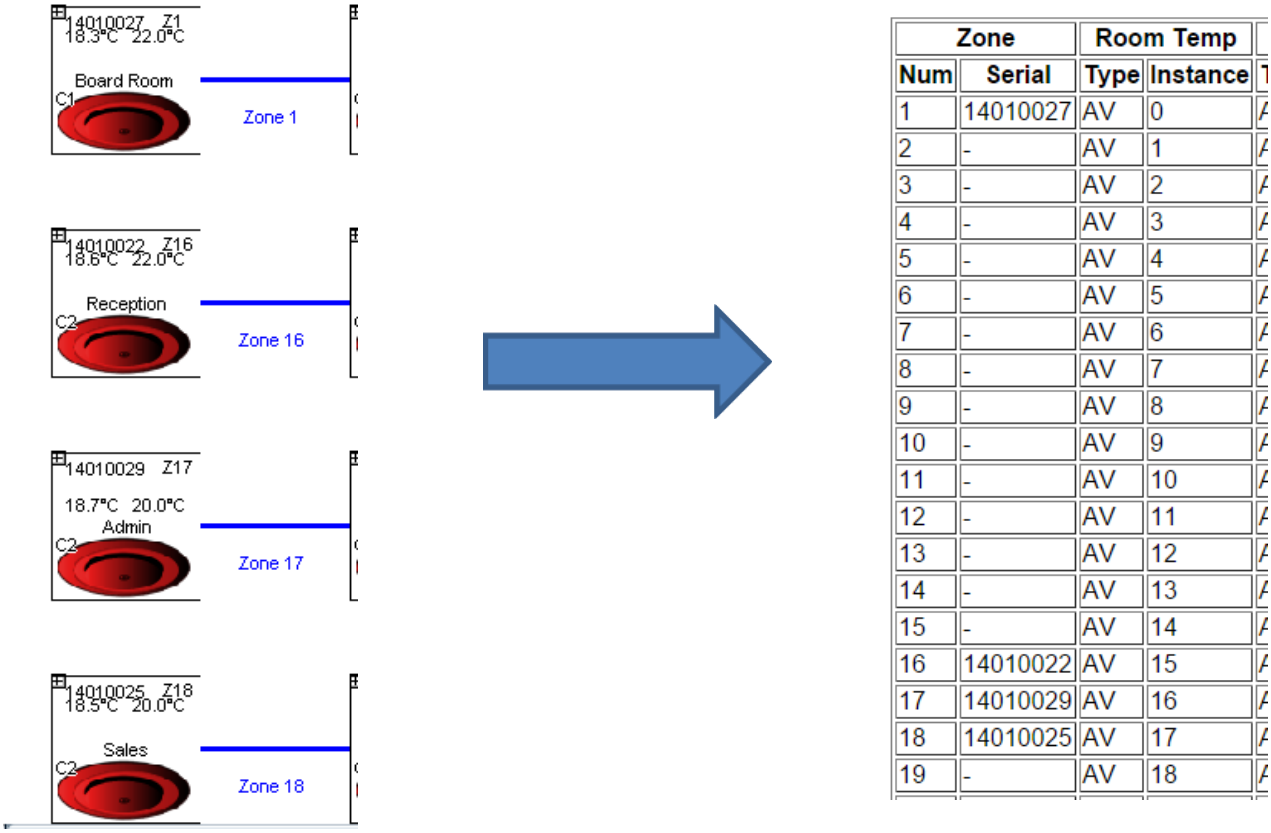



**Figure 8: Web browser options**

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 |
| 1 | 14010027 | AV | 0 |
| 2 | - | AV | 1 |
| 3 | - | AV | 2 |
| 4 | - | AV | 3 |
| 5 | - | AV | 4 |
| 6 | - | AV | 5 |
| 7 | - | AV | 6 |
| 8 | - | AV | 7 |
| 9 | - | AV | 8 |
| 10 | - | AV | 9 |
| 11 | - | AV | 10 |
| 12 | - | AV | 11 |
| 13 | - | AV | 12 |
| 14 | - | AV | 13 |
| 15 | - | AV | 14 |
| 16 | 14010022 | AV | 15 |
| 17 | 14010029 | AV | 16 |
| 18 | 14010025 | AV | 17 |
| 19 | - | AV | 18 |

**Figure 9: mlm Tool set-up relates to zone table on Point List web page**

At the top of the Point List page some configuration parameters are displayed.

The Device Name and BACnet ID are editable on the main page. The IP address can be changed in the 'Configure LAN interface'.
The BACnet port address and deg °C/°F selection is updated on this page by entering and then pressing the 'Save' button.

