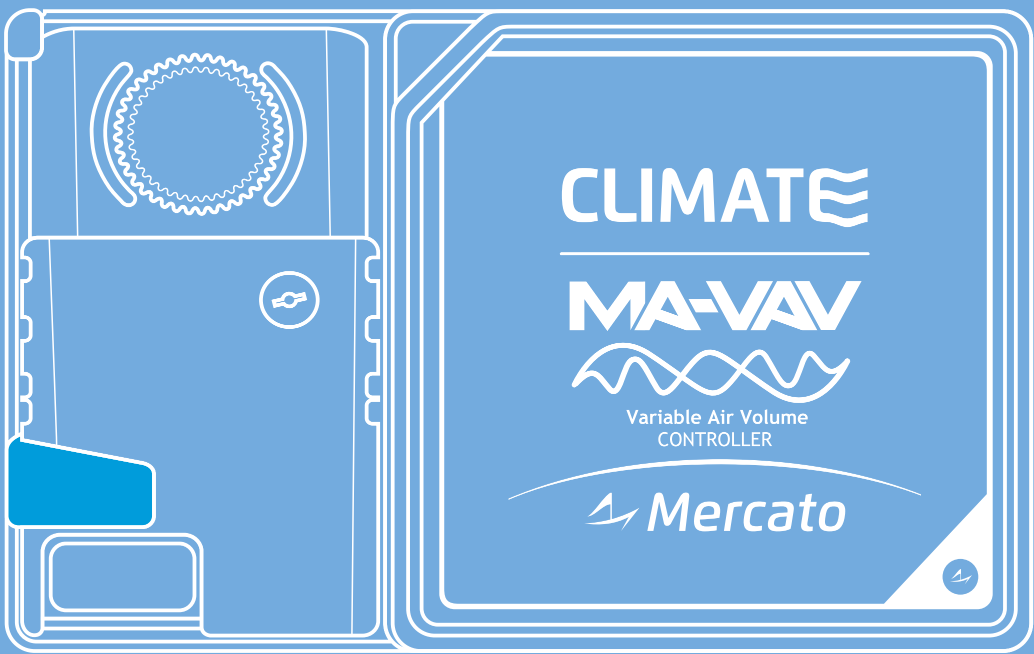
R115C01VAV

CLIMATE

Dedicated and optimized for your demand

MA-VAV



Variable air volume Controller

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OVERVIEW

The MA-VAV is a building controller for variable air volume systems (VAV) that is simple to install and configure. It has pre-configured internal logic that are easily parameterized.

Configuration is done via any web browser (ethernet models) or via the MCONFIG software (Zigbee or RS485 models).

The MA-VAV can be used in the following VAV applications:

- Cooling only.
- Terminal with reheat.
- Terminal in changeover mode.
- Fan-powered terminal units.

Hardware characteristics:

- Integrated zero-drift differential pressure sensor for air flow measurement. Sensor is stable even at very low pressures.
- Optional dual port 10/100M ethernet for daisy chain wiring. Support for BACnet and Modbus protocols.
- Isolated RS485 interface with BACnet MS/TP and Modbus RTU protocols.
- Real time clock and calendar, with weekly schedule, maintained by a supercapacitor (zero maintenance).
- $24V_{AC}$ power supply option.
- Connections via detachable terminals.

Firmware features:

- Cooling and heating controls with terminal reheating option or changeover mode.
- Proportional control or up to two stages of reheating in the terminal.
- Minimum and maximum air flow control.
- All configuration can be done through the internal webserver via any browser.
- Can be used with a remote display.

AVAILABLE MODELS

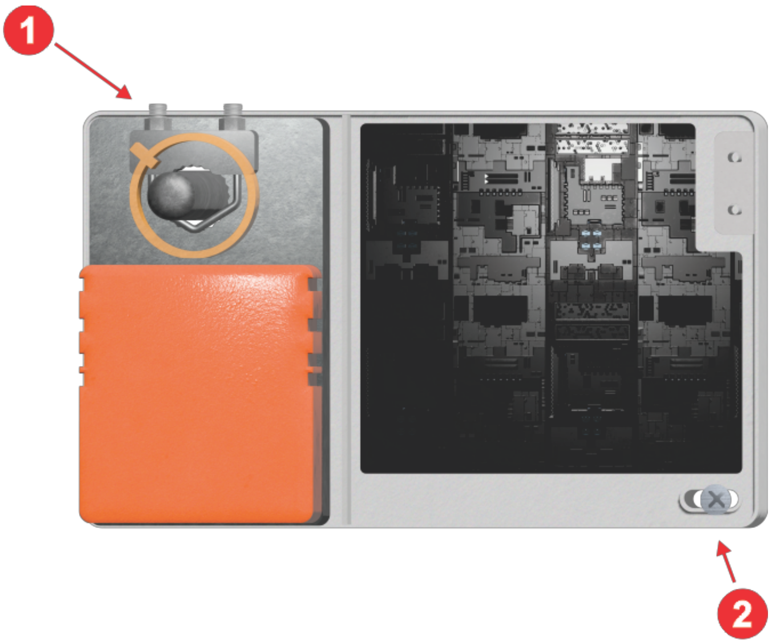
The MA-VAV is available in three models:

MA-VAV-485	With RS485 port.
MA-VAV-ETH	With RS485 and dual ethernet 10/100M.
MA-VAV-ZIG	With RS485 and Zigbee interface.

