INSTALLATION AND OPERATING MANUAL

en/GB

Control component

BM0-D8



TROX DOCU PORTAL

Read this manual before starting any work!

1 General information **4**
1.1 About this manual 4
1.2 Explanation of symbols 4
1.3 TROX contact information 5
1.4 Legal information 6
2 Safety **7**
2.1 Correct use 7
2.2 Safety signs 8
2.3 Dangers when handling the unit 8
2.3.1 Electric shock hazards 9
2.4 System owner's responsibility 9
2.5 Personnel qualifications 10
2.6 Personal protective equipment 10
2.7 General safety measures (only for devices with electronic components) 11
2.8 Repair and spare parts 11
3 Transport, storage and packaging **12**
3.1 Delivery check 12
3.2 Transport on site 12
3.3 Storage 12
3.4 Packaging 13
4 Installation **14**
5 Parts and function **15**
5.1 Product overview 15
5.2 Display of the damper blade position 15
5.3 Functional description 16
5.4 Applications 17
5.4.1 Operation with constant volume flow setpoint 17
5.4.2 Operation with variable volume flow setpoint 18
5.4.3 Override control 18
5.4.4 Bus failure monitoring 18
6 Operating modes **20**
6.1 Selection of the operating mode 20
6.2 Digital operation - Modbus RTU 20
6.2.1 Setpoint specification 20
6.2.2 General principles of Modbus RTU 20
6.2.3 Modbus RTU - Setpoint specification / actual value query 21
6.3 Digital operation - BACnet MS/TP 22
6.3.1 General principles of BACnet MS/TP 22
6.3.2 BACnet MS/TP - Setpoint specification / actual value enquiry 22
7 Electrical connection **24**
7.1 Installation instructions 24
7.2 Connections 25
7.3 Wiring for bus operation 25
8 Operation and status of the control component **27**
9 Commissioning and operation **28**
9.1 Safety instructions 28
9.2 Factory default settings 28
9.3 Adjustment label 29
9.4 Service tools 29
9.4.1 Functional overview service tools 29
9.4.2 Adjustment device ZTH-EU 30
9.4.3 PC software 30
9.4.4 Belimo LINK.10 30
9.4.5 TROX O_x system software 30
9.5 Adjusting the settings of the control component 31
9.5.1 Setting fixed value operation (F) 31
9.5.2 Setting variable operation (V) 31
9.5.3 Quick addressing 31
9.6 Performing a functional test 31
9.7 Modbus register list 32
9.8 Configuring the BACnet interface 35
10 Faults **40**
10.1 Troubleshooting 40
10.2 Common faults 40
10.2.1 Incorrect wiring 40
10.2.2 System pressure too low 40
10.2.3 Use outside of control range 41
10.3 Systematic troubleshooting 41
11 Spare parts **42**
11.1 Order of replacement control components 42
12 Decommissioning **43**
12.1 Safety 43
12.2 Disassembly 43
12.3 Disposal 44

13 Technical data **45**
14 Declaration of Conformity **49**
15 Glossary **50**
16 Index **52**
Appendix **53**
Appendix - Table of contents 53
A Systematic troubleshooting 54

1 General information

1.1 About this manual

This installation and operating manual enables safe and efficient handling of the control component type *BM0-D8* and the associated air terminal unit.

This manual must be kept near the unit to be available for use at all times.

The personnel performing work on the device must read and understand this manual carefully before starting any work. The basic prerequisite for safe working is to comply with all safety notes and instructions in this manual.

In addition, the local health and safety regulations and general safety regulations apply to the area of application of the device.

Illustrations in this manual are mainly for information and may differ from the actual design.

Applicable documents

In addition to this manual, the following documents shall be observed:

- Installation and commissioning manual of the air terminal unit
- Product data sheets
- Project-specific wiring documents from the system planner, if applicable

1.2 Explanation of symbols

Safety notes

Symbols are used in this manual to alert readers to areas of potential hazard. Signal words express the degree of the hazard.

Comply with all safety instructions and proceed carefully to avoid accidents, injuries and damage to property.

DANGER

Imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Potentially hazardous situation which, if not avoided, may result in death or serious injury.

CAUTION

Potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTICE

Potentially hazardous situation which, if not avoided, may result in property damage.

ENVIRONMENT

Environmental pollution hazard.

Tips and recommendations

Useful tips and recommendations as well as information for efficient and fault-free operation.

Safety notes in the operating instructions

Safety notes can refer to specific, individual instructions. Such safety instructions are embedded in the instructions so that they do not interrupt the flow of reading when carrying out the task. The above listed signal words will be used.

Example:

1. ▸ Loosen the screw.
2. ▸ **CAUTION**

   Risk of jamming on the lid!

   Close the lid carefully.
3. ▸ Tighten the screw.

Further symbols/markings

The following markings are used to highlight instructions, results, lists, references and other elements in this manual:

Marking	Explanation
1., 2., 3. ...	Step-by-step instructions
⇨	Results of actions
	References to sections in this manual and to other applicable documents
■	Lists without a defined sequence
[Push button]	Control elements (e.g. push buttons, switches) or display elements (e.g. LEDs)
'Display'	Screen elements (e.g. buttons, assignment of function keys)

1.3 TROX contact information

To ensure that your request is processed as quickly as possible, please have the following information available:

- Product name
- TROX order number and line number
- Delivery date
- Issue or fault report

Please refer to your local TROX website for the latest contact information.

1.4 Legal information

Claims for material defects

Claims for material defects are subject to the seller's terms of delivery.

Copyright

This documentation – including all illustrations – is protected by copyright and pertains only to the corresponding product.

Any use without our consent may be an infringement of copyright, and the violator shall be liable for damages.

This applies in particular to:

- Publishing content
- Copying content
- Translating content
- Microfilming
- Saving and processing in electronic systems

2 Safety

2.1 Correct use

The electronic control component of type BM0-D8 can be used in combination with the following TROX air terminal units:

- TVR
- TZ-Silenzio
- TA-Silenzio
- TVZ
- TVA
- TVM
- TVJ
- TVT

The combination of air terminal unit and control component is used for variable and constant volume flow control in ventilation and air conditioning (HVAC) systems.

The control component is designed for indoor use.

Area of application supply air

The usual conditioning in HVAC systems allows use in the supply air without additional dust protection measures.

Area of application extract air

Use in extract air applications is possible when the dust or lint content is low, without additional dust protection measures.

If the air is heavily contaminated with dust, lint, sticky and/or moist particles, an attachment with a static differential pressure transducer must be used.

Area of application kitchen exhaust air

In kitchen exhaust air systems, air terminal unitss with an attachment with a static differential pressure transmitter may only be used if it is ensured that the extract air is cleaned as well as possible by highly effective aerosol separators. Observe the specifications of VDI 2052.

Improper use

WARNING

Danger due to unauthorised use!

Incorrect use of the control component can lead to dangerous situations.

NEVER use the control component/device:

- in areas with potentially explosive atmospheres (EX)
- in aircraft
- outdoors without sufficient protection against the effects of weather
- for areas of application that are not described in the product brochure
- in wet areas

Modifying the device or using spare parts that have not been approved by TROX is not permitted.

2.2 Safety signs

The following symbols and signs are located in the work area. They refer to the immediate surroundings in which they are attached.

WARNING

Danger due to illegible labelling!

Over time, stickers and signs may fade or become otherwise illegible, meaning that hazards cannot be identified, and necessary operating instructions cannot be followed. There is then a risk of injury.

- Keep all safety signs, warning and operating instructions in a legible condition at all times.
- Replace illegible hazard and safety signs or labels immediately.

Electrical voltage



Only qualified electricians may work in the areas labelled in this way.

Unauthorised persons may not enter or open the marked areas, nor work on the marked components.

2.3 Dangers when handling the unit

The device is designed in accordance with the latest state-of-the-art technology and current safety requirements. Residual risks cannot be excluded, however, and you should proceed with caution. The residual risks identified in a risk assessment are listed below.

To reduce health hazards and avoid dangerous situations, observe the safety instructions listed here and the safety instructions in the other chapters of this manual.

2.3.1 Electric shock hazards

Electric current

DANGER

Danger to life due to electric current!

Contact with live parts poses an immediate danger to life due to electric shock. Damage to the insulation or individual components can be life-threatening.

- Work on the electrical system may only be carried out by qualified electricians.
- If the insulation is damaged, disconnect the power supply immediately and have the insulation repaired.
- Before starting any working on electric systems and equipment, switch off the supply voltage and secure it against being switched on accidentally. Comply with the following safety rules:
  - Switch off the supply voltage.
  - Secure it against being switched on accidentally.
  - Ensure that no voltage is present.
  - Connect to earth; and short-circuit.
  - Cover neighbouring live parts.
- Never bypass or disable any fuses. Be sure to maintain the correct current rating when replacing a fuse.
- Ensure that live parts do not come into contact with moisture. Moisture can cause a short circuit.

2.4 System owner's responsibility

System owner

The system owner is a natural or legal person who for commercial or business purposes owns or manages the ventilation system or component or allows third parties to use or operate it, but continues to bear legal responsibility for the safety of users, staff or third parties while the product is in use.

System owner's obligations

The unit is intended for use in commercial environments. The system owner is therefore subject to the legal obligations of occupational safety.

In addition to the safety notes in this manual, the applicable regulations for safety, accident prevention and environmental protection must also be complied with.

This applies in particular:

- The system owner must be aware of the applicable occupational health and safety regulations and carry out a risk assessment to determine any additional hazards that may exist or result from the specific working conditions at the installation location. The system owner has to create operating instructions for the unit that reflect the results of this risk assessment.
- The system owner has to ensure, throughout the entire operating period of the unit, that these operating instructions conform to applicable standards and guidelines. In case of any deviation, the system owner has to adapt the instructions.
- The system owner must secure the unit to prevent access by unauthorised individuals.
- The system owner must clearly define the responsibilities for operation, maintenance, cleaning, and troubleshooting.

- The system owner has to ensure that all individuals who handle the unit have read and understood this manual.
- The system owner must provide the necessary protective equipment to the personnel.
- The system owner must ensure that maintenance is carried out in the intervals specified in this manual.
- The system owner must have all safeguards checked regularly for functionality and completeness.
- The system owner must comply with the local fire regulations.

