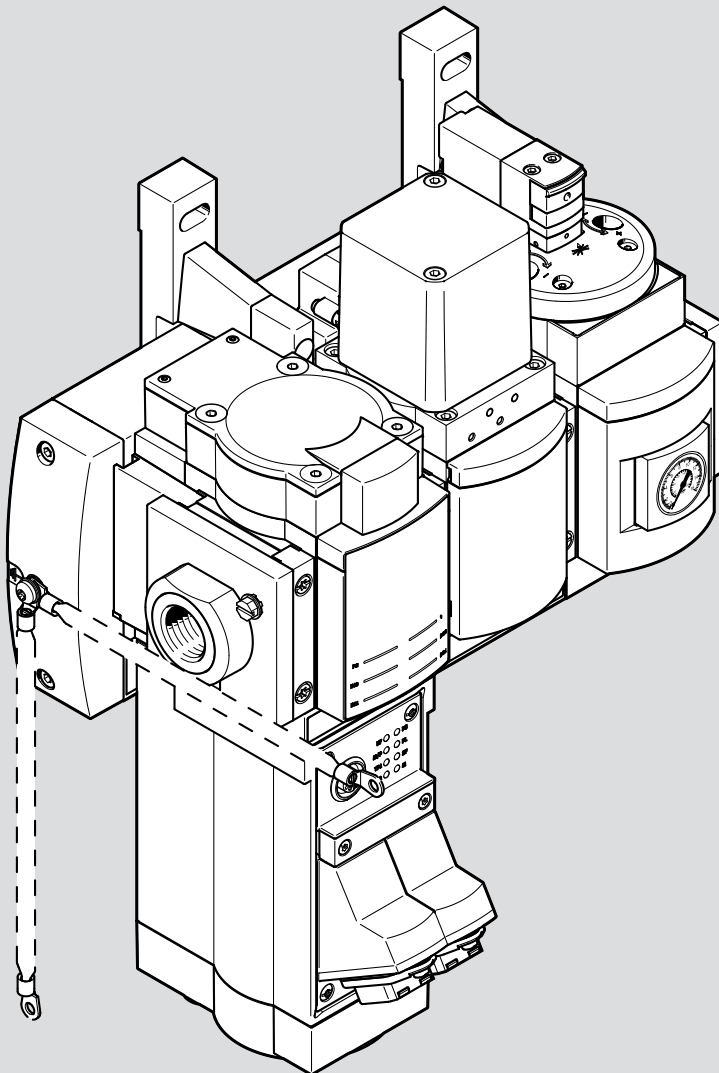


MSE6-C2M

Energy efficiency module

FESTO

Operating instruction



8227990

8227990
2024-12d
[8227992]

Original instructions

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1 Applicable documents



All available documents for the product → www.festo.com/sp.

Document	Product	Table of contents
Manual	CPX-SYS system	CPX system description
Operating instruction	Bus node CPX(-M)-43/44/45	PROFINET IO
Operating instruction	Bus node CPX-FB36	EtherNet/IP
Operating instruction	Bus node CPX-FB37	EtherCAT
Assembly instructions	Wall mounting-SET MS6-WPG	–

Tab. 1: Documentation on the product

2 Safety

2.1 Safety instructions

- Only use the product in its original condition without unauthorised modifications.
 - Only use the product if it is in perfect technical condition.
 - Observe the identifications on the product.
 - Only operate the product with a silencer.
 - Only use the product in an industrial environment.
 - The product may generate high frequency interference, which may require interference suppression measures in residential areas.
 - Before working on the product, switch off the power supply and secure it against being switched on again.
 - When the input pressure is shut off, the functioning of the system means that a residual pressure of < 0.1 MPa (1 bar; 14.5 psi) may remain at the output.
 - Comply with the handling specifications for electrostatically sensitive devices.
 - To exhaust the system: use shut-off valves in the compressed air supply line.
- The product is equipped with a pneumatically-piloted shut-off valve. If there is pressure at pneumatic connection 1, the shut-off valve is open in the normal position.

With preset parameters and applied input pressure P1 the shut-off valve automatically switches to the pressurise state in the following cases:

- Switch-off of the operating voltage or the load voltage
- Interruption of the network communication with correspondingly set system parameters
- Stopping of the higher-order controller (see manufacturer's specifications), e.g. in the case of transmission of control programs, parameters, configuration data

If the shut-off valve was previously closed and the system was exhausted, the system is suddenly pressurised. Take this response into account in the design of the system.

2.2 Intended use

The energy efficiency module is used to monitor and optimise compressed air consumption by adjustable outlet pressures.

2.3 Foreseeable misuse

The following are examples of foreseeable misuse and are not approved as intended use:

- Operation outdoors.
- Closure of exhaust ports.
- Use of the integrated shut-off valve in continuous switching operation for pneumatic components.
- Use of the integrated pressure regulator in operation with continuous changes of setpoint pressure.
- Shutting off a system as a safety function.
- Use in safety functions:
 - The energy efficiency module must not be installed behind an exhaust valve that fulfills a safety function. This can impair the safety functions installed in the system.
 - If the energy efficiency module is installed in front of a safety valve, the design of the layout must not impair the intended operation of the safety valve and of the system, possibly by installation of additional safety measures.

2.4 Training of qualified personnel

Work on the product may only be carried out by qualified personnel who can evaluate the work and detect dangers. The qualified personnel have skills and experience in dealing with electropneumatic (open-loop) control technology.

3 Additional information

- Contact the regional Festo contact if you have technical problems
➔ www.festo.com.
- Accessories and spare parts ➔ www.festo.com/catalogue.
- Information on the CPX bus node ➔ www.festo.com/sp.
- Information on the short documentation for the CPX-Extension
➔ www.festo.com/sp.
- Cyber security measures ➔ www.festo.com/psirt.

4 Cyber security measures

Unauthorised access to a service mode may result in unauthorised access to the product. The service mode is reserved for Festo and is protected by a password. The system operator must therefore take appropriate measures to prevent unauthorised access to the product, its functions and the data stored on the product
➔ 3 Additional information.