INSTALLATION

MOUNTING

The MA-VAV controller must be mounted indoors on a flat surface.



1) Attach the actuator in the VAV box shaft.

2) Attach the MA-VAV enclosure on VAV box/duct using a screw in the indicated position.

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CONNECTIONS

Table 2.1 establishes the purpose of each VAV connection terminal.

POINT	NAME	DESCRIPTION
1	BO1 A	Binary output 1
2	BO1 B	
3	BO2 A	Binary output 2
4	BO2 B	
5	UI1	Universal input 1
6	UI2	Universal input 2
7	GND	Reference for universal inputs
8	UI3	Universal input 3
9	UI4	Universal input 4
10	+24VDC	Power supply to external sensors
11	AO1	Analog output 1
12	AO2	Analog output 2
13	GND	Reference for analog outputs
14	V+	Remote display
15	D+	
16	D-	
17	V-	
18	D+	Main RS485 port
19	COM	
20	D-	
21	V~	Main power supply.
22	V~	

Table 2.1 - Connection Points

MAIN POWER SUPPLY

The MA-VAV controller must be supplied with a $24V_{AC}$ transformer. Use only UL-listed class 2 transformers.

The equipment power supply is isolated from the inputs/outputs and communication.

PRESSURE MEASUREMENT

The MA-VAV controller has an integrated differential pressure sensor for measuring air flow. The pressure outlets of the VAV must be connected using the inlets available on the side of the box. There is no polarity as the sensor is bipolar and control considers only the absolute value of differential pressure.

UNIVERSAL INPUTS

The MA-VAV controller has 4 universal inputs that can be configured in any of the following modes:

- **DIGITAL** - dry contact or open collector NPN transistor.
- **NTC** – 10k type II or type III sensors. Other curves may be available.
- **VOLTAGE** – 0-10V or 2-10V output sensors.
- **CURRENT** – 0-20mA or 4-20mA output sensors.

Inputs configured as **DIGITAL** (dry contact) can be used to monitor the state of a contact. No power can be applied at the input or there will be risk of damaging the equipment. Outputs to an NPN transistor in an open collector can be connected as shown in figure 2.1.

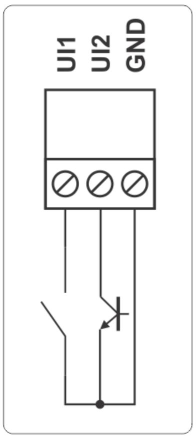

Figure 2.1 - Use of digital inputs.

Inputs configured as **NTC** allows temperature measurement with the use of an NTC sensor model 10k type II or type III. Contact technical support for NTC sensors with a different temperature curve/value.

Inputs configured as 0-10V or 2-10V allows the use of analog **VOLTAGE** sensors.

Inputs configured as 0-20mA or 4-20mA allows the use of analog **CURRENT** sensors.

The equipment is able to supply $24V_{DC}$ for the current loop. If used, the connection should be as per figure 2.2A. If the supply is from an external source, the connection should be as per figure 2.2B.

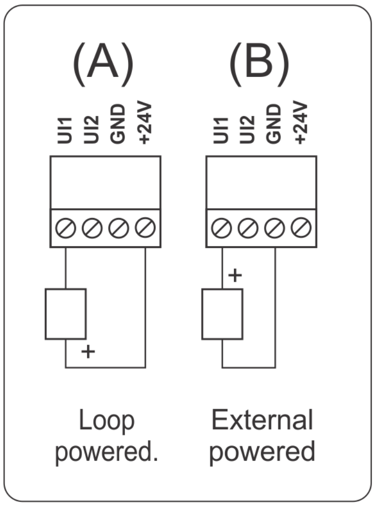

Figure 2.2 - Connection for an analog input.

DIGITAL OUTPUTS

The MA-VAV has two relay outputs to power various loads. The outputs were designed for loads of up to $24V_{AC}$. The outputs have internal protection for inductive loads (varistors).

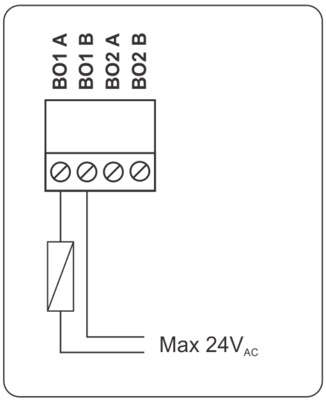

Figure 2.3 - Connection for a digital output.