Hygiene requirements

The system owner has to comply with the local regulations and harmonised standards for hygiene requirements. These include, among other things, compliance with the corresponding maintenance and test intervals.

2.5 Personnel qualifications

WARNING

Danger of injury if insufficiently qualified!

Improper handling may cause considerable personal injury and property damage.

– All activities must only be carried out by qualified personnel.

This manual lists the following qualifications for various areas of activity.

HVAC technician

HVAC technicians are individuals who have sufficient professional or technical training in the field they are working in to enable them to carry out their assigned duties at the level of responsibility allocated to them and in compliance with the relevant guidelines, safety regulations and instructions. HVAC technicians are individuals who have in-depth knowledge and skills related to HVAC systems; they are also responsible for the professional completion of the work under consideration.

HVAC technicians are individuals who have sufficient professional or technical training, knowledge and actual experience to enable them to work on HVAC systems, understand any potential hazards related to the work under consideration, and recognise and avoid any risks involved.

Qualified electrician

Skilled qualified electricians are individuals who have sufficient professional or technical training, knowledge and actual experience to enable them to work on electrical systems, understand any potential hazards related to the work under consideration, and recognise and avoid any risks involved.

2.6 Personal protective equipment

Personal protective equipment must be worn for any work in order to reduce health or safety hazards to the minimum.

The appropriate protective equipment for a job must be worn for as long as the job takes.



Industrial safety helmet

Industrial safety helmets protect the head from falling objects, suspended loads, and the effects of striking the head against stationary objects.



Protective gloves

Protective gloves protect hands from friction, abrasions, punctures, deep cuts, and direct contact with hot surfaces.



Safety shoes

Safety shoes protect the feet against crushing, falling parts, and from slipping on slippery ground.

2.7 General safety measures (only for devices with electronic components)

Large temperature differences

Be careful with large temperature differences. Do not start the device immediately after bringing it from an unheated room into a warm room. Condensation may damage the electronic components beyond repair. The room temperature is only reached after about 2 hours.

Foreign matter and liquids

Be careful when objects or liquids have got into the casing, or if the device emits a smell or smoke. Remove the device from service and have it checked by the manufacturer.

Electrostatic discharges when handling electronic components

When working on electronic components, electrostatic discharges may damage electrical circuits.

- Avoid touching components and conductor tracks on the motherboard or any expansion boards that may be present.
- Work with personal protective equipment for ESD protection (ElectroStaticDischarge). For example, the following items can be used to prevent discharges:
  - Antistatic wrist strap
  - ESD protection work shoes
  - Conductive clothing
  - Grounding mat

2.8 Repair and spare parts

Only qualified personnel may repair the equipment, using only original spare parts. This particularly applies to work on the electrical equipment. Defective equipment may therefore only be repaired by TROX for safety reasons, ➦ *Chapter 1.3 'TROX contact information' on page 5*.

3 Transport, storage and packaging

Safety notes on handling the device

CAUTION

Risk of injury from sharp edges and sheet metal parts!

– Always wear protective gloves during transport and installation.

NOTICE

Risk of damage to the device!

– Handle the device with care.
– Do not lift the device by its control components, the damper blade or the differential pressure sensor.
– Only lift the device by the casing.

3.1 Delivery check

Check delivered items immediately for transport damage and completeness. In case of transport damage or incomplete delivery, inform the forwarding agent and your supplier immediately.

The product is typically delivered mounted on an air terminal unit.

Check the following points on delivery:

- Control component BM0-D8
  - mounted on the air terminal unit and fixed with anti-rotation lock
  - Adjustment sticker on the air terminal unit, ➦ *Chapter 9.3 'Adjustment label' on page 29*

3.2 Transport on site

- If possible, take the product in its transport packaging up to the installation location.
- Do not remove the protective wrapping until just before installation.

3.3 Storage

If the product has to be stored temporarily, observe the following points:

- Moisture and a lack of ventilation can lead to oxidation, even on galvanised components.
  Remove any plastic wrapping in order to avoid oxidation.
- Protect the device from dust and contamination.
- Protect the device (even when packed) from moisture and direct sunlight.
- Do not store the device below -10 °C or above +50 °C.
- The relative humidity must not exceed 95% **(no condensation)**.
- After storage and prior to installation, allow the unit to acclimatise to the installation temperatures for at least 2 hours.

3.4 Packaging

After unpacking, properly dispose of packaging material.

4 Installation

Personnel:

- HVAC technician

Protective equipment:

- Protective gloves
- Safety shoes
- Industrial safety helmet

Only trained and authorised specialist personnel may carry out the described work on the air terminal unit.

Only trained and qualified electricians are allowed to work on the electrical system.

CAUTION

Risk of injury from sharp edges and sheet metal parts!

– Always wear protective gloves during transport and installation.

Pay particular attention to the following points when installing the air terminal unit:

- Upstream section
- Airflow direction
- Fixing/suspension
- Accessibility for maintenance work

▶ Install the air terminal unit with the mounted control component as described.

*You can find specific information on installing the control unit in the **Installation and commissioning manual for the control unit.***

Installation orientation

The control unit can be installed in any position. The air terminal unit may be mounted in such a way that the position of the control component is above, below or to the side of the duct.

The instructions for branching off from a main line, given in the installation and commissioning manual for the air terminal unit, must always be observed.

5 Parts and function

5.1 Product overview

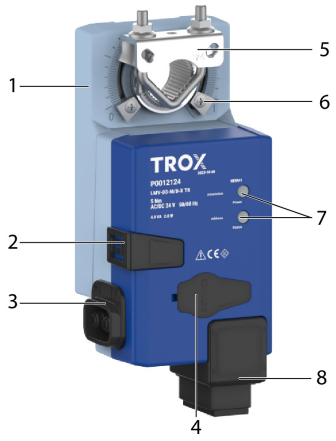


Fig. 1: BM0-D8, type LMV-D3-M/B-X TR, 5 Nm (clamping bracket)

1 VAV Compact
2 Gear release button
3 Hose connections for differential pressure sensor
4 Service socket
5 Shaft clamping device
6 Rotation stop
7 Indicator lights/addressing button, ➦ *Chapter 9.5 'Adjusting the settings of the control component' on page 31*
8 Connection sockets 2× RJ45

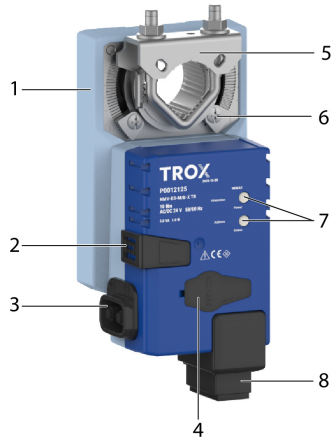


Fig. 2: BM0-D8, type NMV-D3-M/B-X TR, 10 Nm (clamping bracket)

1 VAV Compact
2 Gear release button
3 Hose connections for differential pressure sensor
4 Service socket
5 Shaft clamping device
6 Rotation stop
7 Indicator lights/addressing button, ➦ *Chapter 9.5 'Adjusting the settings of the control component' on page 31*
8 Connection sockets 2× RJ45

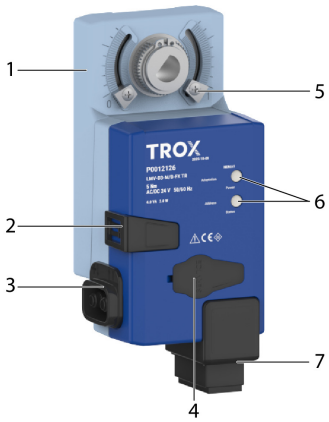


Fig. 3: BM0-D8, type LMV-D3-M/B-FX TR, 5 Nm (positive locking)

1 VAV Compact
2 Gear release button
3 Hose connections for differential pressure sensor
4 Service socket
5 Rotation stop
6 Indicator lights/addressing button, ➦ *Chapter 9.5 'Adjusting the settings of the control component' on page 31*
7 Connection sockets 2× RJ45

5.2 Display of the damper blade position

The damper blade position corresponds to the mark on the shaft and is thus recognisable from the outside.

Positive lock connection

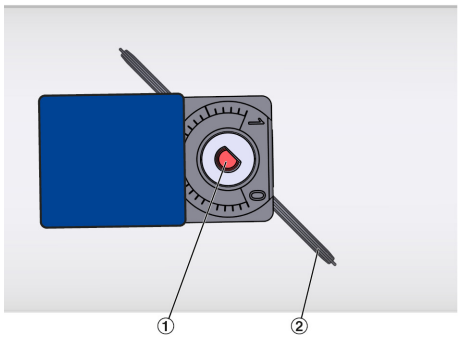


Fig. 4: Display of the positive lock connection

1 Shaft with marking for position indication
2 Damper blade

Clamping device (friction-locked)

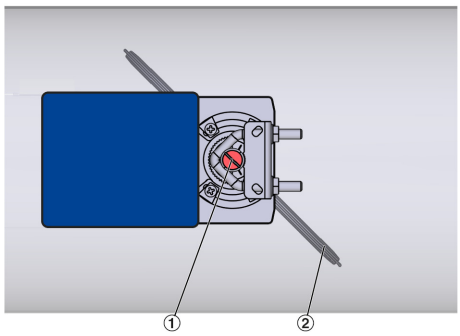


Fig. 5: Display with clamping device

1 Shaft with marking for position indication
2 Damper blade

5.3 Functional description

Basic function

The electronic control component is used for variable and constant volume flow control for the TROX air terminal units types:

- TVR
- TZ-Silenzio
- TA-Silenzio
- TVZ
- TVA
- TVM
- TVJ
- TVT

The control component consists of three functional units:

- dynamic differential pressure transducer
- Control unit
- Actuator

Closed-loop control system

The control component operates in a closed-loop system, i. e. measure – compare – adjust.

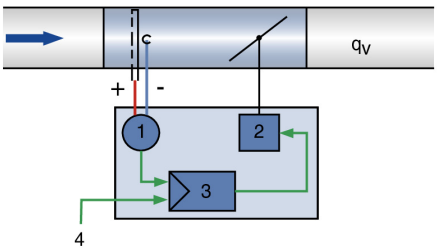


Fig. 6: Principle of operation

1 Differential pressure transducer
2 Actuator
3 Control unit
4 Setpoint signal

The current volume flow is determined by measuring a differential pressure. This is done via a differential pressure sensor. The integrated differential pressure transducer converts the differential pressure into a voltage signal.