5 Product overview

5.1 Product design

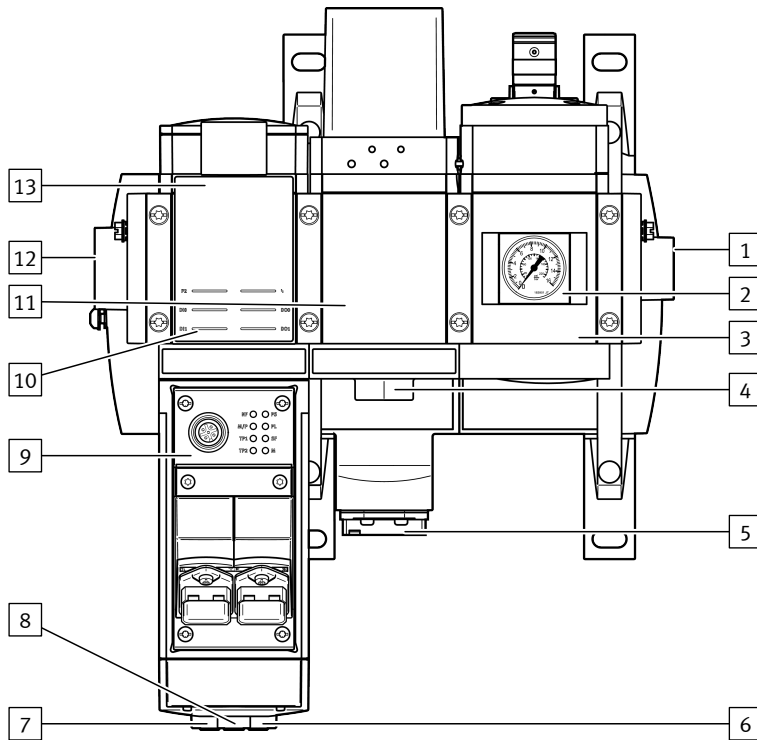


Fig. 1: Product design, example MSE6-C2M-5000-FB44-DM-RG-BAR-AMI-AGD

- | | |
|---|--|
| 1 Pneumatic port 2: compressed air outlet | 8 MSE6-C2M-...-M only: CPX-Extension series 1 connection |
| 2 Pressure gauge | 9 Bus node, here CPX-M-FB44 |
| 3 Shut-off valve with pressure sensor | 10 Status LEDs |
| 4 Pneumatic port 3: exhaust | 11 Proportional pressure regulator |
| 5 Electrical system supply | 12 Pneumatic port 1: compressed air inlet |
| 6 Electrical connection: inputs | 13 Flow sensor |
| 7 Electrical connection: outputs | |

The energy efficiency module consists of the following main components:

- Bus node
- Flow sensor
- Proportional pressure regulator
- Shut-off valve with pressure sensor

The power is supplied to the components by the system supply.

The bus node enables connection to a higher-level controller. The input data, output data, parameters and diagnostic information are transmitted to the higher-level controller via the bus node.

Fixed module numbers are assigned to the energy efficiency module and the bus node.

MSE6-C2M-... as a single device	Module number
Energy efficiency module MSE6-C2M	0
Bus node CPX-FBxx	1

Tab. 2: Module numbers without electrical system extension

The energy efficiency module can be expanded on the left and right with service unit components from the MS6 series → 5.3 Combination with MS6 modules. The CPX extension series 1 connection of the MSE6-C2M-...-M enables extension of the electrical system → 5.2 Electrical system extension CPX-Extension.

5.2 Electrical system extension CPX-Extension

The product variant MSE6-C2M-...-M enables connection of the following devices with a CPX extension series 2 interface via the CPX-Extension series 1 interface:

- 1 energy efficiency module MSE6-D2M or
- up to a maximum of 3 digital and/or analogue CPX input and output modules

The modules connected to the CPX-Extension series 1 interface form an overall system with the MSE6-C2M-...-M and have a consecutive module number, starting with module number 2.

Electrical system extension with MSE6-D2M

The figure below shows the communication paths for a system extension with MSE6-D2M.

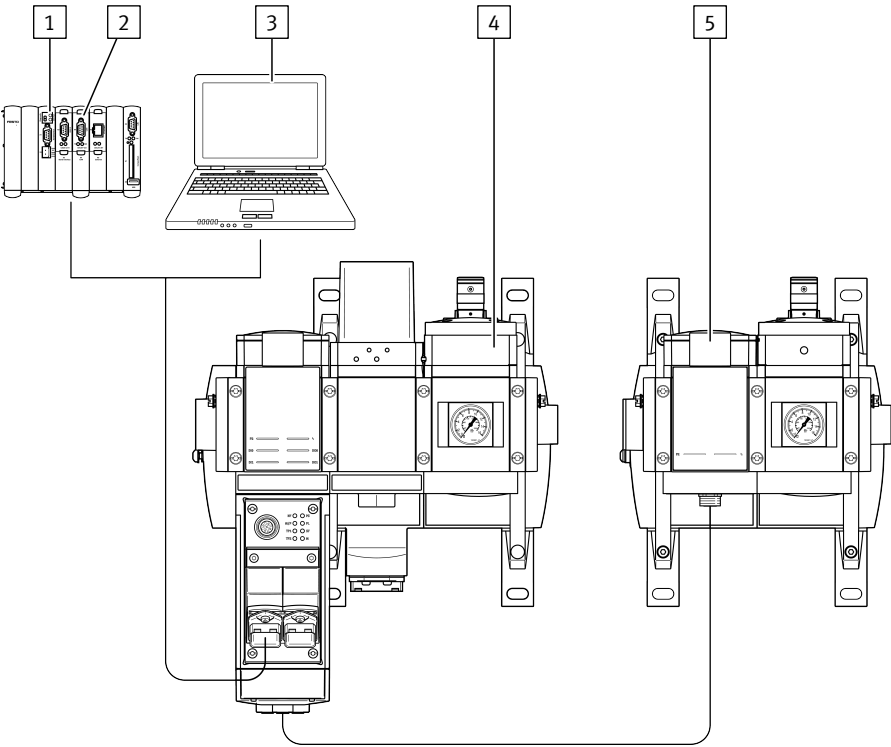


Fig. 2: System configuration with MSE6-C2M-...-M and MSE6-D2M

- 1

Controller board or network scanner/bus master
- 2

User program in the machine controller
- 3

Network-specific configurator
- 4

Energy efficiency module MSE6-C2M-...-M
- 5

Energy efficiency module MSE6-D2M

MSE6-C2M-...-M with MSE6-D2M	Module number
Energy efficiency module MSE6-C2M	0
Bus node CPX-FBxx	1
CPX-Extension series 2 – Energy efficiency module MSE6-D2M	2

Tab. 3: Module numbers for system extension

Electrical system extension with CPX I/O modules

The following CPX I/O modules are approved for extension:

- CPX-4DE, 4 digital inputs
- CPX-8DE, 8 digital inputs
- CPX-4DA, 4 digital outputs
- CPX-8DA, 8 digital outputs
- CPX-8DE/8DA, 8 digital inputs and 8 digital outputs
- CPX-4AE-U-I, 4 analogue inputs
- CPX-2AA-U-I, 2 analogue outputs

A system extension with electrical outputs requires a CPX interlinking block with infeed because the load voltage is not forwarded via a CPX-Extension.