ANALOG OUTPUTS

The MA-VAV analog outputs can be configured as a 0-20mA, 4-20mA, 0-10V or 2-10V signal. It can be used to drive external actuators.

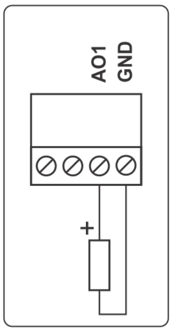

Figure 2.4 - Analog output connection.

DAMPER ACTUATOR

The VAV controller has two internal digital (transistor) outputs to drive the integrated floating damper actuator. If necessary, these outputs may be used to drive external actuators. The outputs are current-limited and short-circuit protected. Software can detect actuator mechanical malfunctions through alarms generated by these outputs. The outputs supply $24V_{DC}$ to the actuators.

For proportional actuators, the analog output can be used for control.

If you use a different damper actuator, it must be UL listed. See technical specifications section to details.

ETHERNET COMMUNICATION

The MA-VAV has an integrated ethernet switch with 2 ports to facilitate communication wiring. A simple daisy-chain connection can be done between several VAV controllers. The Ethernet ports supports 10 or 100M speeds and can be used with patch or crossover ethernet cables (auto MDI/MDI-X).

The Ethernet ports supports BACnet (IP and Ethernet variants) and Modbus (TCP and UDP variants) protocols. They can work simultaneously.

RS485 MAIN PORT

The main RS485 port is galvanic isolated and can be used for BMS integration or to create a BACnet MS/TP network below MA-VAV (it has BACnet routing capability).

For installation, wiring of the RS485 network should be chained from equipment to equipment. Bus and star topologies should be avoided. The GND signal of the controllers may be disconnected in smaller and simpler networks.

For longer networks, a termination via 120Ω / 0.5W resistors may be necessary. These resistors should only be installed in both ends of the network.

RS485 AUXILIAR PORT

The auxiliar RS485 is a non-isolated port and it is dedicated for remote display interface/sensor connection. It currently supports a proprietary protocol that is implemented in Mercato's remote display line.

Connections via the auxiliar RS485 port must be limited to only one equipment and shall use the power supply provided by MA-VAV (V+/V- terminals).

NETWORK TOPOLOGY

The MA-VAV controller is very flexible in its communication ports.

Ethernet wiring can be done in a star topology with each MA-VAV connected to a central switch or in a daisy-chain topology by linking the MA-VAVs via ethernet cables and one to a central switch.

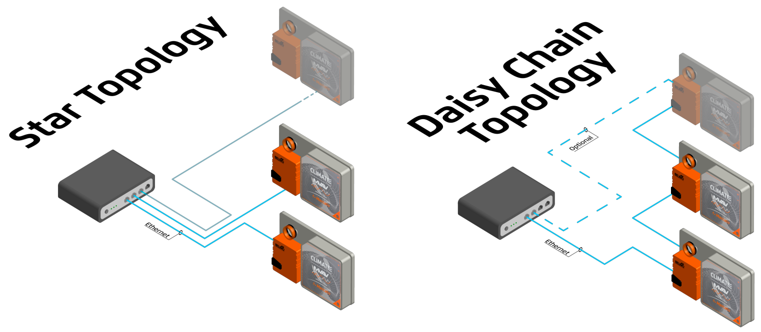

Figure – Ethernet network diagram

In daisy-chain topology, the endmost controller on the chain can be connected back to central switch to make network more robust. If one of controllers fails (or a cable is disconnected), communication continues through the other end. The internal switch automatically discards packets received with its own MAC address, breaking circular networks.

Generally, ethernet ports are used for BMS communication, as an alternative, the RS485 port can be used for it. Both ethernet and RS485 ports supports BACnet and Modbus protocols that can be configured freely in each port, (i.e., BACnet in one port and Modbus in the other). In the ethernet ports, both protocols can operate simultaneously.

For BACnet networks, the MA-VAV can be used as a router between IP and MS/TP port, creating a MS/TP network below MA-VAV.

The ethernet port supports two different BACnet datalinks: BACnet/IP and BACnet/Ethernet. Both can be enabled at the same time.

If more than one BACnet datalink is enabled, caution must be taken not to create a circular network. For example, two MA-VAVs using BACnet/IP and BACnet/Ethernet enabled on same network with routing enabled in those ports would create a circular network.

For Modbus networks, Modbus/TCP and Modbus/UDP variants are available. Both are always enabled and require no configuration to operate. Modbus RTU protocol works via RS485 port and the MA-VAV acts as a slave controller in network.

SETTINGS

Ethernet models are configured via any web-browser. Use the equipment IP's address as an URL in web-browser.

Factory default IP address is 10.1.1.240 with netmask of 255.0.0.0.

The default login credentials to access the settings are "**config**" for both user and password.

RS485 and Zigbee models require Mercato's MCONFIG software to modify the settings. MCONFIG can run over BACnet and Modbus networks.

OPERATIONAL DESCRIPTION

This section describes the various equipment functionalities and necessary configurations for operation.

