MID2012 Passive/Natural Ventilation Controllers with Modbus

The MID2012 is a controller for natural ventilation systems. The MID2012 combines temperature control (cooling via natural ventilation and heating via underfloor heating/heating coils/radiators) and air quality based ventilation boost function with optional fan switching.

The dampers/louvres/windows can be overridden by the user to the required positions from the controller buttons (with a timeout). The controller has also built-in night purge functions to enable building fabric cooling during the cooler night temperatures.

The MID2012 controller has Modbus RTU RS485 interface that can be used for interrogating the controllers from the BMS systems. Via Modbus it is possible to enable system functions such as closing the louvres at high wind speeds when it rains, or activating night time purge. Night time purge can also operate when the controller is stand-alone based on the outside air temperature sensor.

The controller has been designed also for stand-alone operation with digital input purge control and scheduling. The controller is easily integrated into system dampers and fans by using the WC06 wiring center options.

<table>
<thead>
<tr>
<th>Model Types</th>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MID2012</td>
<td></td>
<td>Passive/Natural Ventilation with Modbus RTU, Application Profile Version 1</td>
</tr>
</tbody>
</table>

**Technical Data**

- **Power supply**: 24Vac/dc (20...28V), <1VA
  - Note: If using DC-voltage only 0..10V outputs are operational
- **Inputs**
  - Built-in Temperature Sensor (measurement error +/-0.5°C)
  - 1 x NTC10 e.g. TEHY-NTC10 (for control or measurement only)
  - 1 x Volt-Free (PIR Input)
  - 1 x HDH CO2 Measurement Input
- **Outputs**
  - 2 x 0..10Vdc (Heating/Cooling Actuators, VAV or Fan Speed Control)
  - 4 x 24Vac Triacs, 1A maximum (3-Point Actuators / Thermic Actuators)
- **Communications**
  - RS485 Modbus RTU, 9600/19200/38400 bps, 8 data bits, Parity None, 1 Stop Bit (Up to 128 devices per segment)
- **Buttons**
  - 3 or 4 Touch Buttons (User Mode and Programming Mode)
- **Wiring Terminals**
  - 1.5 mm²
- **Housing**
  - ABS Plastics (White)
- **Operating Humidity**
  - 0..95% rH non-condensing
- **Enclosure**
  - ABS Plastics, IP20
- **Standards**
  - 2004/108/EC (EMC)
  - EN61000-6-3:2001 (Emission)
  - EN61000-6-2:2001 (Immunity)
- **Overall size**
  - 87W x 86H x 32D mm
CONNECTION DIAGRAM

WARNING: The electrical installation, device connection and commissioning can only be carried out by qualified professionals and according to the local wiring regulations!

OPERATION MODES

MID2012 controllers have two operation modes: DAY and NIGHT. The unit can be switched between day and night modes either via Modbus network or via the DAY EXTENSION typically connected to PIR. The user can also change NIGHT mode to DAY mode by pressing "MAN IN THE HOUSE" (occupancy) button on the unit. When in DAY mode the controller operates the damper and valve outputs according to the below diagram.

DAY MODE

In the DAY mode the temperature is controlled to the setpoint using P or PI-control (configurable). The controller has adjustable deadzone between heating and cooling modes. When the temperature is inside the deadzone the control outputs are at 0%. When the temperature drops below the calculated setpoint (CALCSP) minus half of the deadzone, the heating valves start to open. When the temperature increases above the calculated setpoint plus half of the deadzone, the controller cooling demand causes the natural ventilation dampers to open. Please note that the ventilation damper outputs may also open due to high CO2 content.

The controller Calculated Setpoint (CALCSP) is calculated as follows:-

\[ \text{CALCSP} = \text{CNT SP} \pm \text{SP}_{\text{local}} \]

where CNT SP is the setpoint middles point and SP_{local} is the setpoint set by the user by pressing "+" and "-" buttons. SP_{local} range is limited at the commissioning stage (default +/-3°C).

NIGHT MODE

The configuration parameter NCTRL (Night Control Mode) sets the controller operation during the night time; Relaxed Deadzone or Frost Protection On/Off Mode.