The figure below shows the communication paths for a system extension with CPX I/O modules:

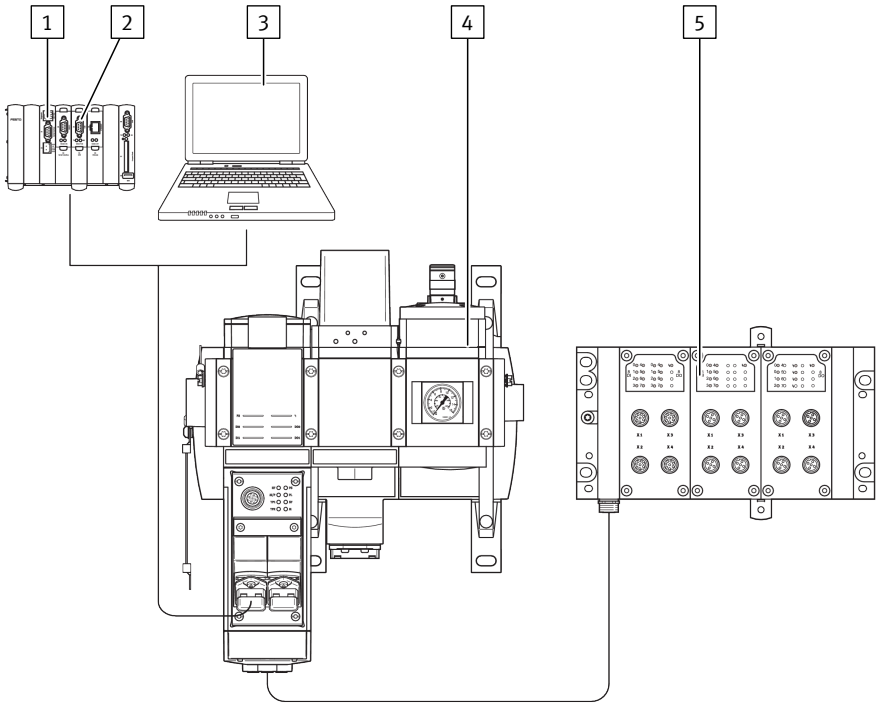


Fig. 3: System configuration with MSE6-C2M-...-M and 3 CPX I/O modules, maximum configuration

- 1

Controller board or network scanner/bus master
- 2

User program in the machine controller
- 3

Network-specific configurator
- 4

Energy efficiency module MSE6-C2M-...-M
- 5

CPX I/O modules with CPX-Extension series 2 connection

MSE6-C2M-...-M with CPX I/O modules	Module number
Energy efficiency module MSE6-C2M	0
Bus node CPX-FBxx	1
CPX-Extension series 2	2
– first CPX I/O module	
– second CPX I/O module	3
– third CPX I/O module	4

Tab. 4: Module numbers for system extension

5.3 Combination with MS6 modules

Additional service unit components from the MS6 series can be connected to the left and right of an energy efficiency module.

General information

- Maximum permissible number of entire service unit component combination: 10 individual modules. The MSE6-C2M product counts as a triple module here.
- When supplementing MS6 modules, only use the wall mounting set MS6-WPG and the module connector MS6-MV-EX.
- When supplementing MS6 modules, the screws on the module connector between the flow sensor, proportional-pressure regulator and the shut-off valve may not be loosened → Restriction of EMC immunity to interference.
- Observe the assembly instructions for the MS6-WPG wall mounting set.

- In the case of a larger device configuration, a longer FE joint is required.
- The cable has a nominal cross section of 5 mm² with cable lug in accordance with DIN 46234-4-6.
- Alternatively: earthing straps are manufactured in a bare or tin-plated design in accordance with DIN 46444 or in accordance with DIN 72333-3. Nominal cross section: > 5 mm². Connection: M4.

Mounting

1. With pre-assembled MS6 combinations: replace the wall bracket with a wall mounting set MS6-WPG.
2. With MS6 individual modules: replace standard module connectors with pre-assembled MS6 combinations with MS6-MV-EX module connectors.
3. For additions to the left side: remove the left-hand pneumatic connecting plate of the MS6 module or MS6 module combination. At this point, install the left pneumatic connecting plate of the product.
4. For additions to the right side: remove the right-hand pneumatic connecting plate base of the MS6 module or MS6 module combination. At this point, install the right pneumatic connecting plate of the product.

Earth terminal

1. Connect the earth terminal on the pneumatic connecting plate with low impedance, short cable with large cross-sectional area, to the end plate of the electrical linkage module of the product, pre-assembled on delivery status, ➔ 8.2 Electrical installation.
2. The earth terminal at the left end plate of the electrical linkage of the product and the earth terminal at the power supply connection must have the same potential. There must be no equalising currents.
3. If necessary, replace the electrical connection pre-installed on the energy efficiency module with a longer, electrically equivalent connection.

5.4 Display components

Status LEDs of the energy efficiency module

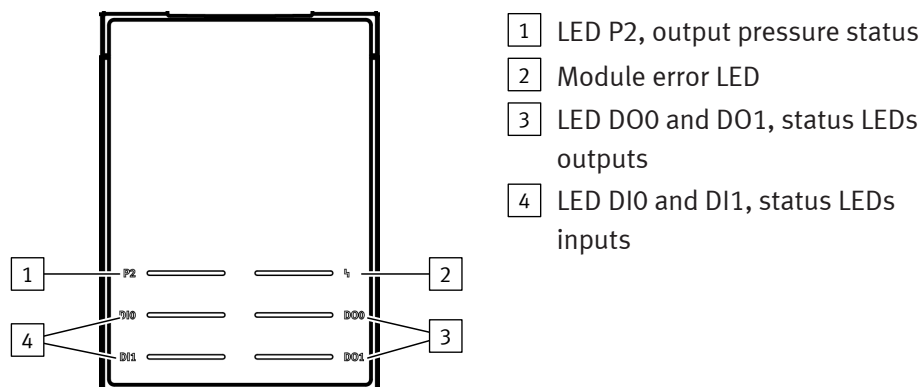


Fig. 4: Status LEDs of the energy efficiency module

LED	Meaning	
P2 (green)		
	LED on	Outlet pressure p2 ≥ lower critical limit pressure p2
	LED flashes	Outlet pressure p2 < lower critical limit pressure p2 and Output pressure p2 ≥ auto standby pressure setpoint value – 0.05 MPa (0.5 bar; 7.25 psi)
	LED is off	Output pressure p2 < auto standby pressure setpoint value – 0.05 MPa (0.5 bar; 7.25 psi)