UNITS SYSTEM

MA-VAV controller can be configurated in SI or US units system. In SI units, flow is measured in m³/h (cubic meters per hour), differential pressure is measured in Pa and temperature in ºC. In US units, flow is measured in CFM (Cubic Feet per Minute), pressure is measured in Pa and temperature in ºF.

When the unit system is changed the configuration values must be manually converted to the selected system. For BACnet objects, a new discovery is required to update the unit information on objects.

I/O MAP

MA-VAV controller has several internal algorithms that can be mapped to physical inputs/outputs. The functions are mapped by selecting the input/output number to its corresponding function in the controller's settings. Values of zero means function disabled. Most functions will be accessible by the network, even when not mapped to physical points of controller.

FLOW MEASUREMENT

Air flow is measured using a differential pressure sensor integrated in the controller. The sensor measures the differential pressure generated in the VAV box to calculate velocity and consequently, the air flow in the terminal.

The equation used to calculate flow is:

$$Q = K.\sqrt{\frac{\Delta\ P}{248.84}}$$

Where Q is the flow (m³/h or CFM), K is the K factor of the VAV box and ΔP is the measured differential pressure (Pa).

By definition, the K-factor is the flow of air that generates a differential pressure of 1 inH2O (248.84 Pa). Check the units of K in the VAV box datasheet.

SPACE TEMPERATURE MEASUREMENT

Controlled space temperature can be measured by an NTC sensor connected to a universal input. The input must be configured as NTC mode and Space temperature must be mapped in the controller's configuration.

Optionally a remote display sensor can be used as space temperature. This can be enabled in the I/O map setting tab.

If both NTC input and remote display are enabled, the mean value is used for space temperature.

OPERATING MODE

The MA-VAV controller can operate in 6 different modes, as shown in table 5.1.

CODE	NAME	DESCRIPTION
0	OCCUPIED	Normal operating mode with occupied space.
1	UNOCCUPIED	Control not operating (unoccupied space).
2	WARMUP	Pre-heating of space, before occupation.
3	COOLDOWN	Pre-cooling of space, before occupation.
4	SETBACK	This mode prevents space from getting too cold in unoccupied mode.
5	SETUP	This mode prevents space from getting too hot in unoccupied mode.

Table 5.1 – Operating modes.

The MA-VAV controller provides a network point to zone controllers to select operating mode. Normally, the VAV itself only cycles between OCCUPIED and UNOCCUPIED modes according to internal schedule (see ENABLING CONTROLLER section). The zone controller must select the operating mode code in the network point as shown in table 5.1.

ENABLING THE CONTROLLER

To operate, VAV control must be enabled. This can be accomplished by selecting a different code than **1** (UNOCCUPIED). An alternative is to use the controller's internal schedule. The latter, when active, automatically switches the mode to **0** (OCCUPIED) thus enabling the control. When inactive, operating mode switches to UNOCCUPIED.

The MA-VAV has two internal schedules: one BACnet and one Modbus. The schedule must be selected in the configuration accordingly.

If the internal schedule is used, a way to periodically set controller's date/time must be provided. This can be done via BACnet, Modbus or even manually via a remote display.

Optionally, an override switch can be mapped to a universal input. When enabled, override puts controller in OCCUPIED mode for a configurable time. The override function can also be enabled via a remote display.

SPACE TEMPERATURE CONTROL

The MA-VAV space temperature control is achieved by modulating the quantity of air in the controlled environment, ensuring the minimum/maximum configured flow limits.

This control is accomplished with two cascading PID controls. The first PID measures the space temperature error and adjusts the flow setpoint of the second PID. The second PID is responsible for controlling the damper position to maintain a specific flow calculated by the first PID.

See CONTROL LOGICs section for details on each operating mode.

REHEAT CONTROL

The MA-VAV controller can control reheating directly at the terminal. This control can be either proportional or up to two stages of ON-OFF.

In proportional reheat control, the reheat signal is mapped to AO1 and it can control a hot water valve or a modulating electric heat coil. In this case, the reheat output signal is controlled by an internal PID.

In ON-OFF mode, up to two stages can be mapped to BO1/BO2 digital outputs. This mode uses an ON-OFF control with individual temperature hysteresis. The first stage is activated when the temperatures are above (setpoint + hysteresis1) and the second stage above (setpoint + hysteresis1 + hysteresis2).

Reheat control needs a discharge air temperature sensor (DAT) to operate. The Space temperature loop modulates the DAT setpoint within the configured minimum and maximum values (see CONTROL LOGICs section for details).

CHANGEOVER MODE

In systems with hot/cold air (changeover mode), there needs to be an indication of the current mode via a supply air temperature (SAT) sensor in the duct or via a network.

If a duct sensor is used, an input can be mapped as supply air temperature. When mapped, mode is set to COOL if the supply air is below cool temperature. Mode is set to HEAT if the supply air is above heat temperature. The temperatures can be changed in controller's settings.

When not using a SAT sensor, the current mode may be changed by the network in changeover mode point.