1) Relaxed Deadzone at Night (NDz on the diagram)

The controller operates as in the DAY mode but the deadzone around the controller calculated setpoint is expanded to NDz value. Therefore at the night time the controller energy consumption is reduced.

NOTE: It is also possible to set the night deadzone to smaller value than day deadzone.
2) Frost Protection On/Off Mode (Set NCTRL control mode to FG)

In the night the controller controls to the FROST (FG) setpoint - see the above diagram. If the temperature falls below the FROST (FG) setpoint (8..50°C), the heating valve is opened. The FROST (FG) setpoint is adjustable via Modbus network or in the configuration mode. If the temperature exceeds NHYS amount (default 2°C) the FROST (FG) setpoint the heating valve is closed.

**AIR QUALITY CONTROL**

The passive ventilation controllers have been designed to control the ventilation dampers/louvres based on cooling demand or based on air quality. If the air quality deteriorates the the controller will automatically open dampers / louvres to let the fresh air to enter to the room space.

The controller cooling/ventilation outputs (Y1 and Y2) are controlled by taking the maximum of cooling (temperature) and ventilation (CO2) demand. The controller heating output is controlled by the temperature and CO2 ventilation demand does not affect heating output i.e. the heating output will be continued to be controlled by the temperature.

The CO2 control is automatically activated when the HDH CO2 input (AI) sees voltage higher than 0.5V. This will add CO2 reading for the controller display.

![Graph of CO2 Influence on Cooling/Ventilation Output](image)

**SUMMER/WINTER MODE**

The controller can operate in winter and summer modes. In the summer mode the maximum damper/louvre position normally equals the maximum demand from the control loop (cooling demand or CO2 demand). In winter mode the cooling/ventilation demand is often limited to a maximum value. This prevents the cold winter air entering to the room space yet providing sufficient fresh air ventilation.

The winter/summer mode is activated through the keypad or via Modbus. To activate/de-activate the winter mode on the keypad press "MAN IN THE HOUSE" button continuously over 5 seconds. The display shows "WIN%" or "SUM%" with the relevant setting for 10 seconds with a sound signal.
MANUAL DAMPER (COOLING/VENTILATION) OUTPUTS OVERRIDE

The MID2012 controller has built-in manual override button for the damper/louvre outputs. This allows the room space users temporarily override the dampers open, close or any position between them. The damper outputs return under normal control after a timeout (configurable parameter).

The override the damper position, press first the "OPEN/CLOSE LOUVRE/DAMPER" button for 5 seconds followed by pressing the "+/-" buttons to control the dampers to the desired value. During the adjustment the display shows the current damper position. After 5 seconds timeout the display returns to a normal mode.

If the "OPEN/CLOSE LOUVRE/DAMPER" button is pressed for 5 seconds during the override the display shows the LCD displays the overridden damper position and the remaining override time.

The override time is configured in the configuration parameters. The controller maintains the required manual position until the timer has counted down.

DAMPER OUTPUTS Y1/Y2 RAIN/PURGE OVERRIDE VIA MODBUS

The damper/louvre outputs can be overridden via Modbus to open or close position. Typically the dampers/louvres are closed in case of heavy rain. The dampers may also be overridden open in summer months to allow night time purge to cool down the building fabric using the cooler air.

DAMPER OUTPUTS Y1/Y2 DIGITAL INPUT PURGE CONTROL

The damper/louvre outputs can be overridden open 100% via the hardware purge control input. This is typically used in stand-alone installations with an external time clock. This mode is activated by selecting option 3 = Purge (DI) for the external sensor input (U2 terminals under the display).

When the Digital Input is closed the purge control is activated (damper outputs = 100%)

When the Digital Input is open the purge control is deactivated (normal control).

DAMPER OUTPUTS Y1/Y2 AUTOMATIC PURGE CONTROL

The MID2012 controller has an automatic purge control function that can be activated by selecting option 4 = Purge (AUTO) for the external sensor input (U2). In this mode an outside air temperature sensor is connected to the sensor input.

The automatic purge only operates when the controller is in the Night mode. The purge is activated when T_{ext} < T_E and T_E + 1°C > SP overriding the damper outputs to 100%.