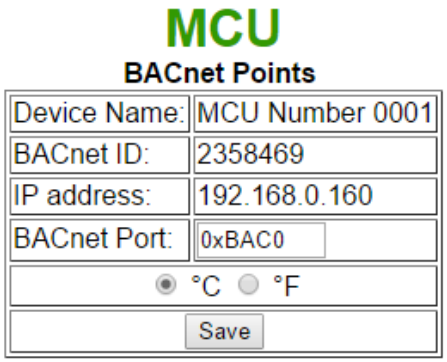
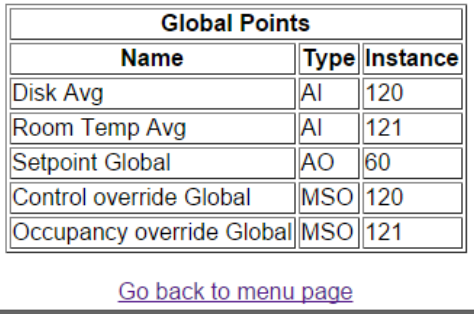



**Figure 10: Configuration parameters**

At the bottom of the page the point positions for global parameters available on the MCU are listed. 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.



| 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 |

Go back to menu page

**Figure 11: Point positions for global parameters on the MCU**

The BACnet live data referenced to the zone and master serial numbers are also displayed on the web page. Note the device type is also indicated, i.e. Diffuser, PCD or Fancoil.

| Diffuser | | | | Room Temp | | Supply Temp | | Disk pos | |
|---|---|---|---|---|---|---|---|---|---|
| PCD | | | | N/A | | N/A | | Damper pos | |
| FanCoil | | | | Room Temp | | Water Temp | | Fan Speed | |
| Zone | Type | Serial | Name | AV | Value | AV | Value | AV | Value |
| 2 | D | 13123607 | Boardroom | 1 | 23.2°C | 61 | 17.5°C | 121 | 10% |
| 3 | D | 13123606 | Louis | 2 | 21.0°C | 62 | 18.0°C | 122 | 30% |
| 4 | D | 21111396 | | 3 | 22.4°C | 63 | 16.0°C | 123 | 100% |
| 5 | D | 18110448 | Dak Ret | 4 | 25.1°C | 64 | 23.9°C | 124 | 80% |
| 6 | D | 15011027 | Dak Supply | 5 | 0.0°C | 65 | 0.0°C | 125 | 30% |
| 7 | D | 13123605 | Reception | 6 | 24.0°C | 66 | 16.7°C | 126 | 100% |
| 16 | P | 18090142 | | 15 | 0.0°C | 75 | 0.0°C | 135 | 0% |
| 31 | D | 18090231 | Damp Retrun | 30 | 23.6°C | 90 | 28.4°C | 150 | 90% |
| 32 | D | 18090233 | Damp Fresh | 31 | 28.2°C | 91 | 0.0°C | 151 | 10% |
| 46 | D | 18100368 | Damp Exhaust | 45 | 30.0°C | 105 | 23.1°C | 165 | 10% |

Type: D (Diffuser), P (PCD), F (FanCo

| Control Override | | Occupancy Override | | Pressure | | Flow | |
|---|---|---|---|---|---|---|---|
| Control Override | | N/A | | Pressure | | N/A | |
| Control Override | | Occupancy Override | | N/A | | N/A | |
| MSO | Value | MSO | Value | AI | Value | AI | Value |
| 1 | 1 | 61 | 1 | 1 | 21.3Pa | 61 | 44.4l/s |
| 2 | 1 | 62 | 1 | 2 | 15.5Pa | 62 | 60.3l/s |
| 3 | 1 | 63 | 1 | 3 | 0.0Pa | 63 | 0.0l/s |
| 4 | 0 | 64 | 0 | 4 | 0.0Pa | 64 | 0.0l/s |
| 5 | 0 | 65 | 0 | 5 | 0.0Pa | 65 | 0.0l/s |
| 6 | 1 | 66 | 1 | 6 | 12.5Pa | 66 | 74.7l/s |
| 15 | 1 | 75 | 0 | 15 | 21.7Pa | 75 | 0.0l/s |
| 30 | 0 | 90 | 0 | 30 | 0.0Pa | 90 | 0.0l/s |
| 31 | 0 | 91 | 0 | 31 | 0.0Pa | 91 | 0.0l/s |
| 45 | 0 | 105 | 0 | 45 | 0.0Pa | 105 | 0.0l/s |

**Figure 12: BACnet web page display (subset indicated)**

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:

**Table 2: Distribution of BACnet points[1] [2] [3]**

| Object Type | Instance # | VAV Parameter | Value |
|---|---|---|---|
| Analog Value | 0..59 | Space Temp 1..60 | 0..50°C |
| Analog Value | 60..119 | Supply Temp 1..60 | 0..50°C |
| Analog Value | 120..179 | Control Disk pos 1..60 | 0..100% |
| Analog Value | 180..239 | Heater output 1..60 | 0..100% |
| Analog Value | 240..299 | Disk Min Pos 1..60 | 0..100% |
| Analog Value | 300..359 | Disk Max Pos 1..60 | 0..100% |
| Analog Value | 360..419 | Heat Max 1..60 | 0..100% |
| Analog Value | 420..479 | CO2 value 1..60 / R-H (humidity) 1..60 | 400..2000ppm / 0..100 % |
| Analog Output | 0..59 | Setpoint 1..60 | 0..40°C |
| Analog Output | 120..179 | CO2 Setpoint 1..60 / R-H Setpoint 1..60 | 400..2000ppm / 0..100 % |
| Multi-State Input | 0..59 | Mode 1..60 | See table |
| Multi-State Input | 60..119 | Occupancy 1..60 | See table |
| Multi-State Input | 120..179 | RF Status 1..60 | See table |
| Multi-State Output | 0..59 | Control override 1..60 | See table |
| Multi-State Output | 60..119 | Occupancy override 1..60 | See table |
| Analog Input | 0..59 | Pressure 1..60 | 0..200 Pa |
| Analog Input | 60..119 | Flow 1..60 | 0..200 l/s |

[1] See doc DM0073-0020 for RH wallstat BMS operation.
[2] See doc DM0073-0021 for Fancoil Controller BMS operation
[3] CO2 or RH (humidity) BMS display will depend on the wallstat configuration and setup

### 3.2.1 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.

**Table 3: Diffuser mode inputs**

| 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 |

### 3.2.2 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.

**Table 4: Occupancy Mode (status)**

| Decimal Value | Mode Description |
|---|---|
| 1 | Occupied |
| 2 | Unoccupied |

### 3.2.3 RF Status – multi-state input 120-179

The following table contains the RF status inputs for RF end-point devices, i.e.RF wallstats or RF PODs. The string value can be read at the state_text_property for the specific point.

**Table 5: RF status**

| Decimal Value | Mode Description |
|---|---|
| 1 | Normal |
| 2 | Low RSSI |
| 3 | Low Bat |
| 4 | Low Bat + Low RSSI |
| 5 | Timeout |
| 6 | Timeout + Low RSSI |
| 7 | Timeout + Low Bat |
| 8 | Timeout + Low Bat + Low RSSI |

### 3.2.4 BMS control override – multi-state output 0-59

The mlm24 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:

**Table 6: BMS commands to force diffuser behaviour**

| 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 |

### 3.2.5 Occupancy override – multi-state output 60-119

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

**Table 7: BMS Occupancy override functions**

| 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.