PID CONTROLS

The controller has several PID loops to adjust controlled variables with the following configurations:

PB (pass-band): defines the error of the monitored variable that generates a proportional output of 100% on the controller.

Ti (integration time): defines the integration time in seconds. With each integration time, the proportional error is duplicated in the internal integrator.

Deadband: defines the minimum error that causes change in the controller's output. Avoids unnecessary actuator/output triggering. Deadband unit is defined in the controlled variable units. For temperature, deadband uses ºC/ºF.

DAMPER ACTIVATION

The MA-VAV controller has an integrated floating actuator to modulate the damper's position. The damper is driven using two transistor outputs with short-circuit protection.

These outputs may be used to drive an external damper as long as the current limits are respected.

If necessary, the analog output AO1 can be used to drive an external proportional actuator.

The controller indicates the activation state with two internal LEDs. If there is a short-circuit, the LEDs blink rapidly and the outputs are deactivated. After a few seconds, the outputs are reactivated.

If an external damper is used, its open time must be properly configured. The default time for the actuator provided with the equipment is 95 seconds.

ACTUATOR REFERENCING

Whenever the MA-VAV is restarted or the control is disabled (i.e., end of schedule period or turned off manually) the actuator position is referenced.

When this occurs, close output is activated for the actuator's opening time (default to 95s).

During this process, the controller ignores any commands. When the process finalizes, the enable signal is updated and the logic operates normally.

DIAGNOSTIC ALARMS

MA-VAV can generate alarms if the air supply is insufficient or excessive.

Insufficient alarm (starving alarm) is generated if the damper is above the minimum configured limit by a configurable time. The alarm for excessive air supply is activated if the damper stays below the configured limit by a configurable time (configurable value).

Alarms can help troubleshoot problems in the AHU (air handling units) that feeds the VAV terminal.

CONTROL LOGICs

The MA-VAV controller defines the air flow setpoint by a PID loop that controls space temperature. Diagrams below show air flow setpoints versus space temperature.

The minimum and maximum flow setpoints can be adjusted in the controller's settings for each operating mode (cooling, heating, deadband).

COOL ONLY

In cool-only mode (heating/reheating disabled), the flow setpoint is controlled as shown in diagram 6.1. Space temperature above the cool setpoint enables cooling control which modulates the flow setpoint linearly between the minimum and maximum values. When space temperature is below the cool setpoint, the VAV maintains the setpoint at minimum value (deadband minimum).

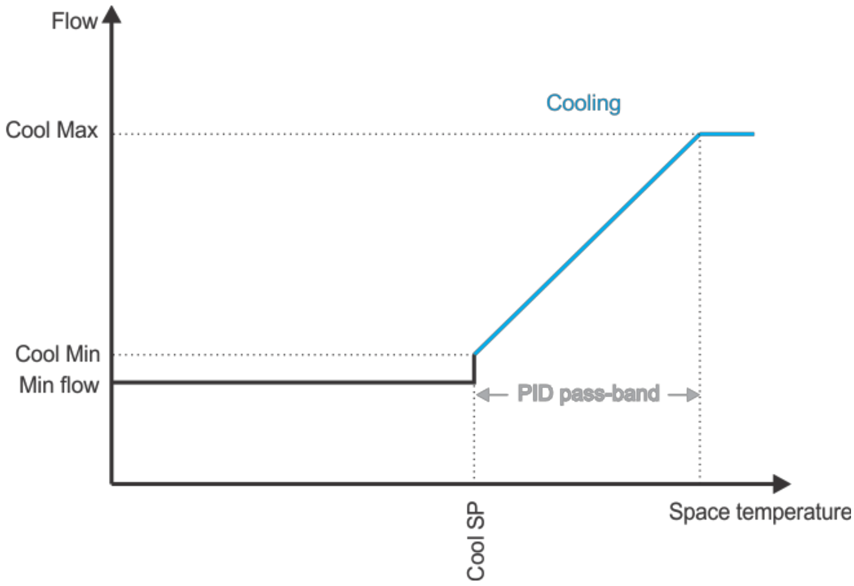

Figure 6.1 – Cool-only mode.

COOL/HEAT CHANGEOVER

In changeover mode, the air handler supplies cold or hot air. Temperature control modulates air flow between minimum and maximum linearly, as shown in figure 6.2. In the deadband, minimum flow is used.