LED		Meaning
DI0 and DI1, green		
	LED on	Signal at electrical input 0 or 1 is pending, logic 1
	LED is off	Signal at electrical input 0 or 1 is not pending, logic 0
DO0 and DI1 (yellow)		
	LED on	Electrical output 0 or 1 sends 1-signal, logic 1
	LED is off	Electrical output 0 or 1 sends 0-signal, logic 0
red		
	LED on	Module error
	LED is off	No module error

Tab. 5: Status indicator LEDs

Status LED of the integrated bus node

Display of outlet pressure p2

For detailed information on the display elements of the bus node, see the associated description ➔ 1 Applicable documents.

Red/green pressure gauge

6 Functions

Overview

- Pressure control function and blocking function, energy efficiency function
 - Automatic blocking and subsequent regulation to the standby target pressure with a prolonged reduced flow rate
 - User-controlled blocking and pressure regulation
 - Parameterisable target pressure rise limitation, soft-start
- Recording and processing measurement data
 - Output pressure P2
 - Pressure change for leak testing
 - Flow rate
 - Air consumption
- Critical limit monitoring
 - Pressure, lower and upper critical limit
 - Pressure change, upper critical limit
 - Flow rate, upper critical limit
- Electrical I/Os
 - 2 digital inputs
 - 2 digital outputs
 - Channel-based status indicator via LED
 - Parameterisable special functions

	– Fieldbus connection – EtherNet/IP connection, CPX-FB36 – EtherCAT connection, CPX-FB37 – PROFINET connection, CPX-FB43 or CPX-FB44
Standby detection and automatic pressure reduction	The energy efficiency module detects downtime of a pneumatic system when correspondingly parameterised. If the parameterised flow rate limit value is continuously undershot during the parameterised delay period, when the automatic function is activated, controller auto-user and controller auto-enable logic 1, the supply air is blocked until the parameterised standby setpoint pressure value is reached. The output pressure is then adjusted to this value. This prevents unnecessary exhausting of the system and enables leakage detection via an analysis of the pressure drop. A control signal can be used to switch back over from standby pressure regulation to normal pressure regulation. When the automatic function is deactivated, the shut-off valve and the pressure regulator can be directly controlled by the machine controller.
Regulation of the compressed air supply	The energy efficiency module regulates the compressed air supply to the set pressure setpoint value. This can be done in manual mode by the setting from the controller. In automatic mode, it is regulated by the parameterised setpoint pressure values.
Circuit with manual override	The manual override is used to switch the energy efficiency module when it is not electrically actuated or if it is de-energised. The manual override is intended solely for set-up or installation work.
Testing pressure-tightness	The energy efficiency module continuously measures the pressure change in the parameterised time interval and monitors this value to ensure it is not exceeded in the blocking status. The measured pressure change serves as a measure of the leakage in the downstream system.
Pressure recording	The energy efficiency module continuously measures the output pressure, processes the data and makes it available cyclically. To detect operating pressures that are too high or too low, the energy efficiency module offers the option of parameterising critical limits for pressure. If the parameterised limit value is exceeded, the energy efficiency module will output a diagnostic message. The status of monitoring to ensure the critical limit is not exceeded is indicated via an input bit and via the P2 LED on the module.
Flow recording	The energy efficiency module continuously measures the flow rate, processes the data and makes it available cyclically. The energy efficiency module offers the option of parameterising the upper critical limit for the flow rate in order to detect excessively high flow rates. If the parameterised limit value is exceeded, the energy efficiency module will output a diagnostic message.
Consumption recording	The energy efficiency module determines the compressed air consumption by recording the system flow rate. With the aid of output data, the consumption measurement can be switched on and off and the consumption value can be reset.
Operational functions	The response of the energy efficiency module can be influenced by accessing the internal parameters, e.g.: – Diagnostic behaviour by enabling maskable diagnostic messages. – Specification of the units and the measuring interval. – Setting of critical limits.



The energy efficiency module is delivered with preset parameters
→ 10 Parameterisation.

6.1 Measurement functions and control function

The following sections provide an overview of the individual measurement and control functions of the energy efficiency module and describe the setting options and their influencing variables.

Individual functions and their behaviour can be controlled using the outputs and parameters. Measurement and status signals are available as input values. The diagnostic information is made available as a combination of the error number and their respective channel allocation.

For the following designations of inputs and outputs and parameters, m is the module number that is based on the address position of the energy efficiency module in the overall CPX system and has the fixed value $m = 0$.

6.1.1 Flow rate

Input signal

The measured flow rate is prepared according to the set parameters of flow rate, Pm.8.2-8.3, and unit flow rate, Pm.8.6-8.7, processed and provided as input signal, Em.0.

Critical limit monitoring

A comparator is used to compare the measured flow rate value with the upper flow rate limit value parameter, Pm.11-12. When the time set in the monitor limit values startup, Pm.7, parameter has elapsed and limit value monitoring is activated, Pm.0.6, the appropriate error/diagnostic message is output if a limit value is exceeded.

Monitoring parameters

The unit flow rate, Pm.8.2-8.3, standard flow rate, Pm.8.6-8.7, upper flow rate limit value, Pm.11-12, limit value monitoring startup, Pm.7, parameters are checked for permissible values when input. In case of error, the appropriate error message is output if parameterisation error monitoring is activated, Pm.0.7.

Sensor monitoring

If there is a sensor error, the appropriate error message, which cannot be deactivated, is output.