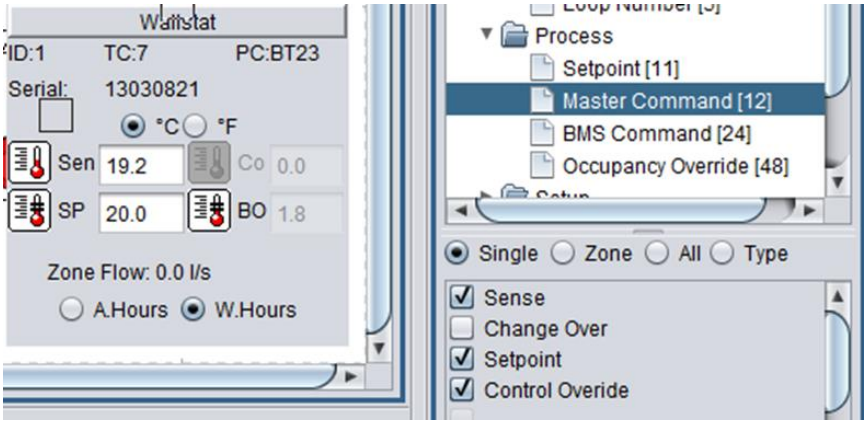



**Figure 13: mlm Tool control override activation**

## 3.3 Mapped MCU on 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.

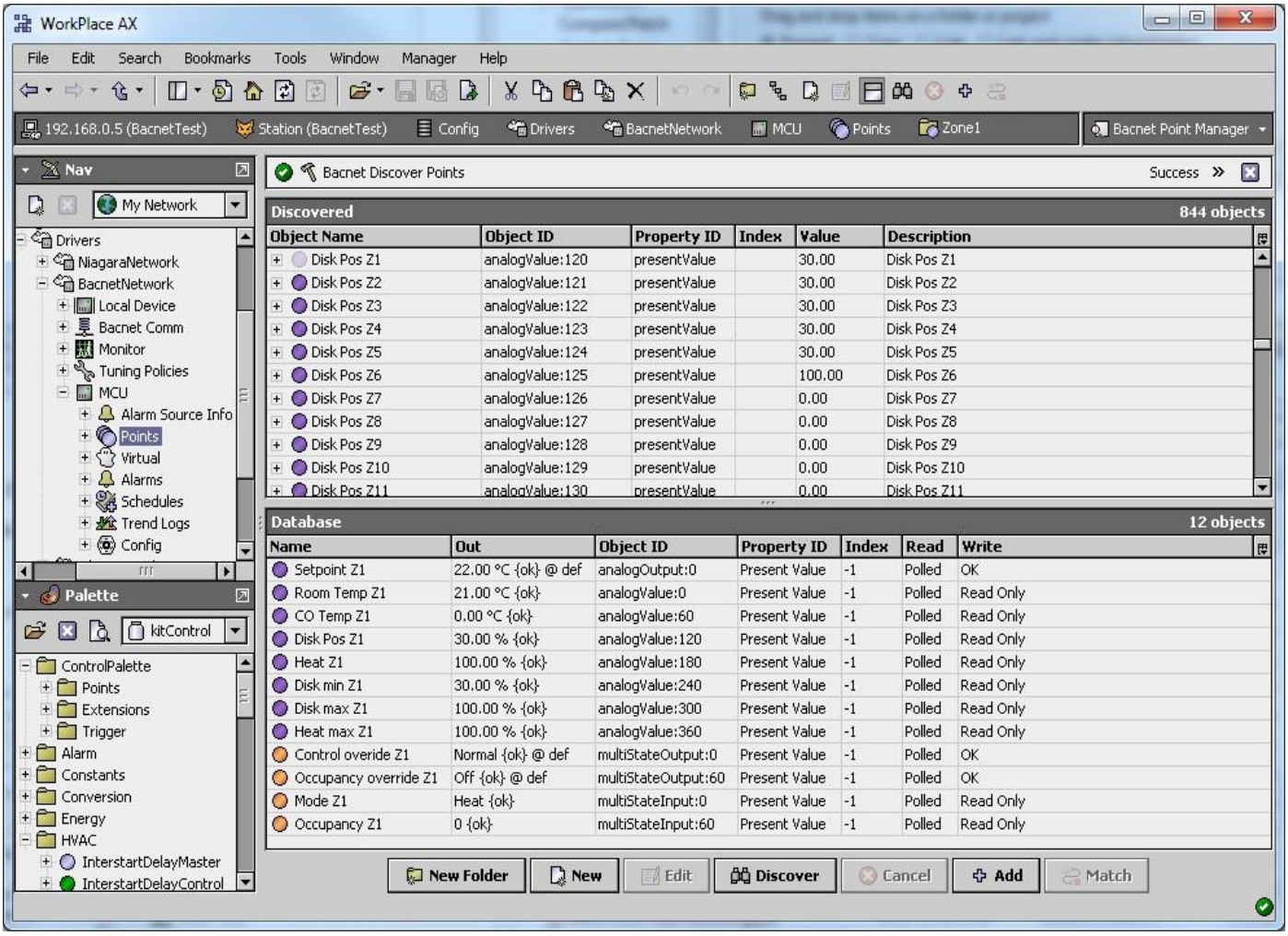



**Figure 14: Typical MCU mapped on a BMS Front-end**

Note: The Read Only fields are indicated in the Write (right hand) column.

# 4 mlm24 Control Override Handling Procedure

Apart from the BMS commands, the mlm24 system contains internal processes for activating system **control override**, or **back-off** from normal control. These are a **manual control override** command entered through the mlm Tool application, the **Occupancy override** feature and a **CO2[4] and RH (humidity)[5]** control override. An external BMS command will take precedence over an internal back-off/override process currently in operation.

[4] See doc DM0073-0008 for CO2 wallstat operation
[5] See doc DM0073-0020 for RH wallstat BMS 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 8.17 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.
- Usually an external 'BMS 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.

## 4.1 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 6. Note these flags also double as status indicators should an external BMS command be active, i.e. 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.