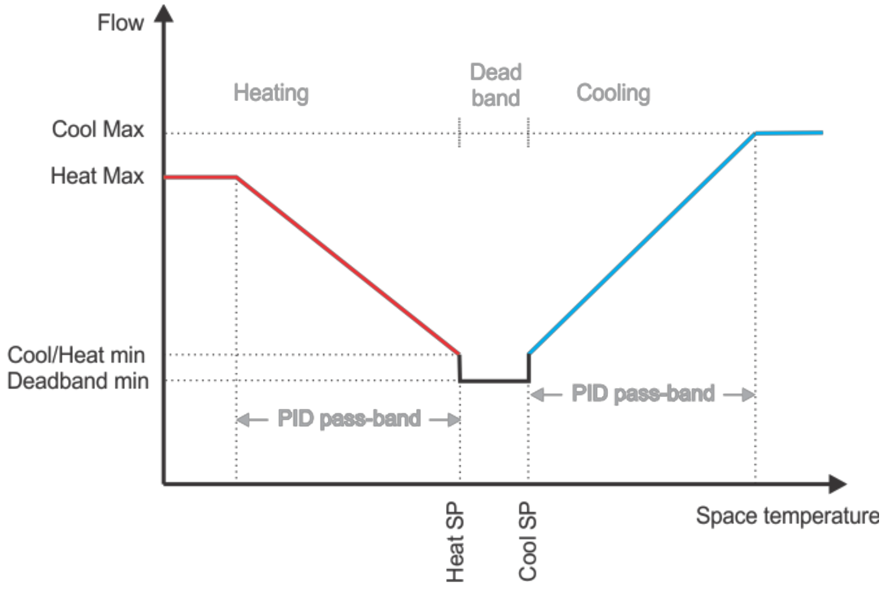

Figure 6.2 – Changeover mode.

REHEAT

In reheat mode, the air supply is always cold and VAV terminal has a water coil heating element or electric heating element. In this mode, the VAV modulates the DAT setpoint between configured minimum and maximum values if the heating loop output is between 0 and 50%. Flow is maintained in minimum heat. If the output of the heat loop is above 50%, DAT setpoint is maintained in maximum heat value and flow is linearly increased from heating minimum to heating maximum. Control diagram is shown in figure 6.3.

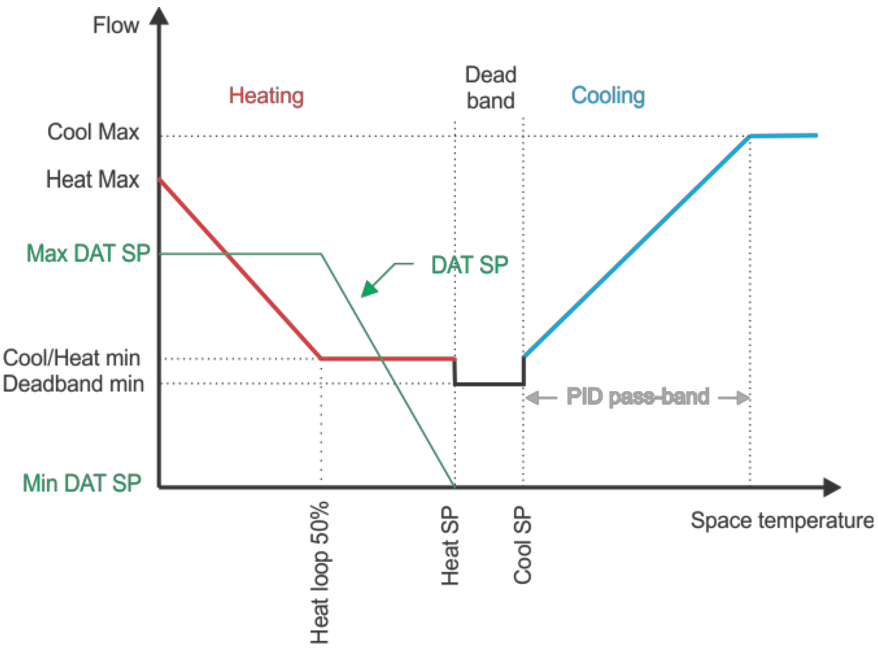

Figure 6.3 – Reheat mode.

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TECHNICAL SPECS

Power supply	24 V_{AC} ± 20%, 50-60Hz Rated impulse voltage: 330V.
Consumption	5 VA maximum with integrated actuator.
Environmental ratings	Pollution degree 2. Operating ambient temperature: -20 to 60ºC (-4 to 140ºF). Relative humidity: 5 to 95%, non-condensing. Maximum altitude 2000m. Indoors use only.
Wiring	For 28-16 AWG wiring sizes, solid or stranded. Use copper conductors only.
Digital outputs	Relays. Maximum load 2A @ $24V_{AC}$. Protection for inductive loads via $39V_{AC}$ internal varistor.
Analog outputs	Current mode (0/4-20mA) - maximum load impedance: 500Ω Voltage mode (0/2-10V) - minimum load impedance: 80kΩ. Resolution: 11 bits
Actuator outputs	Transistor, $24V_{DC}$. Current limited to 120mA.
Actuator	Standard actuator Belimo LMB24-3-T, UL listed (E108966). If using another actuator, it must be any 24V UL listed (UL e cUL) on categories XAPX/7, XABE/7, XACN/7 or PAZX/7.
Inputs - Digital mode	For dry contact, without power. Current ~200uA.
Inputs – Voltage mode	Maximum voltage 12V. Input impedance ~100kΩ. Resolution: 12 bits.
Inputs – Current mode	20mA maximum current. Input impedance 150Ω. Resolution: 12 bits.
Inputs - NTC mode	NTC 10k type sensor Curves available for 10k type II or type III.
+$24V_{DC}$ output	Power for 24V external sensors, max 100mA total.
Clock	Runs on supercapacitor.
RS485 Communication	EIA-485, isolated. Insulation $1500V_{AC}$ Max 115200 bps.
Attachment	Directly in the actuator axle.
External dimensions	197 x 122 x 60 mm (L x D x H);
Actuator torque	5 Nm
Rotation angle	95 ° maximum. Adjustable by mechanical limiter
Axle diameter	1/4" to 3/4" [6 to 20mm] for round axle. 5/16" to 3/4" [8 to 26mm] for square axle.
Compliance information	UL 60730-1 5^{th} edition. Listed under file number **E526483** UL2043 edition 4 (2018) CAN/ULC-S142:2016-R2021