During normal operation, the integrated actuator (2) is activated by continuous evaluation of the control deviation (setpoint/actual) in the control unit (3), which adjusts the damper blade of the air terminal unit via the shaft adapter and thus regulates the volume flow to the setpoint.

Setpoint control independent of the duct pressure

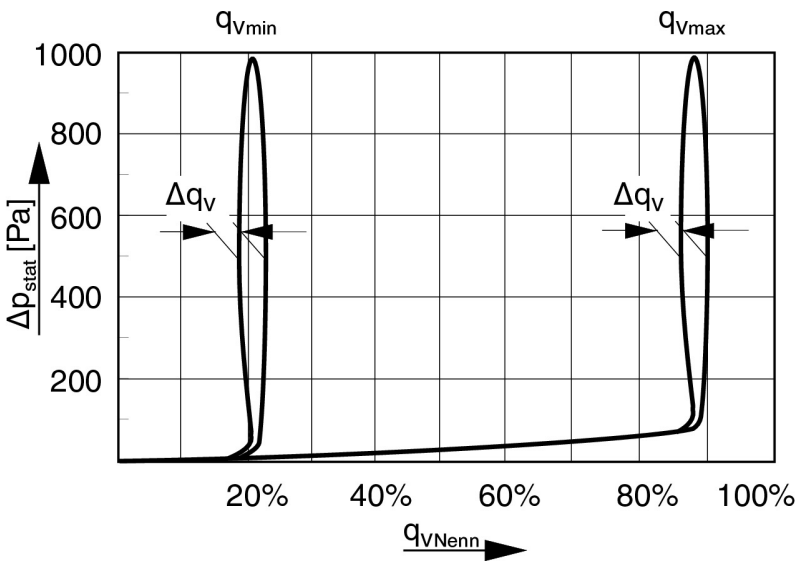


Fig. 7: Control behaviour independent of the duct pressure

If the duct pressure changes, for example due to a change in airflow of other devices, this is detected and corrected by the control component. The control component therefore works independently of the duct pressure, and pressure fluctuations do not result in any permanent changes in volume flow.

To prevent the volume flow control from becoming unstable, the volume flow controller maintains a dead zone (hysteresis) within which the damper blade is not moved. This dead zone and the tolerances of the measurement lead to a volume flow deviation Δq_v, in accordance with the product data sheets of the control units. If the conditions specified in the product data sheets (e.g., minimum differential pressure, upstream conditions) are not met, the volume flow controller will no longer function correctly or more significant system deviations can be expected.

5.4 Applications

5.4.1 Operation with constant volume flow setpoint

Operation with a fixed setpoint

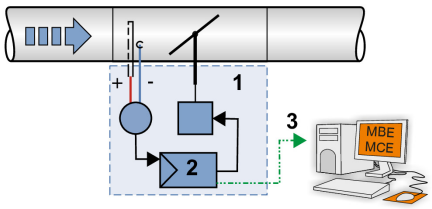


Fig. 8: Constant control

1 Compact control component
2 Control unit with factory-set volume flow setpoint (q_{vmin})

In the simplest case, the control component is operated with a constant volume flow setpoint. The constant setpoint (q_{vconst} = q_{vmin}) is already factory-set. To adjust the factory-set constant values, see: ➦ *Chapter 9.5 'Adjusting the settings of the control component' on page 999*.

In bus operation, the value ($q_{vconst=}$= q_{vmin}) must be specified via the bus.

5.4.2 Operation with variable volume flow setpoint

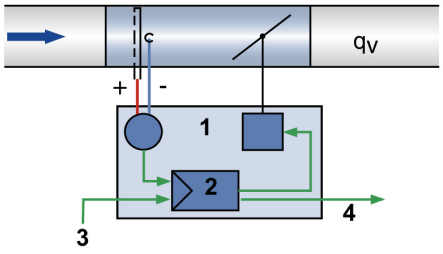


Fig. 9: Variable volume flow control

1 Control component
2 Control unit with factory-set volume flow operating range (q_{vmin} - q_{vmax})
3 Digital control signal via bus as setpoint specification
4 Actual volume flow rate digital via bus

For the use of variable volume flow setpoints, an electrical control signal must be provided by a higher-level controller (e. g. TROX O_x System Controller, room temperature controller, air quality controller, management and control equipment, etc.). After a change in the reference value, the airflow is adjusted to a new setpoint. The variable volume flow range is limited to one minimum value and one maximum value. The factory-set constant values can be adjusted as described: ➦ *Chapter 9.5 'Adjusting the settings of the control component' on page 31*

5.4.3 Override control

The variable control can be disabled by override control functions. For example, a window switch can stop the ventilation of the room when the window is open by closing the damper blade.

Further application examples:

- Switching to intensive ventilation (boost / q_{vmax})
- Opening the damper blade

Further information can be found here:

- Override control for Modbus operation: ➦ *Chapter 9.7 'Modbus register list' on page 32*
- Override control for BACnet operation: ➦ *Chapter 9.8 'Configuring the BACnet interface' on page 35*

5.4.4 Bus failure monitoring

In bus mode, a predefined operating state can be activated if bus communication fails.

Modbus

In the factory default Modbus configuration, bus failure monitoring is disabled!

To enable this function, a trigger time for bus failure monitoring with a value > 0 must be entered in register 109.

- The operating status that is activated in the event of a bus failure is defined in Modbus register 108 (bus failure monitoring).
- The bus failure time after which the predefined operating state is activated is defined in Modbus register 109 (time until bus failure monitoring is triggered).
- The bus failure monitoring counter counts the seconds in which there is no bus communication. This counter is reset by a setpoint change in Modbus register 0 or by a priority command in register 1. (This also applies after a detected bus failure)
- Register 104 (Service Information) shows whether bus failure monitoring has been triggered.

Factory default Modbus configuration:

Reg. 108 = 0 (0 = last setpoint)
Reg. 109 = 0 s (bus failure monitoring deactivated)

Modbus register list: ➦ *Chapter 9.7 'Modbus register list' on page 32*

BACnet

Bus failure monitoring is disabled in the factory default configuration!

To enable this function, a trigger time for bus failure monitoring with a value > 0 must be entered in object AV[130].

- The operating state that is activated in the event of bus failure is defined in the BACnet object AO[1] (SpRel) via the "Relinquish_default" function.
- The BACnet object AV[130] (bus watchdog) is used to define the bus failure time after which the predefined operating state is activated.
- The bus failure monitoring counter counts the seconds in which there is no bus communication. This counter is reset by a setpoint change in BACnet object AO[1] (SpRel) or by a override command in BACnet object MO[1] (Overrride).
- The BACnet object MI[110] (StatusDevice) indicates whether bus failure monitoring has been triggered.

Factory default for BACnet MS/TP configuration:

AO[1], Relinquish_default = 0 (0 = set q_{vmin} in AV[97])
AV[130] = 0 s (bus failure monitoring deactivated)

BACnet object list: ➦ *Chapter 9.8 'Configuring the BACnet interface' on page 35*

6 Operating modes

6.1 Selection of the operating mode

The control component is supplied from the factory with the Modbus RTU operating mode. The operating mode can be changed to BACnet MS/TP at any time using a service tool (➦ *Chapter 9.4 'Service tools' on page 29*).

6.2 Digital operation - Modbus RTU

6.2.1 Setpoint specification

In Modbus RTU operating mode (factory default), the setpoint is specified by defining the volume flow setpoint [%] in Modbus register 0, or by the settings of the TROX O_x system.

6.2.2 General principles of Modbus RTU

The Modbus RTU is a client-server bus system. The Modbus RTU enables simple wiring of up to 32 control components (servers) which can be controlled centrally via a Modbus client (e.g. a control cabinet) and can be parameterised, written to and read out. This makes it easy to check the function of up to 32 volume flow controllers.

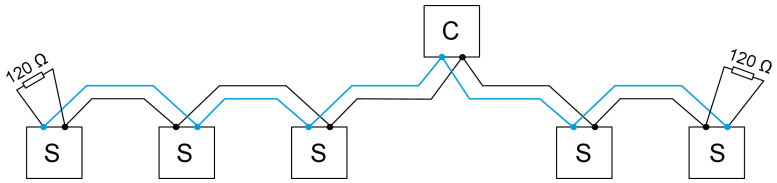


Fig. 10: Example: Modbus segment with one client and 5 servers

C Client
S Server

Modbus allows a line structure (daisy chain) as a bus structure. Due to on-site circumstances, signal reflections can occur at the end of a Modbus line. To filter this, a 120 Ω terminating resistor is required at the end of the bus line. Communication between bus participants is based on a serial two-wire line (twisted pair) in accordance with the EIA/TIA-RS485 standard with client-server configuration. All Modbus participants must be given a unique Modbus address (1 - 32) for system affiliation.

Specifications for Modbus installations

The Modbus wiring must be set up in accordance with the specification "Modbus over Serial Line Specification and Implementation Guide" of the Modbus organisation (published on the website ➦ *www.modbus.org)*.

- Modbus wiring must always be implemented in a linear topology. Stub lines should be avoided or, if necessary, kept as short as possible.
- According to the specification, e.g. in a fully expanded network. only a maximum length of approx. 1 m is permitted for the stub lines,
- The cable length of the entire network is limited and depends on the baud rate, the cable cross-section and the number of bus participants.
- Shielded cables must be used.
- The Modbus wiring must always be earthed. Earthing only takes place at the client via the shielding of the cable.

Stub lines

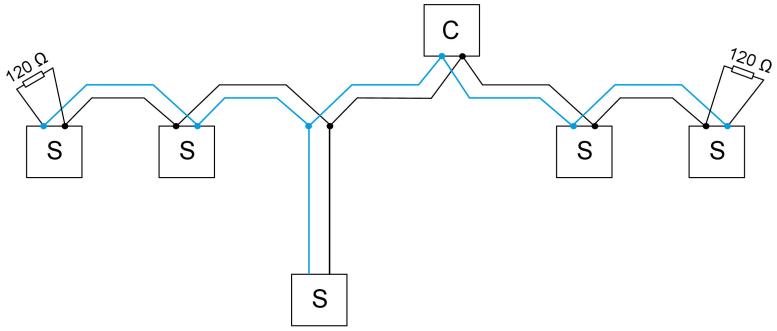


Fig. 11: Example: Modbus segment with one stub line

C Client
S Server

The Modbus organisation specifications listed above apply in particular to stub lines, as the installation should generally be in a linear topology.