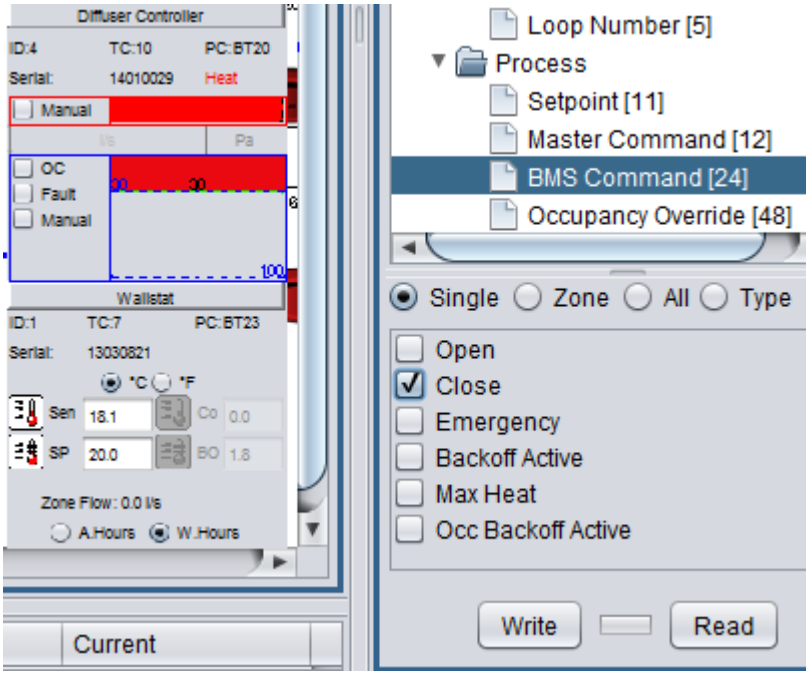



**Figure 15: Activation of manual override**

## 4.2 Occupancy Sense

### 4.2.1 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 wallstats 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.

### 4.2.2 Occupancy control override operation

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 are 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.

### 4.2.3 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.

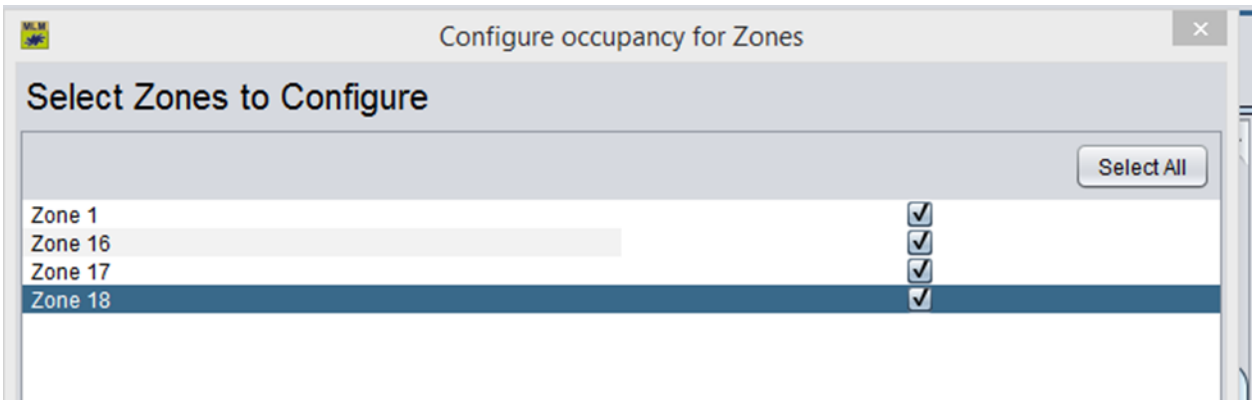



**Figure 16: mlm Occupancy setup wizard**

### 4.2.4 Manual setup for Occupancy Sense

The user can also set the system up manually for occupancy control override. The procedure as described in the following paragraphs needs to be followed.

**Diffuser**

- 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.