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MODBUS TABLE

The following types of data are used in the Modbus registers, accessible without distinction using functions 03 (Read Holding Registers) and 04 (Read Input Registers).

TYPE	NUM REGS	DESCRIPTION
WORD	1	Integer 16 bit, unsigned
DWORD	2	Integer 32 bit, unsigned. Bit order is MSB...LSB (high end)
FLOAT	2	Standard floating point IEEE754. Bit order is MSB...LSB

The RS485 interface uses the following fixed configurations: 8 bits of data, 1 stop bit, without parity. The communication baud rate is configurable.

Modbus register (decimal)	Type	R/W	Description
0	FLOAT	R	Air flow
2	FLOAT	R	Space temperature
4	FLOAT	R	Supply air temperature
6	FLOAT	R	Discharge air temperature
8	FLOAT	R	Zone demand
10	FLOAT	R	Temperature setpoint deviation
12	FLOAT	R	Flow setpoint deviation
14	FLOAT	R	Cooling setpoint
16	FLOAT	R	Heating setpoint
18	FLOAT	R	DAT setpoint
22	WORD	RW	Changeover mode (0 = cool, 1 = heat)
23	WORD	R	VAV starving (1 = active)
24	WORD	R	VAV overfed (1 = active)
25	WORD	R	Control enabled
26	WORD	R	Override active
27	WORD	R	Occupancy sensor: 1 when unpopulated space
28	WORD	R	Zone state (0 = cooling, 1 = heating, 2 = deadband).
29	WORD	R	Operating mode (0=occupied, 1=unoccupied, 2=warmup, 3=cooldown, 4=setback, 5=setup).
30	FLOAT	R	Flow setpoint
100	FLOAT	RW	Occupied cool setpoint
102	FLOAT	RW	Occupied heat setpoint
104	FLOAT	RW	Unoccupied cool setpoint
106	FLOAT	RW	Unoccupied heat setpoint
200	WORD	RW	Modbus operation schedule – period 1 - valid days Bit 7 = Monday … Bit 3 = Friday, Bit 2 = Saturday, Bit 1 = Sunday, Bit0 = Holidays.
201	WORD	RW	Operation schedule - period 1 - initial hour
202	WORD	RW	Operation schedule - period 1 - initial minute
203	WORD	RW	Operation schedule - period 1 - final hour
204	WORD	RW	Operation schedule - period 1 - final minute
205..209		RW	Operation schedule - period 2
210..214		RW	Operation schedule - period 3
215..219		RW	Operation schedule - period 4

500	WORD	R	Clock - day
501	WORD	R	Clock - month
502	WORD	R	Clock - year
503	WORD	R	Clock - hour
504	WORD	R	Clock - minute
505	WORD	R	Clock - second
600	WORD	RW	Clock adjustment - day
601	WORD	RW	Clock adjustment - month
602	WORD	RW	Clock adjustment - year
603	WORD	RW	Clock adjustment - hour
604	WORD	RW	Clock adjustment - minute
605	WORD	RW	Clock adjustment - second
606	WORD	RW	Clock adjustment - command to set. Write 12345.
1000	FLOAT	RW	Cool PID: PB
1002	FLOAT	RW	Cool PID: deadband
1004	WORD	RW	Cool PID: Ti
1005	FLOAT	RW	Heat PID: PB
1007	FLOAT	RW	Heat PID: deadband
1009	WORD	RW	Heat PID: Ti
1010	FLOAT	RW	Flow control PID: PB
1012	FLOAT	RW	Flow control PID: deadband
1014	WORD	RW	Flow control PID: Ti
1015	FLOAT	RW	Reheat PID: PB
1017	FLOAT	RW	Reheat PID: Deadband
1019	WORD	RW	Reheat PID: Ti
1500	FLOAT	RW	Box K-factor
2000	WORD	R	Binary input 1
2001	WORD	R	Binary input 2
2002	WORD	R	Binary input 3
2003	WORD	R	Binary input 4
2004	FLOAT	R	Universal input 1 - analog value
2006	FLOAT	R	Universal input 2 - analog value
2008	FLOAT	R	Universal input 3 - analog value
2010	FLOAT	R	Universal input 4 - analog value
2012	FLOAT	R	Differential pressure
2050	WORD	R	UI_1 reliability (0 = if no error).
2051	WORD	R	UI_2 reliability
2052	WORD	R	UI_3 reliability
2053	WORD	R	UI_4 reliability
2100	WORD	R	Binary output 1 (BO1)
2101	WORD	R	Binary output 2 (BO2)
2102	FLOAT	R	AO1 value
2103	FLOAT	R	AO2 value
65001	WORD	R	Firmware version (1.01 = 101).