When using daisy-chain wiring for BM0-D8, the special instructions given in ➦ 'Wiring in the TROX O_x system' on page 26 must be observed.

6.2.3 Modbus RTU - Setpoint specification / actual value query

In Modbus mode, the setpoint is transmitted digitally to the control component via the Modbus. To ensure smooth data exchange in the on-site Modbus RTU network, the communication parameters and the participant address for the Modbus interface must be set. The control component can be addressed either using quick addressing (➦ *Chapter 9.5.3 'Quick addressing' on page 31*) or using one of the following service tools (➦ *Chapter 9.4 'Service tools' on page 29*):

- Belimo PC-Tool
- ZTH-EU
- Belimo Assistant 2
- TROX O_x System Controller

Various standardised Modbus registers are available for setpoint specification, actual value feedback or status messages. For example, the volume flow setpoint is defined via the Modbus address by writing the new setpoint to Modbus register 0. The volume flow actual value is queried for each control component with the Modbus address by reading out Modbus register 6. Further Modbus registers are explained in the following section:
➦ *Chapter 9.7 'Modbus register list' on page 32*

Observe the installation instructions!

➦ *Chapter 7 'Electrical connection' on page 24*

6.3 Digital operation - BACnet MS/TP

6.3.1 General principles of BACnet MS/TP

BACnet MS/TP (Building Automation and Control networks) is a bus system that is used in building technology. It offers a high level of interoperability between different devices and manufacturers. The high level of interoperability due to standardised, detailed rules and structures for communication exchange represents the key added value compared to other communication systems. Accordingly, there is a very complex certification process for the BACnet protocol.

BACnet MS/TP is based on a serial transmission of RS485 and stands for Multidrop Serial Bus/Token Passing. MS/TP controls access to the bus using a token-passing procedure. This means that there can be several managers in one network who take turns accessing the bus. After communication is complete, a token is passed on to the next manager. Managers can communicate if they have the token. Subordinates only respond to requests from managers, but have no independent communication rights.

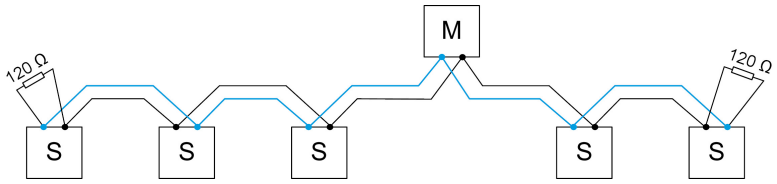


Fig. 12: Example: BACnet segment with one manager and 5 subordinates

M Manager
S Subordinate

BACnet MS/TP allows a line topology (daisy-chain) as the bus structure. Due to on-site circumstances, signal reflections can occur at the end of a BACnet MS/TP line. To filter this, a 120 Ω terminating resistor is required at the end of the bus line. Up to 127 participants can be operated in one BACnet MS/TP network.

When using daisy-chain wiring for BM0-D8, the special instructions given in ➦ 'Wiring in the TROX O_x system' on page 26 must be observed.

6.3.2 BACnet MS/TP - Setpoint specification / actual value enquiry

In BACnet mode, the setpoint is digitally transmitted to the control component via BACnet. To ensure smooth data exchange in the on-site BACnet MS/TP network, the communication parameters and the participant address for the BACnet interface must be set.

The control component can be addressed either using quick addressing (➦ *Chapter 9.5.3 'Quick addressing' on page 31*) or using one of the following service tools (➦ *Chapter 9.4 'Service tools' on page 29*):

- Belimo PC-Tool
- ZTH-EU
- Belimo Assistant 2

Various standardised BACnet objects are available for setpoint specification, actual value feedback or status messages. This means, for example, that the volume flow setpoint is specified by providing the BACnet address and transmitting the new setpoint via the BACnet object AO[1]. The actual

volume flow value is queried for each control component by specifying the BACnet address and reading the BACnet object RelFlow AI[10] (relative) or object AbsFlow_UnitSel AI[19] (absolute).

Further BACnet objects are explained here: ➦ *Chapter 9.8 'Configuring the BACnet interface' on page 35*.

Observe the installation instructions!

➦ *Chapter 7 'Electrical connection' on page 24*

7 Electrical connection

7.1 Installation instructions

Safety information

DANGER

Danger of electric shock! Do not touch any live components. Electrical equipment carries a dangerous electrical voltage.

- Only skilled qualified electricians are allowed to work on the electrical system.
- Before working on the electrical system, switch off the supply voltage and secure it against being switched on again.

The air terminal unit was manufactured and configured on a project-specific basis. The control components are mounted and adjusted at the factory. For installation, the supply voltage and, if necessary, signal lines, must be connected for electrical control components.

The connection is established based on the information specified on the control components or connection diagrams in this manual. The voltage ranges specified on the control components and the terminal assignments must be observed!

Personnel:

- Qualified electrician

Observe the following during installation:

- Legal and official regulations, in particular VDE guidelines.
- Observe the Technical Connection Conditions of the local grid operator.
- Wiring work for supply voltage and signal lines provided by the customer.
- Sizing and establishing customer-side connections and wiring must be carried out in accordance with the recognised rules of electrical engineering.
- Observe the wiring guidelines and the customer's project-specific connection diagrams of the control component.
- The electrical connection to the volume flow controller may only be made if the installation has been carried out correctly.
- The 24 V supply voltage may only be supplied with a safety power supply unit.
- If several control components are connected to a 24 V network, it must be ensured that a common neutral/ground line is defined and not interchanged.
- The control component contains no parts that can be replaced or repaired by the user and may only be opened by the manufacturer.
- Lay power supply lines in such a way that mechanical or thermal damage is excluded.

Electrical safety

The control component complies with all relevant standards and guidelines, see declaration of conformity.

Connection sockets

In accordance with electrotechnical regulations, touch protection is only required for live parts.

As control components of type BM0-D8 are operated with safety extra-low voltage (SELV), the connection sockets are not considered live parts.

7.2 Connections

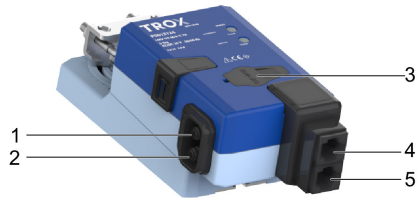


Fig. 13: BM0-D8 Connections

1 Hose connection Differential pressure sensor (input)
2 Hose connection Differential pressure sensor (output)
3 Serial connection for service tool
4 RJ45 socket (input)
5 RJ45 socket (output)

Assignment of the RJ45 plugs



Fig. 14: Assignment of RJ45 plugs according to T568B

TROX recommends the use of the T568B standard for uniform assignment of the RJ45 plugs. This standard is used throughout the TROX O_x system.

The arrangement of the conductors according to T568B is shown in the following diagram:

1 Supply voltage 24 V
2 Ground, neutral
3 Modbus RTU, BACnet MS/TP (D+)
4 Supply voltage 24 V
5 Supply voltage 24 V
6 Modbus RTU, BACnet MS/TP (D-)
7 Ground, neutral
8 Ground, neutral

The pin assignment is matched to the TROX O_x system. It is possible to use the control components outside the TROX O_x system. The technical data and the routing of the power supply via several pins must be observed in order to ensure the transmission of the connected load and data.

As the power is supplied via daisy-chain wiring, the total power consumption of all connected devices must not exceed 24 VA.

7.3 Wiring for bus operation

The notes on the basic principles of wiring Modbus installations in ➦ Chapter 6.2.2 'General principles of Modbus RTU' on page 20 or to BACnet installations in ➦ Chapter 6.3.1 'General principles of BACnet MS/TP' on page 22must be observed.

Setpoint and actual values as well as override controls are transmitted for all control components via digital communication in the common bus network.

- The volume flow setpoint for each control component is defined by specifying the Modbus address and transferring the new setpoint to Modbus register 0, or by specifying the BACnet address via BACnet object AO[1].
- The actual volume flow rate is queried for each control component by specifying the Modbus address and reading Modbus register 6, or by specifying the BACnet address via BACnet object AI[10].

Wiring in the TROX O_x system



Fig. 15: BM0-D8_Daisy-Chain

Up to four control components can be operated in daisy-chain wiring on one RJ45 connection of a field module (e.g. FAM-E). Although the Modbus would allow more devices, there is a risk that the supply voltage will not be sufficient for more devices.

When planning the bus topology with daisy-chain wiring, the following points must always be observed:

- the loop-through is limited to a maximum of 4 control components type BM0-D8
- the distance between the control components must be at least 3 m
- the total cable length must not exceed 40 m

8 Operation and status of the control component

Display and control elements

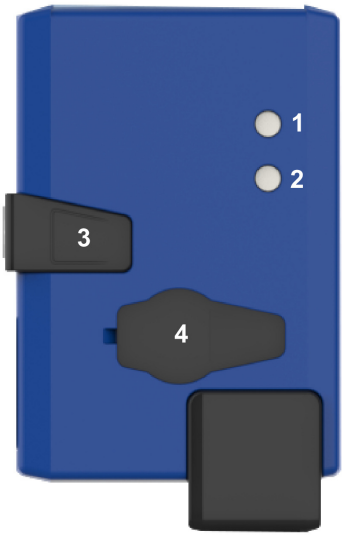


Fig. 16: BM0-D8_Control elements

1 *[Adaptation]* push-button and green LED indicator	
OFF:	No power supply or malfunction
ON:	In operation
Press button:	In normal operation: triggers angular position adaptation In addressing mode: confirms the set address (1...16)
Blinking:	In addressing mode: pulses corresponding to the set address (1...16) On start-up: resets to factory settings (communication)

2 *[Address]* push-button and yellow LED indicator	
OFF:	Normal operation
ON:	Adaptation or synchronisation process active, or drive in addressing mode (LED flashing)
Flickering:	Bus communication active
Press button:	In operation (>3 s): switches addressing mode on and off In addressing mode: sets the address by pressing several times On start-up (>5 s): resets to factory settings (communication)

3 Manual adjustment button	
Press button:	Gearbox disengages, motor stops, manual adjustment possible
Release button:	Gearbox engages, synchronisation starts, normal operation

4 Service socket - for connecting configuration and service tools

9 Commissioning and operation

9.1 Safety instructions

DANGER

Danger of electric shock! Do not touch any live components. Electrical equipment carries a dangerous electrical voltage.