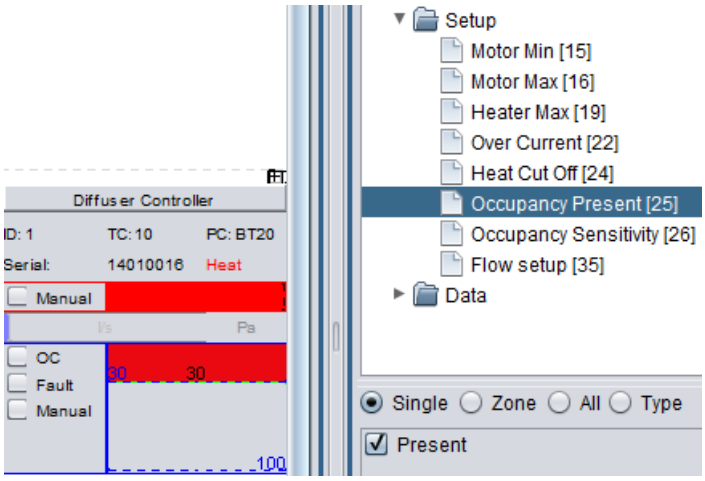



**Figure 17: Occupancy Present Setup display**

**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.

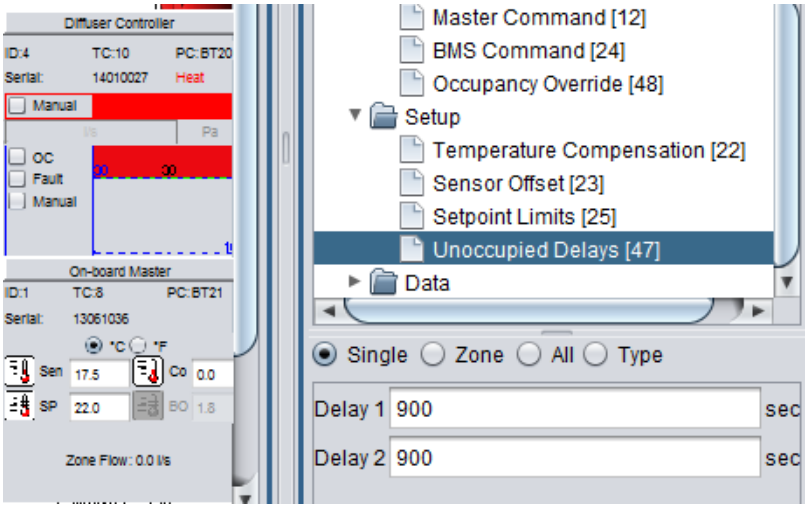



**Figure 18: Setup On-board master Unoccupied Delays**

**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.
- Under Master Command, check and write the control override parameter.

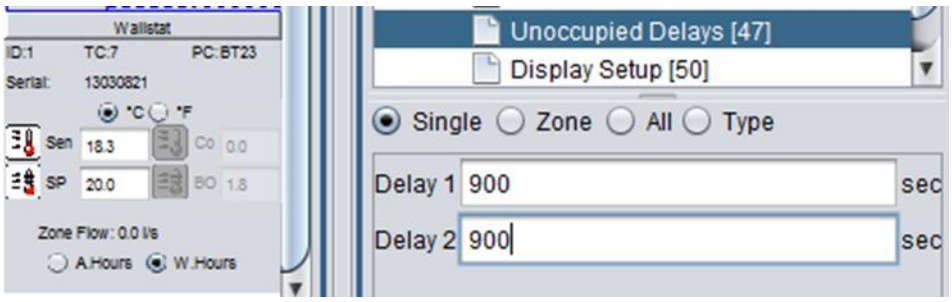



**Figure 19: Setup Wallstat Unoccupied delays**

Note: The three parameters that must be set for occupancy control 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.

### 4.2.5 mlm 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 (refer Figure 20) 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.

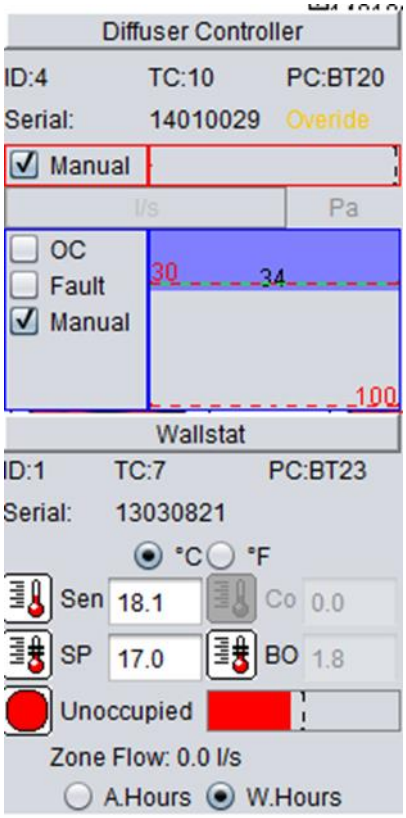



**Figure 20: Wallstat master unit entering the second delay period**

### 4.2.6 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 (refer Table 7).

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; refer Figure 21.

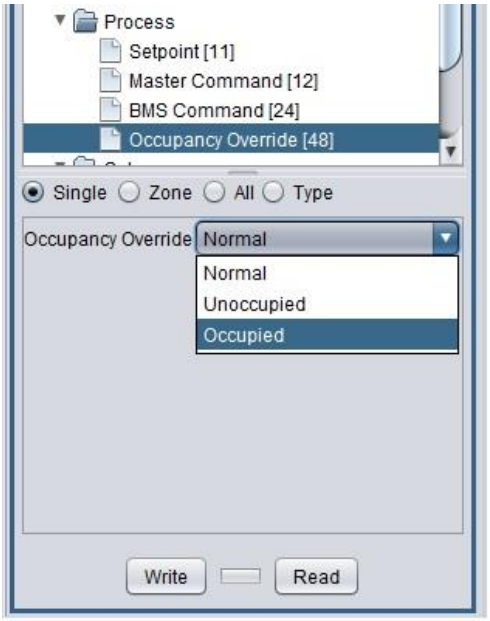



**Figure 21: Master Command/Control override**

## 4.3 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 (refer Figure 22).

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 occupied again. The same operation goes for Delay 2.