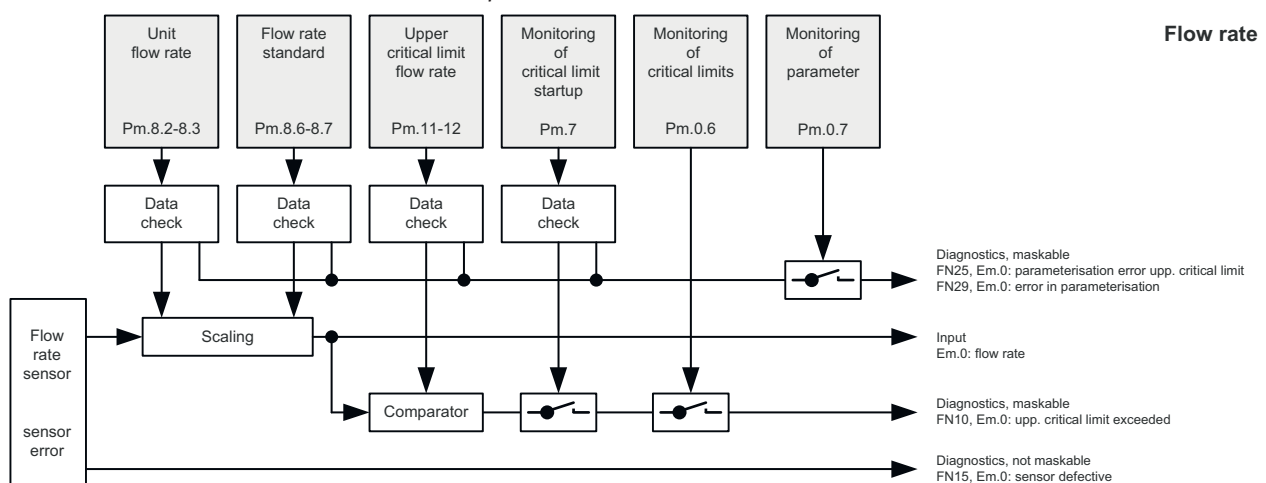


Fig. 5: Block diagram of the flow rate function

6.1.2 Consumption

Input signals

The consumption measurement is based on the prepared flow rate value. Depending on the unit consumption, Pm.8.4-8.5, and standard flow rate, Pm.8.6-8.7, parameters, the consumption values are processed in 2 independent channels and provided as input signals in the 16-bit and 32-bit data format:

- Consumption V0, 16 bit: input Em.1 and selectable inputs Em.5 and/or Em.6
- Consumption V0, 32 bit: selectable inputs Em.5-6
- Consumption V1, 16 bit: selectable inputs Em.5 and/or Em.6
- Consumption V1, 32 bit: selectable inputs Em.5-6

There is also a continuous consumption measurement which, after a certain, unit-dependent consumption, generates a logic one measurement impulse with a duration of 100 ms. For the consumption units l and m³, the consumption value is 200 l. For the consumption unit scf, the consumption value is 10 scf.

The measuring pulse is provided at the measuring pulse consumption VC, Em.3.7, input. In addition, the signal is output at electrical output 0 if the selection DO0 signal parameter has the value Pm.28.3 = 1.



If there is a change to the unit flow rate or standard flow rate parameter values, the measured consumption values are reset to the value 0. If there is a change to the unit consumption parameter value, the current measured consumption values are saved and converted to the new consumption unit.

User-controlled consumption measurement

The 2-channel consumption measurement is controlled using two data bits in the output word for module control, Am.0. The respective consumption measurement is started, continued or stopped with the consumption V0 Run, Am.0.12, or consumption V1 Run, Am.0.14, outputs. The respective consumption measurement values can be reset to the value 0 via the consumption V0 Reset, Am.0.13, or consumption V1 Reset, Am.0.15, outputs.

Monitoring parameters

The unit flow rate, Pm.8.2-8.3, standard unit flow rate, Pm.8.6-8.7, and unit consumption, Pm.8.4-8.5, parameters are checked on input for permitted values. In the event of an error, the corresponding error message is output if parameterisation error monitoring is activated, Pm.0.7.

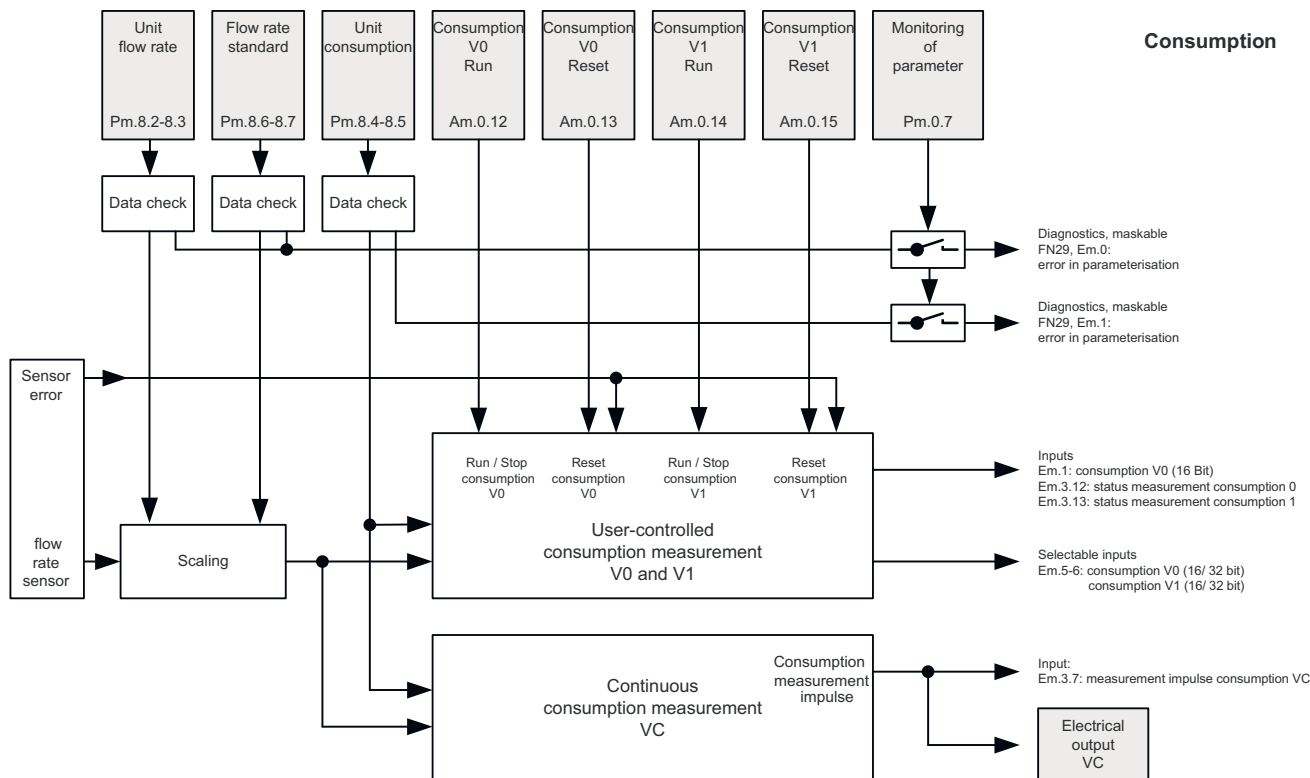


Fig. 6: Block diagram of the consumption function

6.1.3 Pressure

Input signal

The output pressure P2 measured value is processed according to the unit pressure, Pm.8.0-8.1, parameter and made available as an input signal pressure P2, Em.2.