BACNET OBJECTS

Name	Type	Instance	Description
VAV	Device	DeviceID	Equipment information.
Alarms	NotifyClass	1	Notification object
Configs	File	0	Configuration file.
UI_1	AnalogInput	1	Universal input 1
UI_2	AnalogInput	2	Universal input 2
UI_3	AnalogInput	3	Universal input 3
UI_4	AnalogInput	4	Universal input 4
Diff Pressure	AnalogInput	5	Differential pressure input
AO_1	AnalogOutput	1	Analog output 1
AO_2	AnalogOutput	2	Analog output 2
Damper	AnalogOutput	2	Damper position
Flow	AnalogValue	1	Air flow
Space temperature	AnalogValue	2	Space Temperature.
Supply air temperature	AnalogValue	3	Air temperature in duct.
Discharge air temperature	AnalogValue	4	DAT
Occupied cool SP	AnalogValue	5	Cool setpoint in occupied mode.
Occupied heat SP	AnalogValue	6	Heat setpoint in occupied mode.
Unoccupied cool SP	AnalogValue	7	Cool setpoint in unoccupied mode.
Unoccupied heat SP	AnalogValue	8	Heat setpoint in unoccupied mode.
Zone demand	AnalogValue	9	Zone demand (%)
Temperature SP deviation	AnalogValue	10	Temperature deviation.
Flow SP deviation	AnalogValue	11	Flow deviation.
Current cool SP	AnalogValue	12	Current cool setpoint.
Current heat SP	AnalogValue	13	Current heat setpoint.
Current DAT SP	AnalogValue	14	Current discharge air temperature setpoint.
Cool PID: PB	AnalogValue	15	Cool PID loop proportional gain.
Cool PID: Ti	AnalogValue	16	Cool PID loop integration time
Cool PID: deadband	AnalogValue	17	Cool PID loop deadband.
Heat PID: PB	AnalogValue	18	Heat PID loop proportional gain.
Heat PID: Ti	AnalogValue	19	Heat PID loop integration time.
Heat PID: Deadband	AnalogValue	20	Heat PID loop deadband.
Flow PID: PB	AnalogValue	21	Flow PID loop proportional gain.
Flow PID: Ti	AnalogValue	22	Flow PID loop integration time.
Flow PID: Deadband	AnalogValue	23	Flow PID loop deadband.
Reheat PID: PB	AnalogValue	24	Reheat PID loop proportional gain.
Reheat PID: Ti	AnalogValue	25	Reheat PID loop integration time.
Reheat PID: Deadband	AnalogValue	26	Reheat PID loop deadband.
Box K-factor	AnalogValue	27	Box K factor (flow at 1 inH2O of pressure).
Flow setpoint	AnalogValue	28	Current calculated flow setpoint.
BI_1	BinaryInput	1	UI_1 as digital input state
BI_2	BinaryInput	2	UI_2 as digital input state
BI_3	BinaryInput	3	UI_3 as digital input state
BI_4	BinaryInput	4	UI_4 as digital input state
BO_1	BinaryOutput	1	BO_1 state
BO_2	BinaryOutput	2	BO_2 state
Changeover mode	BinaryValue	1	Changeover mode (0=cool, 1=heat)
VAV starving	BinaryValue	2	If active, indicates VAV with insufficient air supply.
VAV overfed	BinaryValue	3	If active, indicates VAV with excessive air supply.
Control enabled	BinaryValue	4	Control enabled to operate.
In override	BinaryValue	5	If active, indicates user requested override.
Occupancy	BinaryValue	6	Indicates occupancy calculated by occupancy sensor.
Zone state	MultistateValue	1	Zone state (0=cooling, 1=heating, 2=deadband).
Operating mode	MultistateValue	2	Indicate VAV operating mode (see table 5.1)
Operation schedule	Schedule	1	Occupied mode schedule.

REVISION CONTROL

Revision E – 2023-07-04
- Added UL2043 compliance.
- Added AO2 output.

Revision D – 2022-11-22
- Language corrections.
- Added warning about damper actuator.

Revision C – 2022-09-20
- Updated to firmware 1.02.

Revision B – 2022-02-21
- Updated compliance information to add file number.

Revision A – 2021-11-08
- Initial version

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MA-VAV – SERVICE MANUAL
Revision E - 20230704

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