The automatic purge is deactivated if T_E < SP - P_HYS or if the maximum purge time (P_TIME) is reached.
DAMPER (COOLING / VENTILATION) OUTPUTS Y1 AND Y2 SCALING

The damper outputs Y1 and Y2 can be scaled to match the maximum voltage allowed by the certain louvre manufacturers to develop better airflow. Each damper/louvre output has individual maximum setting configurable through the configuration parameters. The cooling/ventilation demand 0..100% demand is scaled over the 0V and maximum allowed physical voltage as shown in the below diagram.

DAY EXTENSION VIA DIGITAL INPUT (DI)

The controller has a digital input (DI) that can be connected to a momentary push button contact (e.g. PJP1) or to a PIR sensor (e.g. LA14) to override the controller to DAY operation. These are typically used out of hours to provide comfort control. Alternatively PIR input can be used as the primary means of switching between DAY and NIGHT modes. The digital input direction (DIR) is selectable via configuration parameters.

Once the controller detects transition in the input (opening or closing edge depending on the DIR configuration), the controller starts "Detection Delay". The "Detection Delay" is 50% of the PIR Detection Timer setting. If during the "Detection Delay" the controller detects contact being opened/closed again the day mode is activated.

Once the controller is overridden to the DAY mode for 1..480 minutes (default 120 minutes). This setting (HOLD) is adjustable via Modbus.

NOTE: As factory default the day extension input is disabled. The input can be activated by closing the contact and opening the contact.

DAY EXTENSION VIA KEYPAD

The controller can be overridden to DAY operation by pressing the "MAN IN THE HOUSE" occupancy button. When pressed the controller is overridden to DAY mode for the period of two hours. This time setting is adjustable between 1..480 minutes via Modbus network.

TRANSITION FROM NIGHT TO DAY MODE VIA MODBUS

When the controller operating mode is changed via Modbus from Night to Day mode, the controller Calculated DAY setpoint is decided based on the configuration setting SP_ND.

1) If SP_ND is set to "OFF", then the controller will use the last setpoint defined by the user. E.g. if the user sets the setpoint to 23.3°C on the previous day, the controller returns to control to this setpoint.

2) If SP_ND is set to "ON", then the controller returns to the middle setpoint (CNT SP). E.g. if the middle setpoint has been set to 21°C (typically via Modbus) and the user adjusted the setpoint to 23.3°C during the previous day, the controller will return to control to 21°C on the transition. This is a very useful energy saving feature for installations such as schools, hotels and other public buildings.

THERMIC ACTUATOR SELECTION / ANTI-JAM (HEATING OUTPUT)

If the controller is in the SUMMER mode and the heating output mode is selected to be THERMIC + ON/OFF (MOTOR=t) and parameter TmJAM=ON then the thermic actuator is opened and closed for 10 minutes every 72 hours to prevent jamming.

3-POINT ACTUATOR SELECTION / OVERRUN (HEATING OUTPUT)

If the 3-point actuator operation has been selected (MOTOR = 3-P), then the controller will after power up drive the 3-point actuator to closed position for 1.5 x the actuator running time (Tmot). This actuator initialisation routine (overrun) is carried out to find out the correct actuator position.
During the normal operation when the actuator is in fully open or closed position, the controller will carry out 5s overrun every 5 minutes to maintain the correct actuator operation.

**NOTE!** It is very important to set as accurate as possible actuator running time to get best process control.

**STACK FAN CONTROL**

The MID2012 controller has intelligent stack fan control function. The stack fans are used in natural ventilation systems to boost the fresh air circulation. The stack fans are often solar powered and therefore intelligent time logic is required to maximise the system performance.

The stack fan is connected to the controller output A1 (24Vac Triac switching to 0V).

Stack fan output is switched on when the damper/louvre demand has been above the SOV "Switch On Value" for minimum time of SOD "Switch On Delay". The stack fan is switched off automatically after MaxRT "Maximum Run Time" or if the damper/louvre demand drops 10% below the SOV value.

**MINIMUM SUPPLY AIR TEMPERATURE CONTROL**

If the heating output is used to control a heating coil in some cases it is required to maintain minimum supply air temperature. This can be achieved by monitoring the minimum supply air temperature and opening the heating valve according to the demand.