The user has the option to select both Switch channels to operate off the same timer.

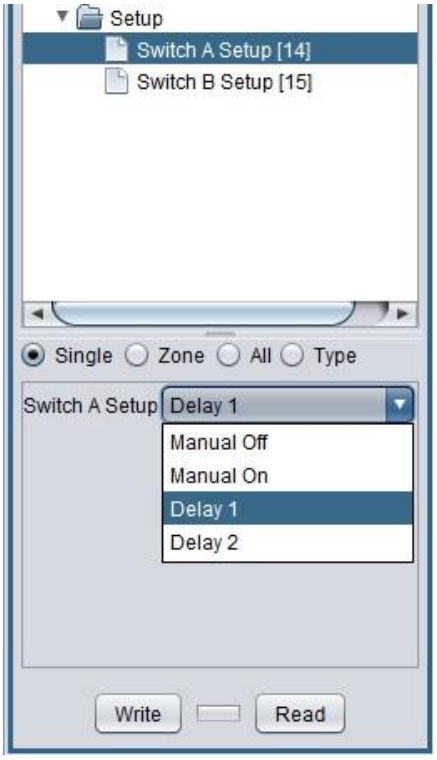



**Figure 22: Light Switch operation**

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 that 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.

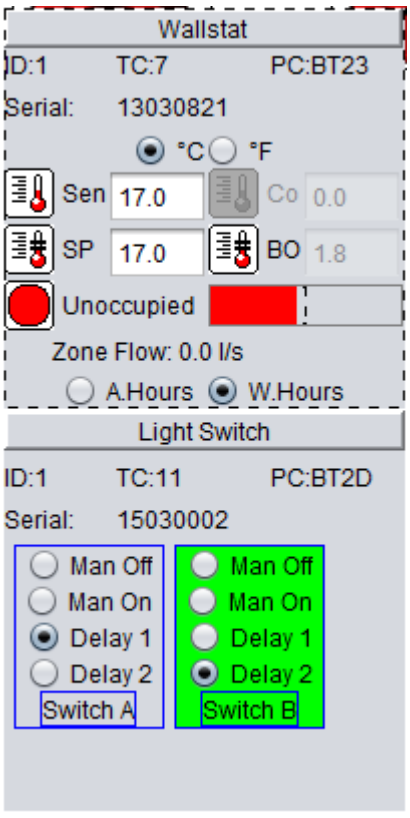



**Figure 23: Light Switch in mlm Tools**

## 4.4 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 mlm24 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 are required 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 6.35 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 (refer Figure 24).
- Ensure a flow sensor is correctly fitted to the diffuser neck.

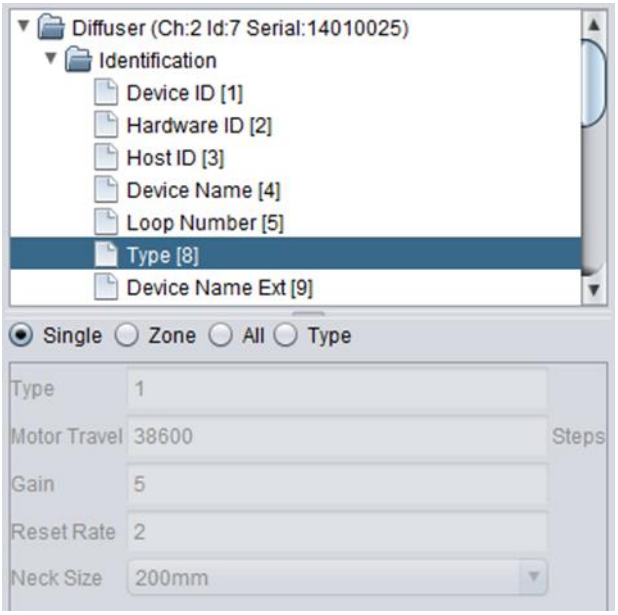



**Figure 24: Airflow sense setup checks**

Once this check list is confirmed, the user must select Pressure present under the 'Flow setup' tab on the Diffuser controller node (refer Figure 25).

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.