Monitoring of lower pressure critical limit P2 and status indicator

A comparator is used to compare the measured pressure value with the “Lower pressure critical limit” parameter P2. The result is indicated in two ways.

- Status LED P2
 - The LED lights: output pressure $P2 \geq$ lower pressure limit value P2
 - The LED flashes: output pressure $P2 <$ lower pressure limit value P2 and output pressure $P2 \geq$ auto standby pressure setpoint value - 0.05 MPa (- 0.5 bar; - 7.25 psi).

The condition is not applicable if:
The lower pressure limit value $P2 <$ auto standby pressure setpoint value - 0.05 MPa (- 0.5 bar; - 7.25 psi).

 - The LED is off: output pressure $P2 <$ auto standby pressure setpoint value - 0.05 MPa (- 0.5 bar; - 7.25 psi).
- Input monitoring lower pressure limit value P2, Em.3.6
 - Logic 1: outlet pressure $P2 <$ lower critical limit pressure P2
 - Logic 0: outlet pressure $P2 \geq$ lower critical limit pressure P2

The figures show the behaviour of the status LED P2 and the input signal Monitoring of lower critical limit pressure P2 for the two parameterisation cases:

- Case 1: lower pressure limit value $P2 >$ auto standby pressure setpoint value - 0.05 MPa (- 0.5 bar; - 7.25 psi).
- Case 2: lower pressure limit value $P2 <$ auto standby pressure setpoint value - 0.05 MPa (- 0.5 bar; - 7.25 psi).

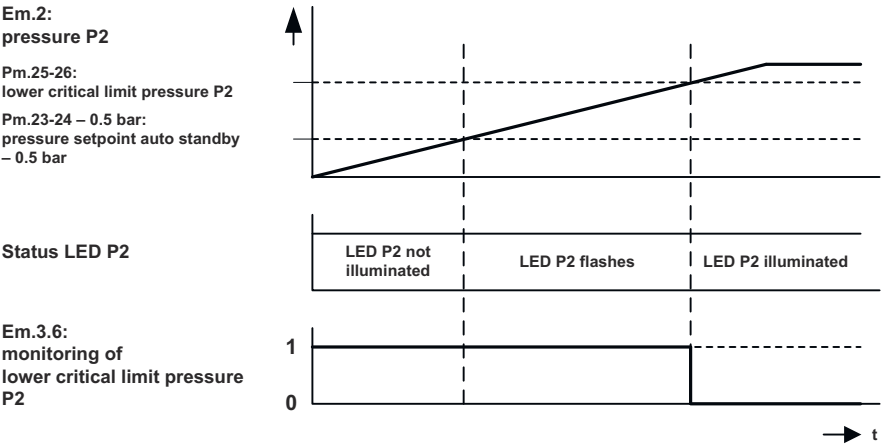


Fig. 7: Monitoring of lower pressure limit value P2 and status indicator, case 1

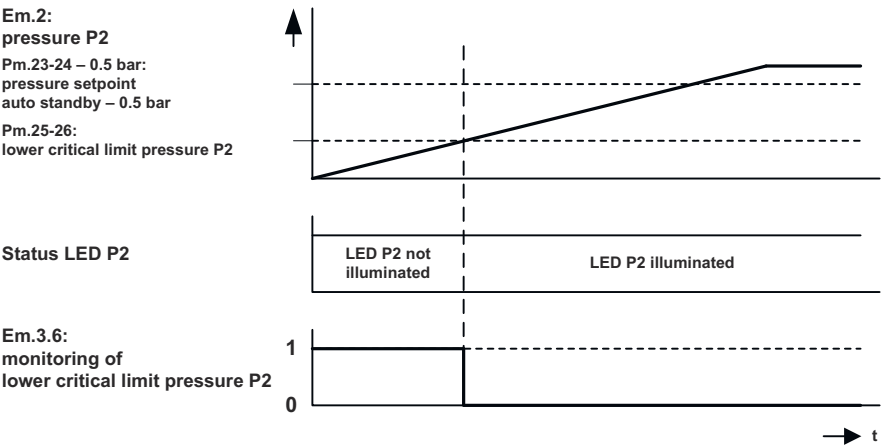


Fig. 8: Monitoring of lower pressure limit value P2 and status indicator, case 2

**Monitoring of upper
pressure critical limit**

A comparator is used to compare the measured pressure value with the upper pressure limit value, Pm.13-14, parameter. When the time set in the monitor limit values startup, Pm.7, parameter has elapsed and limit value monitoring is activated, Pm.0.6, the appropriate error/diagnostic message is output if a limit value is exceeded.

Monitoring parameters

The unit pressure, Pm.8.0-8.1, lower pressure limit value P2, Pm.25-26, upper pressure limit value, Pm.13-14, limit value monitoring startup, Pm.0.7, parameters are checked for permissible values on input. In the event of an error, the corresponding error message is output if parameterisation error monitoring is activated, Pm.0.7.

Sensor monitoring

If there is a sensor error, the appropriate error message, which cannot be deactivated, is output.