To activate minimum supply air temperature control, select option 2 (DLLC) from the external sensor configuration option. The supply low limit sensor is connected to the external sensor input under the MID2012 controller display (U2 terminals). The low limit temperature setpoint (SPmin) is configured in the configuration parameters.

The MID2012 controller minimum supply temperature control works together with the normal heating output control. The controller takes the maximum of the normal heating demand and the low temperature control demand.

\[
\text{OUTPUT}_{\text{lowtemp}} = (\text{SPmin} - \text{U2}) \times 100 / \text{XPmin}
\]

**INTERNAL / EXTERNAL SENSOR CALIBRATION**

The internal and external sensors can be calibrated by +/- 10°C (the below configuration parameters).
LED INDICATION
The LED on the top right corner of the controller indicates the current operation mode:
- Amber: Heating valve is opening
- Green: Cooling dampers/louvres are opening
- No light (Grey): Controller temperature in the dead-zone
- Flashing Amber: Error condition e.g. display disconnected

CONTROLLER CONFIGURATION
The controller is parameterised locally via a configuration mode. To configure the controller locally, first remove the top cover. A CONFIGURATION MODE jumper is located below the LCD display. When the jumper is set the controller is in normal operation. By removing the jumper the controller enters to the configuration mode.

Once the configuration has been completed, by setting the jumper the controller returns to the normal operation.

NOTE: The controller is supplied with the configuration jumper unset i.e. in the configuration mode.

PIR INPUT MODE SELECTION
DI input can be made operate with PIR sensors or with an external time clock to override to day mode. To se the input to operate with external time clock, select PIR displayt in H_ST mode. The occupancy = ON when the input is linked and occupancy is OFF when the input is open.

In the H_ST mode the "Occupancy ON Delay Timer" is not in use. "Day Override Timer" works when the "Man in the House" button is pressed.
CONFIGURATION PARAMETERS

Push \( \text{up}\) -button to proceed in the menu. \( \text{left}\) -button goes forward and \( \text{right}\) -button backward. Change values by \( \text{up}\) or \( \text{down}\) -buttons. Parameters will be saved at the end.

BUS TERMINATION

The MID2012 Controller has built-in termination resistor (120 Ohms) for the RS-485 Modbus network that can be enabled by setting the termination jumper.

FIRMWARE VERSION

The controller displays the firmware version when the unit is powered up.

MODBUS NETWORK

Up to 128 MID2012 controllers can be connected to a single network segment. The diagrams below illustrate the typical installation options.

It possible to connect the controllers to SyxthSense FDX BMS system or to an existing BMS (e.g. to TRIDUIM JACE, HONEYWELL HAWK, TREND BMS, CYLON etc.) via a Modbus interface. Please contact SyxthSense for more information.

MODBUS REGISTERS (MID2012 Ver1.0)