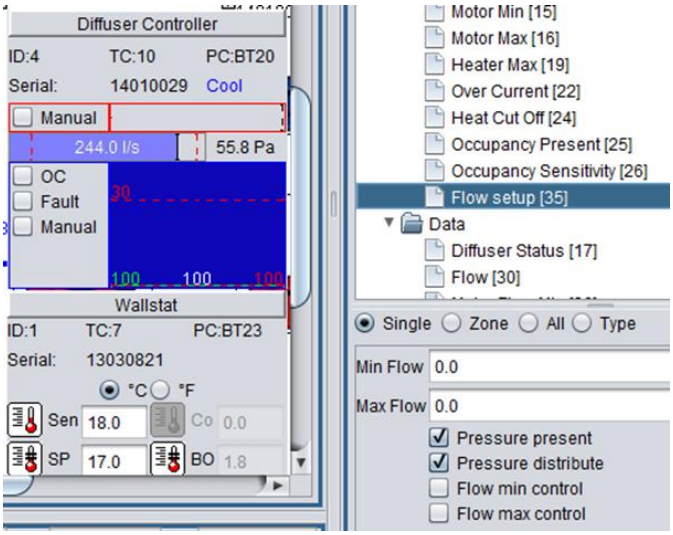



**Figure 25: Airflow setup**

The airflow data can also be monitored under the Data/Flow tab on the Diffuser controller, refer Figure 26.

- 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.

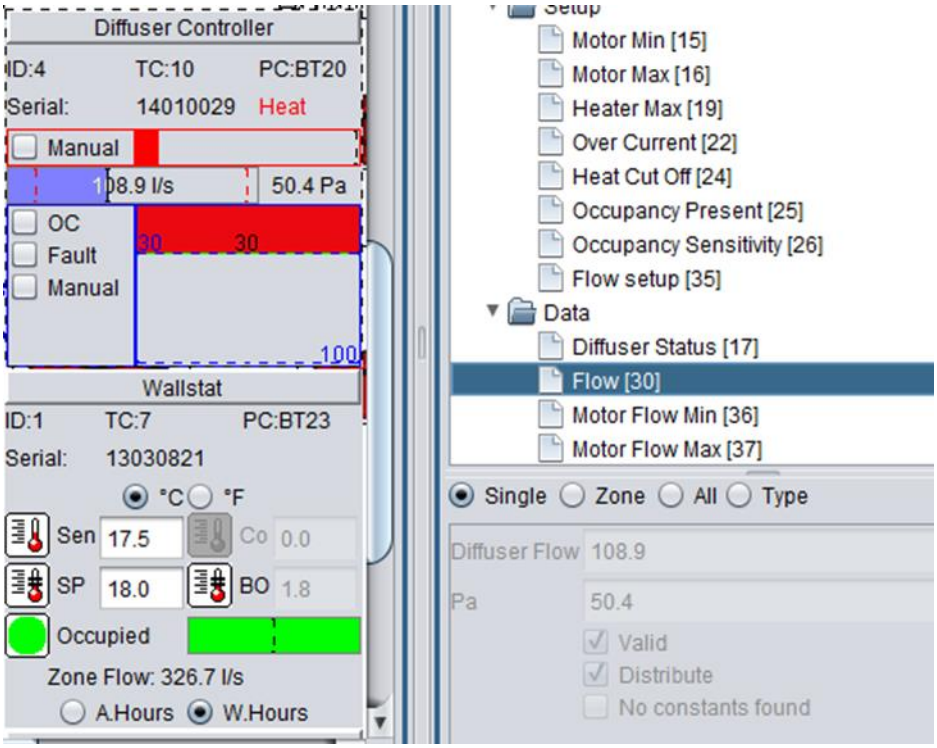



**Figure 26: Monitor airflow data**

Notice how the airflow volume decreased with a change in control disk position – Ref Figures 25 & 26.

The total airflow volume for zone 17 (below) is displayed on the master controller icon for that zone (wallstat Figure 26). For this zone only the master controller was fitted with an airflow sensor, hence the distribute function was selected. The zone consists of three equal size diffusers. The total volume flow of 326.7 l/s for three diffusers as shown is a multiple of the single diffuser flow of 108.9 l/s.

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

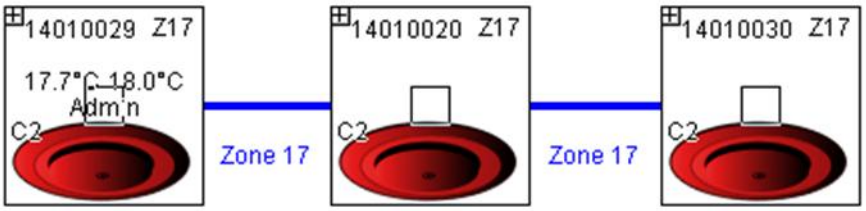



**Figure 27: Airflow volume for a zone**