- Only skilled qualified electricians are allowed to work on the electrical system.
- Before working on the electrical system, switch off the supply voltage and secure it against being switched on again.

9.2 Factory default settings

The volume flow controller is adjusted at the factory and set to the operating mode and operating parameters specified in the order code. As the volume flows are factory-set, the air terminal units must be installed only at the designated locations.

The factory-set operating parameters can be found on the adjustment sticker on the terminal unit. (➥ *Chapter 9.3 'Adjustment label' on page 29*)

Modbus (M)

Factory-set operating parameters:

q_{vmin} [m³/h]; [l/s] - lower limit of the operating range for the air terminal unit

q_{vmax} [m³/h]; [l/s] - upper limit of the operating range for the air terminal unit

During commissioning, adjust the Modbus settings as required (➥ *Chapter 9.7 'Modbus register list' on page 32*). Simplified commissioning can be carried out via quick addressing (➥ *Chapter 9.5.3 'Quick addressing' on page 31*).

BACnet (B)

Factory-set operating parameters:

q_{vmin} [m³/h]; [l/s] - lower limit of the operating range for the air terminal unit

q_{vmax} [m³/h]; [l/s] - upper limit of the operating range for the air terminal unit

During commissioning, adjust the BACnet settings as required (➥ *Chapter 9.8 'Configuring the BACnet interface' on page 35*). Simplified commissioning can be carried out via quick addressing (➥ *Chapter 9.5.3 'Quick addressing' on page 31*).

9.3 Adjustment label

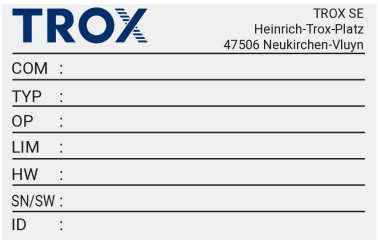


Fig. 17: Example of an adjustment sticker

Line	Explanation	Entered values (example)
COM	Order number. Position number	"000000000.0001"
TYPE	Type name of air terminal unit	TVR
	Nominal size	"100"
	Control component	"BM0-D8"
	Operating mode abbreviation	■ "M" ⇨Modbus ■ "B" ⇨BACnet
OP	Operating mode	■ Modbus ■ BACnet
	Volume flow range	"100 – 300 m³/h"
	Direction of rotation	"ccw"
LIM	Nominal volume flow q_{vNom}	"354 m³/h"
	Conductance	"242Pa@354m³/h"
	C value	"22.0"
HW	Hardware type designation	"LMV-D3-M/B-X"
	Delivery condition	■ "OF" ⇨ factory-fitted ■ "SP" ⇨ spare part
SN	Serial number	"V1.4.6 #02542-00080-158-153"
ID	Test ID	"DE.4.01.2025106.0005"

9.4 Service tools

9.4.1 Functional overview service tools

Tab. 1: Functional overview service tools

Functions / parameter settings	PC software	ZTH-EU[1]	O_x System
Setting $q_{vmin,vmax}$	R, W	R, W	R, W
Modbus, BACnet settings (address, communication parameters)	–	R, W	–
Setpoint specification via bus (Modbus, BACnet)	–	R, W	R, W
Triggering override controls (OPEN, CLOSE, q_{vmin}, q_{vmax})	R, W	–	R, W

Notes:

R,W = Function readable and writable
– = Function not available for the service tool
[1] Minimum version for ZTH-EU firmware: V 2.09.0004

9.4.2 Adjustment device ZTH-EU

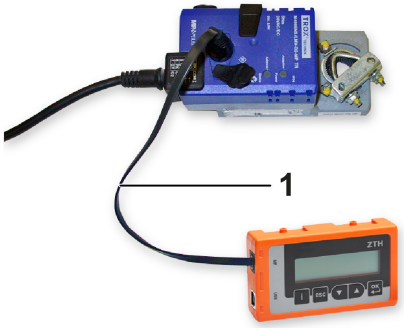


Fig. 18: ZTH-EU is connected to the control component using the cable supplied.

1 Connecting cable ZK1-GEN

The ZTH-EU adjustment device can be ordered with TROX order code **AT - VAV - B**.

Included in the scope of delivery:

- Adjustment device ZTH-EU
- Connection cable with circular connector ZK1-GEN
- Connection cable with free wire ends ZK2-GEN
- USB connection cable

To ensure proper function, the cables included in the scope of delivery must be used.

9.4.3 PC software

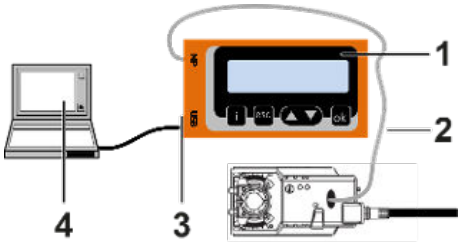


Fig. 19: ZTH-EU as interface converter

1 Adjustment device ZTH-EU
2 Connecting cable ZK1-GEN
3 Connecting cable USB
4 PC / Notebook with PC-Tool

The ZTH-EU can be used as an interface converter for using the Belimo PC tool.

Belimo no longer updates the PC tool, and it does not support new products or Windows versions later than Windows 10. All key functions of the tool are integrated into the Belimo Assistant 2 app.

9.4.4 Belimo LINK.10

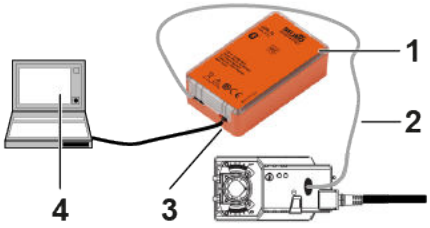


Fig. 20: LINK.10 as an interface converter

The Belimo LINK.10 can be used as an interface converter for using the Belimo Assistant 2 management tool on a PC or notebook.

9.4.5 TROX O_x system software

If the device is operated within a TROX O_x system, the settings are usually made via the TROX O_x system software or via the connected MCE.

Please also refer to the documentation for the other TROX O_x system components in your system.

9.5 Adjusting the settings of the control component

Settings can be made using the aforementioned service tools (➦ *Chapter 9.4 'Service tools' on page 29*).

9.5.1 Setting fixed value operation (F)

If the factory-set value q_{vconst} is to be changed, or an ordered variable volume flow controller is to be converted into a constant volume flow controller, this can be adjusted via the service tools described.

Here, the fixed value is set to q_{vmin}, since $q_{vmin=}$= q_{vconst} for constant control. The q_{vmax} value has no relevance in this case and no further setting is required.

9.5.2 Setting variable operation (V)

The factory-set values for q_{vmin} and q_{vmax} can be adjusted using the service tools described.

The following points must be observed for control operation:

- The q_{vmin} and q_{vmax} settings define the controllable operating range of the control component.
- In order to achieve a higher resolution in the assignment of voltage signals to the volume flow setpoints, the operating range can be limited using q_{vmin} and q_{vmax}.

9.5.3 Quick addressing

To simplify commissioning in a bus network, quick addressing can be carried out using the LED buttons (➦ *'Display and control elements' on page 27*).

1. Press and hold the *[Address]* button until the green *[Power]* LED indicator turns off. The green *[Power]* LED indicator flashes according to the address already set.
2. Set the address by pressing the *[Address]* button the corresponding number of times (1...16).
3. Green LED display flashes according to the address entered (1...16). If the address is not correct, it can be reset as described in step 2.
4. Confirm the address setting by pressing the green *[Adaptation]* button.

   If no confirmation is received within 60 seconds, the addressing process is cancelled. A change of address that has already been started is cancelled.

   ➡ The resulting BACnet MS/TP and Modbus RTU address is the sum of the set base address and the short address (e.g. 100+7=107).

9.6 Performing a functional test

Initial commissioning

1. Check that the wiring is correct (➦ *Chapter 7 'Electrical connection' on page 24*).

2. ▶ Switch on the supply voltage.

   ➡ After switching on the supply voltage, the LED button lights up green to indicate correct wiring.

   The yellow status LED provides feedback on the status of the actuator (➦ *'Display and control elements' on page 27*).

Personnel:

- Qualified electrician
- HVAC technician

For commissioning, we recommend creating commissioning documentation in which the function of the volume flow controller is checked and documented.

The functional test of the volume flow controller can be carried out in various ways.

To check the function of the volume flow controller, check the position of the damper blade on the damper blade shaft (marking), ➦ *Chapter 5.2 'Display of the damper blade position' on page 15*.

Preparation:

- Switch on the supply voltage; the green LED indicates that the supply voltage is properly connected.
- Switch on the HVAC system.

  Note: The system pressure at the volume flow controller must be sufficient for a proper functional test.

1. ▶ Initiate a synchronisation run

   Press and release the manual adjustment button to trigger a synchronisation run (➦ *'Display and control elements' on page 27*).

2. ▶ Activate override control

   Trigger override control (e.g. OPEN, CLOSE, q_{vmin}, q_{vmax}) using a service tool (➦ *Chapter 9.4 'Service tools' on page 29*). Check various override control commands.

9.7 Modbus register list

The Modbus parameters can be set via a service tool ➦ *Chapter 9.4 'Service tools' on page 29* or via external Modbus software.
When used in the TROX O_x system, the setting is made using a TROX O_x field module or the System Controller.
The following table lists and explains the Modbus registers.