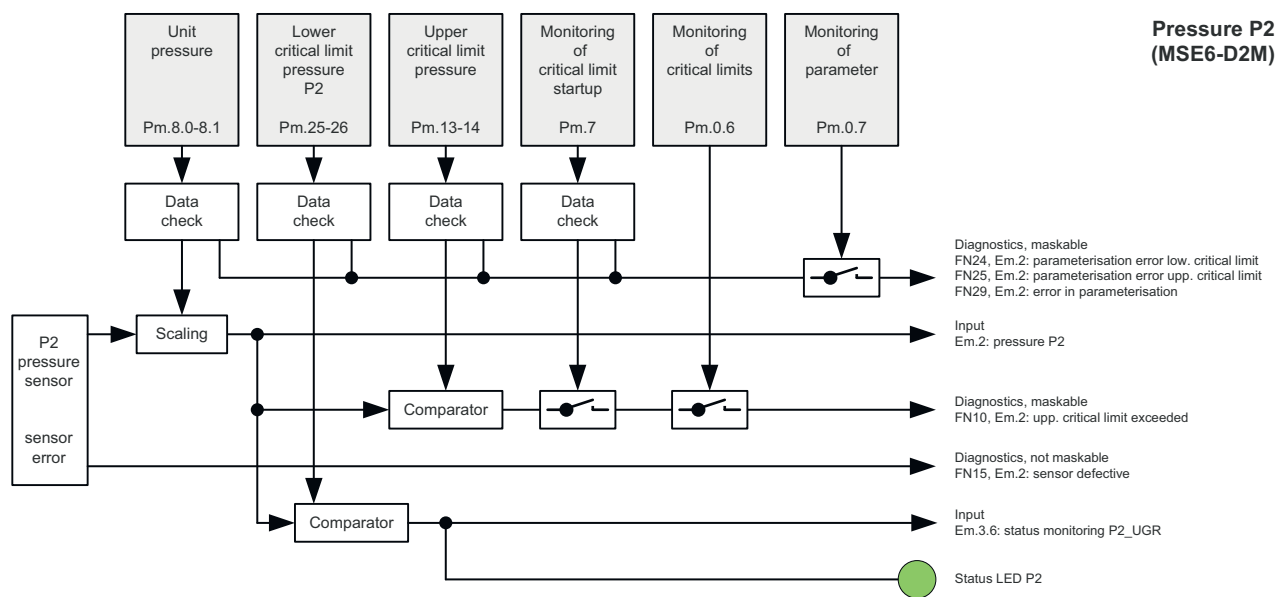


Fig. 9: Block diagram of the “Pressure” function

6.1.4 Pressure change

6.1.4.1 Measurement method

The pressure change DP2 is determined cyclically at intervals of the parameterisable pressure change sample time DT. When calculating the pressure change, the difference between the current measured pressure value and the measured pressure value DT, based on the pressure change sample time P2, is calculated:
 $DP2 = P2(t) - P2(t-DT)$; t = current measuring point.

The start of the measuring cycle to calculate the pressure change is automatically synchronised with the activation signal of the shut-off valve. The current pressure change value DP2 remains constant up to the next measuring time. Every time the unit, Pm.8, parameter is written, a re-synchronisation follows.

In the blocking state, the amount of the pressure change value is compared to the upper pressure change critical limit DP2_OGR and monitored to determine whether the critical limit has been exceeded. Once critical limit monitoring is activated, a diagnostic message is generated if the parameter $ABS(DP2) > DP2_OGR$. Information on the resolution of the pressure measurement range
 ➔ 13.2 Technical data, pneumatic.

DT synchronisation and DP2 OGR critical limit monitoring

The time diagrams show the DT synchronisation and DP2 OGR critical limit monitoring.

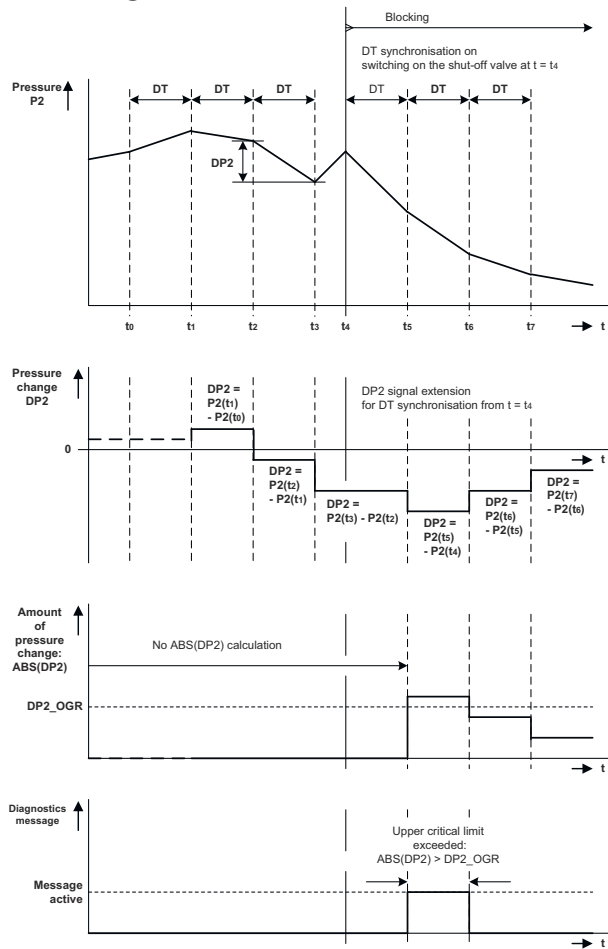


Fig. 10: DT synchronisation and DP2 OGR critical limit monitoring

6.1.4.2 Function structure

Input signal

The measured pressure change value DP2 is prepared according to the set unit pressure, Pm.8.0-8.1, and pressure change sample time, Pm.10, parameters and can be shown as a selectable input signal in Em.5 and/or Em.6.

Critical limit monitoring

If the shut-off valve is in the blocking state, the amount of the measured pressure change is compared with the upper pressure change limit value, Pm.15-16, parameter using a comparator. If limit value monitoring is activated, Pm.0.6, the appropriate error/diagnostic message is output if the limit value is exceeded.

Monitoring parameters

The unit pressure, Pm.8.0-8.1, pressure change sample time, Pm.10, and upper pressure change limit value, Pm.15-16, are checked for permissible values on input. In the event of an error, the corresponding error message is output if parameterisation error monitoring is activated, Pm.0.7.