The controller supports the following Modbus registers and function codes. The default communication speed is 9600 bps, 8 data bits, Parity None, and 1 Stop Bit.
<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>Data Type</th>
<th>Value</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Night Mode Bit 0 On - Off</td>
<td>Bit 0</td>
<td>On - Off</td>
<td>On - Off</td>
</tr>
<tr>
<td>Winter Mode Bit 1 On - Off</td>
<td>Bit 1</td>
<td>On - Off</td>
<td>On - Off</td>
</tr>
<tr>
<td>Occupied by PIR Digital Input (NIGHT mode to DAY-transition)</td>
<td>Bit 0</td>
<td>On - Off</td>
<td>On - Off</td>
</tr>
<tr>
<td>Occupied via Local Keypad using Man In The House Button (NIGHT mode to DAY-mode)</td>
<td>Bit 1</td>
<td>On - Off</td>
<td>On - Off</td>
</tr>
<tr>
<td>Day Extension Activated (NIGHT mode to DAY mode)</td>
<td>Bit 2</td>
<td>On - Off</td>
<td>On - Off</td>
</tr>
<tr>
<td>Control via External Sensor Activated</td>
<td>Bit 3</td>
<td>On - Off</td>
<td>On - Off</td>
</tr>
<tr>
<td>Discrete Inputs 16 - 01</td>
<td>16 bit</td>
<td>-600..+600</td>
<td>-60.0..+60.0°C</td>
</tr>
<tr>
<td>Temperature</td>
<td>Signed 16</td>
<td>-600..+600</td>
<td>-60.0..+60.0°C</td>
</tr>
<tr>
<td>External Temperature</td>
<td>Signed 16</td>
<td>0..2000</td>
<td>0.0..2000 ppm</td>
</tr>
<tr>
<td>Effective Setpoint</td>
<td>Signed 16</td>
<td>0..1000</td>
<td>0.0..100.0%</td>
</tr>
<tr>
<td>Stack Fan Demand</td>
<td>Signed 16</td>
<td>0..1000</td>
<td>0.0..100.0%</td>
</tr>
<tr>
<td>Current Cooling Demand (Y1)</td>
<td>Signed 16</td>
<td>0..1000</td>
<td>0.0..100.0%</td>
</tr>
<tr>
<td>Current Heating Demand (A2/B2)</td>
<td>Signed 16</td>
<td>0..1000</td>
<td>0.0..100.0%</td>
</tr>
<tr>
<td>Coils 16 - 01</td>
<td>16 bit</td>
<td>0..500</td>
<td>0.0..50.0°C</td>
</tr>
<tr>
<td>Day Set Point by Modbus</td>
<td>Signed 16</td>
<td>0..500</td>
<td>0.0..50.0°C</td>
</tr>
<tr>
<td>Day Setpoint User Adjustment Limits</td>
<td>Signed 16</td>
<td>0..160</td>
<td>0.0..16.0°C</td>
</tr>
<tr>
<td>Setpoint Center</td>
<td>Signed 16</td>
<td>0..500</td>
<td>0.0..50.0°C</td>
</tr>
<tr>
<td>Night Frost Set Point (FG Setpoint)</td>
<td>Signed 16</td>
<td>80..500</td>
<td>8.0..50.0°C</td>
</tr>
<tr>
<td>Deadzone (Day)</td>
<td>Signed 16</td>
<td>0..30</td>
<td>0.0..3.0°C</td>
</tr>
<tr>
<td>Night Deadzone (Relaxed Mode)</td>
<td>Signed 16</td>
<td>0..100</td>
<td>0.0..10.0°C</td>
</tr>
<tr>
<td>XP (Proportional Band)</td>
<td>Signed 16</td>
<td>10.320</td>
<td>1.0..100.0%</td>
</tr>
<tr>
<td>Tint (Integral Action Time)</td>
<td>Signed 16</td>
<td>50..5000</td>
<td>50..5000</td>
</tr>
<tr>
<td>Day Extension Period</td>
<td>Signed 16</td>
<td>1.480</td>
<td>1.480 (min)</td>
</tr>
<tr>
<td>CO2 Low Limit</td>
<td>Signed 16</td>
<td>400..1000</td>
<td>400..1000 (ppm)</td>
</tr>
<tr>
<td>CO2 High Limit</td>
<td>Signed 16</td>
<td>500..2000</td>
<td>500..2000 (ppm)</td>
</tr>
<tr>
<td>Damper Output (Y) Man Override</td>
<td>Signed 16</td>
<td>0=0%, 1=100%, 2=AUTO</td>
<td>0,1,2</td>
</tr>
</tbody>
</table>
TYPICAL APPLICATIONS

BALANCED STACK APPLICATION

The diagrams below illustrate the typical applications. The controller can be configured to operate in a wide range of natural and passive ventilation schemes.

In this application the room temperature is controlled with underfloor heating and balanced stack cooling/fresh air boost. Auxiliary stack fan control output is used when ventilation boost is required. Typically systems also have low level damper that follows the balanced stack damper positions.

PASSIVE VENTILATION SCHEME

The passive ventilation scheme is very similar to the balanced stack application but in this case the controller does not have stack fan control.

NATURAL VENTILATION

In the natural ventilation scheme the cooling and supply of fresh air is carried out by the roof ventilation.
In this application passive ventilation via louvres is combined with the low level supply of fresh air. The low level supply is combined with local heating coil to supply warm air to the room space. The supply temperature is monitored by the low limit sensor and the minimum supply temperature is controlled by the system minimising the draft feeling.