Register address	Description	Range overview	Unit	Scaling	Access
0	Setpoint Setpoint between q_{vmin} and q_{vmax}	0 – 10000 Factory setting: 0	%	0.01	[R / W]

Register address	Description	Range overview	Unit	Scaling	Access
1	Override control overwrites the setpoint with an override control	0: none 1: OPEN 2: CLOSED 3: q_{vmin} 4: q_{vmid} 5: q_{vmax} Factory setting: none (0)	-	-	[R / W]
2	Command triggering – Activation of functions for service and testing purposes.The Reset function resets the controller and clears the internal fault memory, such as e. g. register 104.	0: none 1: adaptation 2: Test 3: synchronisation 4: reset Factory setting: none (0)	-	-	[R / W]
3	Type of actuator	0: Actuator not connected/not known 1: Actuator Air/Water with/without safety function 2: Volume flow controller VAV/EPIV 3: Fire damper 4: Energy Valve 5: 6-way EPIV	-	-	[R]
4	current damper blade position [%]	0 – 10000	%	0.01	[R]
5	Blade angle (°)	0 – max.	°	1	[R]
6	relative volume flow in relation to q_{vnom}	0 – 10000	%	0.01	[R]
7	absolute volume flow in relation to q_{vnom}	0 – q_{vnom}	m^3/h	1	[R]
8	Sensor value in mV	0 – 65353	mV	1	[R]
9	-	-	-	-	[–]
10	absolute volume flow in selected volume flow unit acc. to register 117 (Lowword)	-	UnitSel	0.0001	[R]
11	absolute volume flow in selected volume flow unit acc. to register 117 (Highword)	-	UnitSel	0.0001	[R]
12	analogue setpoint (%). Shows the setpoint in % during analogue control.	0 – 10000	%	0.01	[R]
99	Bus terminal resistor. Indicates whether the terminal resistor (120 Ω) is active or inactive.	0: inactive 1: active Factory setting: inactive (0)	-	-	[R / W*]
100	Serial number, part 1	-	-	-	[R]
101	Serial number, part 2	-	-	-	[R]
102	Serial number, part 4	-	-	-	[R]
103	Firmware Version. Example: 302, version 3.02	-	-	-	[R]

Register address	Description	Range overview	Unit	Scaling	Access
104	Malfunctions and service information	■ Bit0: not used ■ Bit1: Mechanical travel exceeded ■ Bit2: Actuator cannot be moved (e.g. mechanical overload) ■ Bit8: Internal activity (e.g. test run, adaptation) ■ Bit9: Gear release active ■ Bit10: Bus monitoring triggered	-	-	[R]
105	Setting of operating range q_{vmin} Conditions qvmin < q_{vmax} Vmax in the range 0 – 100 % q_{vnom}	0 – q_{vmax} Standard: 0	%	0.001	[R / W*]
106	Setting operating range q_{vmax} Conditions qvmax < q_{vmin} Vmax in the range 20 – 100 % q_{vnom}	q_{vmin} – 10000 Standard: 10000	%	0.01	[R / W*]
107	Sensor type	0: none 1: active sensor (in hybrid mode) 2: - 3: - 4: switch contact Factory setting: none (0)	-	-	[R / W*]
108	Bus failure monitoring	0: last setpoint 1: fast closing – CLOSED 2: quick opening – OPEN 3: Centre position Factory setting: last setpoint (0)	-	-	[R / W*]
109	Time until bus failure monitoring is triggered	0 – 3600 s Factory setting: 0 (bus failure monitoring deactivated)	s	1	[R / W*]
110	Nominal volume flow [m³/h]	-	m³/h	1	[R]
111	-	-	-	-	[–]
112	Nominal volume flow in selected volume flow unit acc. to Reg 117 (LowWord)	-	UnitSel	0.001	[R]
113	Nominal volume flow in selected volume flow unit acc. to Reg 117 (HighWord)	-	UnitSel	0.001	[R]
114	-	-	-	-	[–]
115	-	-	-	-	[–]
116	Control mode	0: Position control (open loop) 1: Volume flow control	-	-	[R / W*]

Register address	Description	Range overview	Unit	Scaling	Access
117	Unit selection	0: m³/s 1: m³/h 2: l/s 3: l/min 4: l/h 5: gpm 6: cfm Standard m³/h (1)	-	-	[R / W*]
118	Setpoint specification	0: Analogue (0 – 10 V, 2 – 10 V) 1: Bus (Modbus, BACnet, MP-Bus) Factory setting: Bus (1)	-	-	[R / W*]
Explanations access: **R = register readable** **R,W = readable and writable register** **R/W* = read register with restricted write access**					

All writable registers from address 100 onwards are persistent (stored in EEPROM) and must not be written to regularly or cyclically.

9.8 Configuring the BACnet interface

Tab. 2: Protocol Implementation Conformance Statement – PICS (General information)

Date	2023-12-01
Vendor Name	TROX SE
Vendor ID	329
Product Name	VAV Compact
Product Model Number	..MV-D3-M/B-X, ..MV-D3-M/B-FX
Applications Software Version	Modbus module V1.0
Firmware Revision	BTL:0002 B:0001
BACnet Protocol Revision	12
Product Description	Volumetric flow compact control device
BACnet Standard Device Profile	BACnet Application Specific Controller (B-ASC)
BACnet Interoperability Building Blocks supported	Data Sharing – ReadProperty-B (DS-RP-B) Data Sharing – ReadPropertyMultiple-B (DS-RPM-B) Data Sharing – WriteProperty-B (DS-WP-B) Data Sharing – WritePropertyMultiple-B (DS-WPM-B) Data Sharing – COV-B (DS-COV-B) Device Management – DynamicDeviceBinding-B (DM-DDB-B) Device Management – DynamicObjectBinding-B (DM-DOB-B) Device Management – DeviceCommunicationControl-B (DM-DCC-B)

Segmentation Capability	No
Data Link Layer Options	MS/TP Manager Node
Device Address Binding	No static device binding supported
Networking Options	None
Character Sets Supported	ISO 10646 (UTF-8)
Gateway Options	None
Network Security Options	Non-secure device
Conformance	Listed by BTL

Object type	Optional properties	Writeable properties
Analogue Input [AI]	Description COV Increment	COV Increment
Analogue Output [AO]	Description COV Increment	Present Value COV Increment Relinquish Default
Analogue Value [AV]	Description COV Increment	Present Value COV Increment
Binary Input [BI]	Description Active Text Inactive Text	
Device	Description Location Active COV Subscrip-tions Max Master Max Info Frames Profile Name	Object Identifier Object Name Location Description APDU Timeout (1000 – 60000) Number Of APDU Retries (0 – 10) Max Master (1 – 127) Max Info Frames (1 – 255)
Multi-state Input [MI]	Description State Text	
Multi-state Output [MO]	Description State Text	Present Value Relinquish Default
Multi-state Value [MV]	Description State Text	Present Value (if marked)

Notes:

The device does not support the services CreateObject and DeleteObject.
Maximum length of writeable strings is based on single-byte characters

- Object name: 32 char
- Location: 64 char
- Description: 64 char

Service processing

- The device supports the DeviceCommunicationControl service functions.
- A password is not required.
- A maximum of 6 active COV subscriptions with a lifetime of 1 - 28,800 seconds (8 hours) are supported

Supported standard object types

Object details

Object name	Object type	Description	Values	COV increment	Access
Device	Device [Inst.Nr]	BACnet Internetwork-wide unique number for device identification.	0 – 4194302	-	W
RelPos	AI[1]	Damper blade position in % Overridden = 1 (gear disengagement pressed)	0 – 100	0.01 – 100	R
AbsPos	AI[2]	Absolute position in ° Overridden = 1 (gear disengagement pressed)	0 - max. rotation angle	0.01 – 65353	R
SpAnalogue	AI[6]	analogue setpoint in % shows the analogue setpoint in %, if setpoint specification is Analogue (1) in (SpSource[122]). If setpoint specification (SpSource[122]) Bus (2) = then Out_Of_Service is set to TRUE	0 – 100	0.01 – 100	R
RelFlow	AI[10]	relative volume flow in %	0 – 100	0.01 – 100	R
AbsFlow_UnitSel	AI[19]	absolute volume flow rate of selected unit acc. to MV[121]	0 – V_{nom}	0.01 – 1000	R
Sens1Analogue	AI[20]	Sensor 1 is an analogue value in mV Analogue value in mV, if Sensor1Type MV[220] is active. If (sensor1type MV[220]) = 2 (not active) or (SpSource MV [122]) = 1 (analogue), then Out_of_Service = TRUE	-	0.01 – 1000	R
SpRel	AO[1]	relative setpoint in % Setpoint between q_{vmin} AV [97] and q_{vmax} [98] (only with bus control) If SpSource (MV[122]) = 1 (Analogue), then Out_of_Service = TRUE	0 – 100	0.01 – 100	C
Min.	AV[97]	minimum setpoint in % (q_{vmin}) Condition: $q_{vmin} < q_{vmax}$ q_{vmin} in the range 0 – 100 & q_{vnom}	0 – V_{max}	0.01 – 100	W
Max.	AV[98]	maximum setpoint in % (q_{vmax}) Condition: $q_{vmax} > q_{vmin}$ q_{vmax} in the range 20 – 100 % of q_{vnom}	V_{min} – 100	0.01 – 100	W
Vnom_UnitSel	AV[104]	current volume flow as per selected volume flow unit (UnitSelFlow MV[121])	-	0.01 – 100	R
Bus Watchdog	AV[130]	Time until bus failure monitoring is triggered (s) If Present_Value ≠ 0, then write access to Present_Value is monitored by AO[1] and MO[1]. Writing to Present_Value AO[1] MO[1] resets the timer. In hybrid mode, only write accesses to MO[1] are monitored.	0 – 3600 s	0.01 – 1000	W
Sens1Switch	BI[20]	Status of the switch at the sensor input. If SenType MV [122] = 5 (switch). If SensType MV [122] ≠ 5 , Out_of_Service = TRUE	Inactive_Text: Switch not active	-	R

Object name	Object type	Description	Values	COV increment	Access
BusTermination	BI[99]	Terminal resistor indicates whether the terminating resistor (120 Ω) has been activated via the service tools.	Inactive_Text: Switch not active	-	R
SummaryStatus	BI[101]	Condensed status Summary status (MI[106], MI[110])	Inactive_Text: no error	-	R
InternalActivity	MI[100]	Status activity	1: none 2: Test 3: Adaptation	-	R
StatusActuator	MI[106]	Status of actuator	1: OK 2: Actuator cannot be moved 3: Gear disengagement active 4: Mechanical travel exceeded	-	R
StatusDevice	MI[110]	Device status Shows the general status of the device	1: OK 2: Bus failure monitoring activated	-	R
Override	MO[1]	Override control overwrites the setpoint (SpRel AO[1]) with a forced command	1: none 2: OPEN 3: CLOSED 4: q_{vmin} 5: q_{vmid} 6: q_{vmax} Factory setting: none (1)	-	C
Command	MV[120]	Trigger test functions	1: none 2: Adaptation 3: Test 4: Reset Factory setting: none (1)	-	W
UnitSelFlow	MV[121]	Unit selection The selected unit is displayed in AI[19] and AV[104]	1: m^3/s 2: m^3/h 3: l/s 4: l/min 5: l/h 6: gpm 7: cfm Factory setting: m^3/h (2)	-	W
SpSource	MV[122]	Setpoint specification	1: Analogue (0 – 10 V, 2 – 10 V) 2: Bus (Modbus, BACnet, MP-Bus) Factory setting: Bus (2)	-	W

Object name	Object type	Description	Values	COV increment	Access
ControlMode	MV[123]	ControlMode	1: Position control (OpenLoop) 2: Volume flow control	-	W
Sens1Type	MV[220]	Definition of sensor type for analogue input	1: none 2: active sensor (in hybrid mode) 5: switch Factory setting: none (1)	-	W

10 Faults

10.1 Troubleshooting

TROX volume flow controllers are technically tested before delivery. The factory-set operating parameters are documented on the adjustment sticker and must be checked at commissioning ➦ *Chapter 9.3 'Adjustment label' on page 29*.

If faults occur after commissioning, they can usually be resolved using the following descriptions.

If a fault cannot be resolved independently, the TROX contacts will be happy to assist with troubleshooting (contact ➦ *Chapter 1.3 'TROX contact information' on page 5*).

The following information is required (to be found on the rating plate and/or the adjustment sticker):

- Commission and line number
- Serial number
- Type and nominal size of the air terminal unit
- Operating parameters q_{vmin} / q_{vmax}
- Control component
- Actuation

10.2 Common faults

10.2.1 Incorrect wiring

In many cases, wiring faults are the cause of malfunctions.

Therefore, when troubleshooting, check that the connection cable is wired in accordance with the TIA T568B standard (➦ *'Assignment of the RJ45 plugs' on page 25*).

10.2.2 System pressure too low

The aim of volume flow control is to regulate the actual volume flow to the specified setpoint. However, this requires sufficient fan capacity so that the terminal unit can regulate (restrict) the desired volume flow setpoint. If the required minimum differential pressure is not reached due to an inadequate fan capacity, the setpoint of the terminal unit cannot be reached either.

If the system pressure is too low, the volume flow controller will attempt to open the damper blade further to reach the desired volume flow setpoint. This can be recognised on the damper blade shaft of the unit ➦ *Chapter 5.2 'Display of the damper blade position' on page 15*.

If the damper blade is still in the OPEN position with the setpoint signal present, instead of in a control position (throttling position), the volume flow is not sufficient to reach the setpoint.

Remedy:

- Check fan output,
- Check duct section blocking, e.g., fire damper closed
- ➦ *Appendix A 'Systematic troubleshooting' on page 54*

10.2.3 Use outside of control range

If the unit-specific control range is left with the q_{vmin}- / q_{vmax} setting, the setpoints cannot be reached. The actual value reached by the volume flow controller is undefined.

Match the settings for q_{vmin} and q_{vmax} with the specific control ranges of the terminal unit.

Additional information:

- Usable control range (see adjustment sticker):
  - Type TVR: 10 – 100 % of q_{vNom}
  - Type TZ-Silenzio: 10 – 100 % of q_{vNom}
  - Type TA-Silenzio: 10 – 100 % of q_{vNom}
  - Type TVZ: 10 – 100 % of q_{vNom}
  - Type TVA: 10 – 100 % of q_{vNom}
  - Type TVM: 30 – 100 % of q_{vNom}
  - Type TVJ: 20 – 100 % of q_{vNom}
  - Type TVT: 20 – 100 % of q_{vNom}

10.3 Systematic troubleshooting

If the control unit malfunctions, we recommend systematic trouble-shooting using our flow chart, ➦ *Appendix A 'Systematic troubleshooting' on page 54*.

11 Spare parts

11.1 Order of replacement control components

The unit type, nominal size/dimensions as well as operating mode, signal voltage ranges, operating values (q_{vmin}, q_{vmax}) and the nominal flow rate are required for ordering spare parts. Additional information such as order number and delivery date help to specify parameters of the control unit.

The adjustment sticker on the terminal unit provides all the information required for ordering replacement parts for a control component, which can be sent as a photo when ordering.

12 Decommissioning

Once the end of its service life has been reached, the unit must be dismantled and disposed of in an environmentally responsible manner.

12.1 Safety

Personnel

- Dismantling must only be carried out by specially trained qualified personnel.
- Only trained and qualified electricians may work on the electrical system.

Electrical system

DANGER

Danger of death due to electric current!

Danger of electric shock! Do not touch any live components! Live electrical components may suddenly move uncontrollably and seriously injure people.

Therefore:

– Switch off the power supply and disconnect the product permanently before you begin to disassemble it.

WARNING

Risk of injury due to improper dismantling!

Stored residual energy and sharp edges, points or corners on or inside the unit, or on the tools used, may cause injuries.

Therefore:

– Make sure there is sufficient space before starting work.
– Handle all exposed sharp-edged components with care.
– Dismantle components properly. Note that certain components may be of considerable weight. Use lifting gear if necessary.
– Secure components to prevent them from falling or tipping over.
– When in doubt, contact the manufacturer.

12.2 Disassembly

Before you start disassembly:

- Switch off the device and secure it against being switched on accidentally.
- Physically disconnect the entire power supply from the device and discharge any stored residual energy.
- Remove operating and auxiliary materials, as well as residual processing materials, and dispose of them in an environmentally sound manner.

Then professionally clean subassemblies and components and disassemble them in compliance with local occupational safety and environmental protection regulations.

12.3 Disposal

If no return or disposal agreement has been made, disassembled components must be recycled:

- Scrap metals.
- Send plastic elements for recycling.
- Dispose of other components appropriately, depending on their material properties.

ENVIRONMENT

Environmental damage caused by improper disposal!

Electronic waste, electronic components, lubricants and other auxiliary materials are considered hazardous waste and may only be disposed of by authorised specialist companies!

Contact the local authorities or specialised disposal companies for details on environmentally safe disposal.

13 Technical data

Tab. 3: General operating conditions of the control component

Ambient temperature	10 – 50 °C
Ambient humidity	5 – 90% RH

Tab. 4: Assignment of attachment type and air terminal unit

VAV terminal units	Type of attachment
TVR[1)]	LMV-D3-M/B-FX TR
TVR2[2)], TZ-Silenzio, TA-Silenzio, TVZ, TVA	LMV-D3-M/B-X TR
TVM	2 x LMV-D3-M/B-X TR
TVJ, TVT	NMV-D3-M/B-X TR
[1)] TVR Initial equipment [2)] TVR Spare part	



Fig. 21: Compact controller BM0-D8, type LMV-D3-M/B-X TR (clamping bracket), and BM0-D8, type LMV-D3-M/B-FX TR, (positive locking)

Compact controller BM0-D8, type LMV-D3-M/B-X TR (clamping bracket) and LMV-D3-M/B-FX TR (positive locking)	
Measuring principle / installation orientation	dynamic measuring principle, independent of installation position
Rated voltage	24 V AC / DC

Compact controller BM0-D8, type LMV-D3-M/B-X TR (clamping bracket) and LMV-D3-M/B-FX TR (positive locking)	
Rated voltage (Frequency)	50/60 Hz
Functional range	AC 19.2 – 28.8 V / DC 21.6 – 28.8 V
Power consumption – operating / standby	2 W / 1 W
Power consumption - sizing / inrush current	4 VA 8.0 A @ 5 ms
Bus connection	RS485 interface - **Modbus RTU****, BACnet MS/TP protocol
Adjustable communication parameters Modbus RTU	Baud rate: 9600, 19200, **38400****, 76800, 115200 Address: **1****,2,3 – 247 Parity: **1-8-N-2****, 1-8-N-1, 1-8-E-1, 1-8-O-1 Number of nodes: max. 32 (without repeater) Termination resistor: 120 Ω;
Adjustable communication parameters BACnet MS/TP	Baud rate: 9600, 19200, 38400, 76800, 115200 Address: 0,1,2,3 – 127 Number of nodes: max. 32 (without repeater) Termination resistor: 120 Ω;
Setpoint/actual value interface	via Modbus register list, e.g. via TROX O_x field modules; alternatively via BACnet objects
Addressing	required on site: e.g. adjustment device ZTH-EU or external software
Bus termination	internal connection resistor 120 OHM can be activated
Maximum bus topology daisy-chain	max. loop-through: 4 control components type BM0-D8 Distance between two control components: min. 3 m Total cable length: max. 40 m
Torque	5 Nm
Setpoint/actual value interface	via Modbus register access, e.g. via TROX O_x field modules; alternatively via BACnet objects
Connections	RJ45 dual socket, unshielded, max. 1 A / 20 W per port Wiring: straight-through patch cable AWG24, compliant with TIA T568A
IEC protection class	III (protective extra-low voltage)
Protection degree (IP code)	IP 20
Weight	0.55 kg
EC conformity	EMC according to 2014/30/EU
**Factory setting	



Fig. 22: Compact controller BM0-D8, type NMV-D3-M/B-X TR (clamping bracket)

Compact controller BM0-D8, type NMV-D3-M/B-X TR (clamping bracket)	
Measuring principle / installation orientation	dynamic measuring principle, independent of installation position
Rated voltage	24 V AC / DC
Rated voltage (Frequency)	50/60 Hz
Functional range	AC 19.2 – 28.8 V / DC 21.6 – 28.8 V
Power consumption – operating / standby	3 W / 1.5 W
Power consumption - sizing / inrush current	4 VA 8.0 A @ 5 ms
Bus connection	RS485 interface - **Modbus RTU****, BACnet MS/TP protocol
Adjustable communication parameters Modbus RTU	Baud rate: 9600, 19200, **38400****, 76800, 115200 Address: **1****,2,3 – 247 Parity: **1-8-N-2****, 1-8-N-1, 1-8-E-1, 1-8-O-1 Number of nodes: max. 32 (without repeater) Termination resistor: 120 Ω;
Adjustable communication parameters BACnet MS/TP	Baud rate: 9600, 19200, 38400, 76800, 115200 Address: 0,1,2,3 – 127 Number of nodes: max. 32 (without repeater) Termination resistor: 120 Ω;
Setpoint/actual value interface	via Modbus register list, e.g. via TROX O_x field modules; alternatively via BACnet objects

Compact controller BM0-D8, type NMV-D3-M/B-X TR (clamping bracket)	
Addressing	required on site: e.g. adjustment device ZTH-EU or external software
Bus termination	internal connection resistor 120 OHM can be activated
Maximum bus topology daisy-chain	max. loop-through: 4 control components type BM0-D8 Distance between two control components: min. 3 m Total cable length: max. 40 m
Torque	10 Nm
Setpoint/actual value interface	via Modbus register access, e.g. via TROX O_x field modules; alternatively via BACnet objects
Connections	RJ45 dual socket, unshielded, max. 1 A / 20 W per port Wiring: straight-through patch cable AWG24, compliant with TIA T568A
IEC protection class	III (protective extra-low voltage)
Protection degree (IP code)	IP 20
Weight	0.83 kg
EC conformity	EMC according to 2014/30/EU
****Factory setting**	

14 Declaration of Conformity

We hereby declare that the control component complies with all relevant provisions of the following EU Directives:

- Directive 2014/30/EU
- Directive 2014/35/EU
- Directive 2011/65/EU

The individual CE certificates can be found at ➦ *www.trox.de* .

15 Glossary

Basic device

Device for controlling volume flow rates without attached control components. The main components are the casing with sensor element(s) to measure the differential pressure and the damper blade to restrict the volume flow. The basic device is also referred to as a terminal unit or control unit. Important distinguishing features: Geometry or device shape, material and connection variants, acoustic characteristics (e.g. optional acoustic cladding or integrated silencers), range of volume flow.

Control component

Electronic unit(s) mounted on the basic device to control the volume flow rate, or the duct pressure, or the room pressure by adjusting the damper blade position. The electronic unit basically consists of a controller with differential pressure transducer (integrated or external) and an integrated actuator (Easy and Compact control components).

Important distinguishing features:

- Transducer: dynamic transducer for clean air or static transducer for contaminated air
- Actuator: standard actuator, slow-running
- Interface technology: analogue interface or digital bus interface for connecting and tapping signals and information

MCE

Management and control equipment

Central control system for building technology, usually realised by a software solution (internet or intranet-based or software installed on a local PC with its own user interface). It is operated via a user interface. The settings made are often transmitted to the components installed in the building via bus communication (Modbus or BACnet).

q_{vconst}

q_{vconst} [m³/h]; [l/s]

Site-adjustable value for operation with a constant volume flow setpoint. When operating with a fixed setpoint, $q_{vkonst} = q_{vmin}$.

q_{vmax}

q_{vmax} [m³/h]; [l/s]

Upper limit of the operating range of the terminal unit, to be set by the client: q_{vmax} can only be set to less than or equal to q_{vNom}. With analogue control of volume flow controllers (typically used), the set maximum value (q_{vmax}) is assigned to the maximum value of the setpoint signal(10 V), see characteristic curve.

q_{vmid}

q_{vmid} [m³/h]; [l/s]

Site-adjustable value that must lie between the lower and upper limits of the air terminal unit's operating range (i. e.: $q_{vmin} < q_{vmid} < q_{vmax}$).

q_{vmin}

q_{vmin} [m³/h]; [l/s]

Lower limit of the operating range of the terminal unit, to be set by the client: q_{vmin} should only be set to less than or equal to q_{vmax}. Do not set q_{vmin} to less than q_{vmin} device, otherwise control will be unstable or damper blade will close. $q_{vmin} = 0$ is a valid value. With analogue control of volume flow controllers (typically used), the set minimum value (q_{vmin}) is assigned to the minimum value of the setpoint signal(0 or 2 V), see characteristic curve.

$q_{vmin\ device}$

$q_{vmin\ device}$ [m³/h]; [l/s]

Technically possible minimum volume flow rate: The value depends on product type, nominal size and control component (attachment). Values are defined in the Easy Product Finder design programme. Lower limit of the setting range and minimum volume flow setpoint for the terminal unit. Setpoints below $q_{vmin\ device}$ (if q_{vmin} is set to 0) lead to unstable control or shut-off, depending on the controller.

q_{vnom}	q_{vnom} [m³/h]; [l/s]
q_{vNom}	q_{vNom} [m³/h]; [l/s] Nominal volume flow (100 %): The value depends on product type, nominal size and control component (attachment). Values are published on the internet and in technical leaflets and stored in the Easy Product Finder design programme. Reference value for calculating percentage values (e. g. q_{vmax}). Upper limit of the setting range and maximum volume flow setpoint for the terminal unit.
Volume flow controller	Consists of a basic device and an attached control component.

16 Index

A

Adjustment device 30
Ambient temperature 45
Applicable documents 4
Application 7
Area of application 7

B

BACnet interface
  configuring 35

C

CE conformity 49
CE marking 49
Checking delivered goods for completeness 12
Claims for material defects 6
Connection diagram
  Digital operation 25
  Modbus operation 25
Control system
  Constant 17
  Override control 18
  Variable 18
Copyright 6

D

Damper blade position 15
Declaration of Conformity 49
Decommissioning 43
Defect liability guarantee 6
Disassembly 43
Display and control elements 27
Disposal 44

E

Electric current 9
Electrical connection data 45
Electrical wiring 24
EU Directives 49

F

Factory setting 28
Fault
  System pressure too low 40
  Systematic 41
  Systematic troubleshooting 54
  Use outside of control range 41
  Wiring fault 40
Faults 40
Functional description 16
Functional test 32

H

Hazards 8
Hybrid mode 29
Hygiene requirements 10

I

Improper use 7
Installation 14
Installation orientation 14
Intended use 7

M

Misuse 7
Modbus
  Register 32
Modbus interface
  configuring 32

O

Operating mode
  Analogue 17
  Digital 20
  Modbus RTU 20
Operating modes 20
Override control 18

P

Packaging 13
Parts and function 15
PC software 30
Personnel 10
  Dismantling 43
Position of the damper blade 15
Product description 15
Product overview 15
Protective equipment 10

R

Repair 11
Replacement controller 42
Residual risks 8

S

Service 5
Service tool 29
Setting
  Fixed value operation (F) 31
  Variable operation (V) 31
Signs 8
Spare parts 11, 42
Storage 12
Supply voltage 45
Symbols 4
System owner 9
System owner's obligations 9
Systematic troubleshooting 54

T

Technical data 45
Technical support 5
Transport 12
Transport damage 12
Transport inspection 12
Troubleshooting 40, 54

U

Unauthorised use 7
Use 7

Appendix

Appendix - Table of contents

A Systematic troubleshooting 54

A Systematic troubleshooting

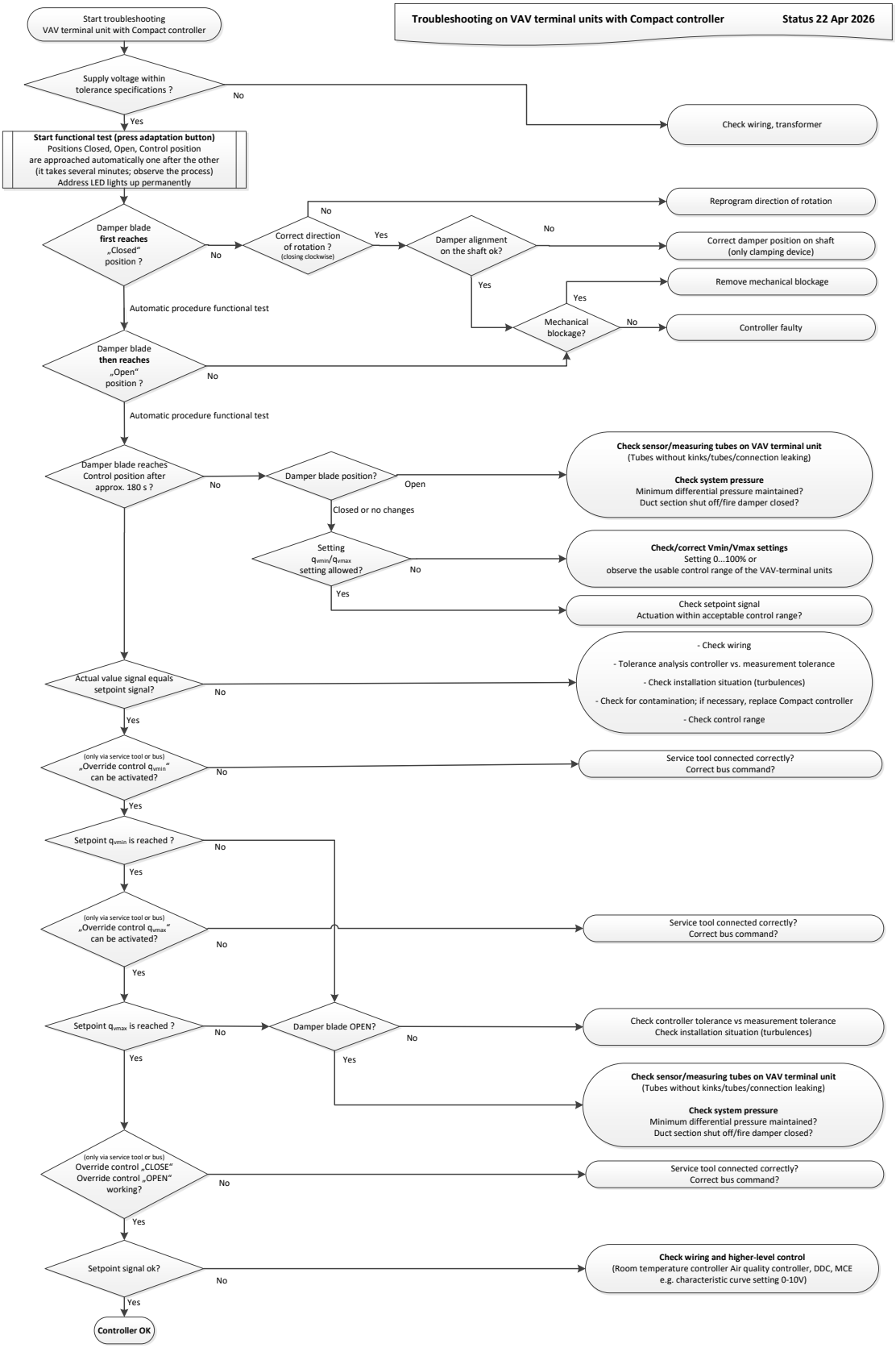


Fig. 23: 2026_03_18_Troubleshooting BM0-D8

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IOS **ANDROID**

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