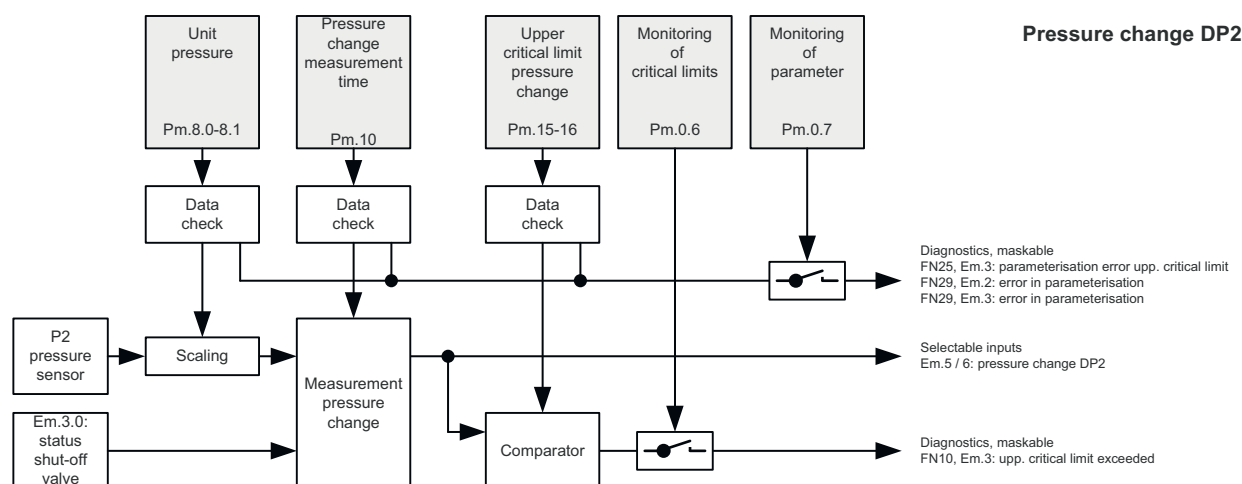


Fig. 11: Block diagram of the pressure change function

6.1.5 Pressure regulation and blocking function

6.1.5.1 Overview

The pressure control function and blocking function determine the current module status by evaluating sampled pressure values and flow rate values. The desired outlet pressure P2 is set by controlling the pressure regulator and the shut-off valve accordingly.

Depending on the setting, the module works in user-controlled or automatic pressure regulation mode and blocking function.

The shut-off valve is controlled directly in the user-controlled pressure regulation and blocking mode. One of the various fixed values or a variable value can be set as the target pressure.

The target pressure is set to Auto Normal in the basic state in the automatic pressure regulation and blocking function. If the flow rate falls below the set flow rate critical limit for the specified period of time, the automatic pressure regulation and blocking function first switches to shut-off mode if activated accordingly. After a pressure drop to the auto standby setpoint pressure, the function then switches to pressure regulation mode with the target pressure auto standby setpoint pressure.

In this state, a corresponding control signal is required to change to pressure regulation mode with the auto normal setpoint pressure. Depending on the selection, this control signal must be generated by an output control bit or one of the two electrical inputs.

Status signals and status signals of the pressure control and blocking function are displayed in an input word for process monitoring by the user.

In both user-controlled and automatic pressure regulation there is an internal module setpoint pressure value limitation to a range of 0.25 MPa ... 1 MPa (2.5 bar ... 10-bar; 36.3 psi ... 145.04 psi) and a parameterisable setpoint pressure rise limitation.

The entire structure of the pressure regulation and blocking function with all sub-functions, operands, inputs, outputs, parameters and error/diagnostic messages is described in the Function Structure section.

6.1.5.2 User-controlled pressure regulation and blocking function, USER

The user-controlled pressure regulation and blocking function is activated if the auto user output control, Am.0.1 has the value 0, not active.

In this state, the user can then switch the shut-off valve to the pressurise or block status with the output controller shut-off valve, Am.0.0. The switching status of the shut-off valve is signalled in input Em.3.0.

For the setpoint pressure value for the pressure regulating valve, the setpoint pressure user selection, Am.0.3-0.4, output can be used to select the following values and functions:

- Power-on setpoint pressure, with the setpoint pressure power-on parameter, Pm.28.2, adjustable to 1 MPa (10 bar; 145.04 psi) or 0.6 MPa (6 bar; 87.02 psi).
- minimum setpoint pressure, 0.25 MPa (2.5 bar; 36.3 psi).
- deactivated electronic pressure regulation.
- variable setpoint pressure setting via user setpoint pressure output, Am.2.

At power-on and any further user-side increase in the setpoint pressure value, the rise slope is limited to the value set with the setpoint pressure rise limitation parameter, Pm.28.4-28.6.

The time diagram shows the module behaviour after power-on and subsequent variable target pressure adjustment to 2 different values.

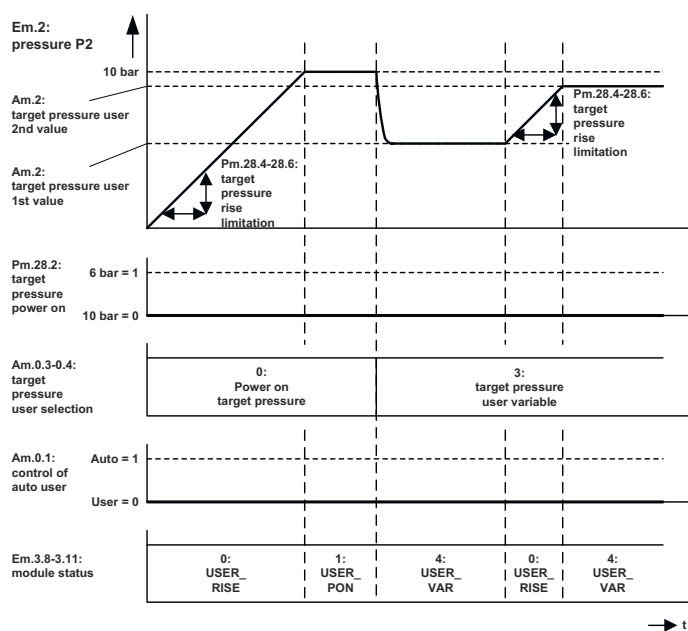


Fig. 12: User controlled pressure control and blocking operation

6.1.5.3 Automatic pressure control and locking operation, AUTO

The automatic pressure regulation and blocking function is activated when the auto user output control Am.0.1 has the value 1, active.

The automatic pressure control and blocking function starts each time it is activated in the module state AUTO_NORMAL, Em.3.8-3.11 = 8. In this state, the non-return valve is open and the pressure regulator controls at the setpoint value pressure Auto Normal parameter value, Pm.21-22. At the same time, the Q_low-Timer function starts monitoring to check whether the flow rate value falls below the auto controller flow rate critical limit parameter value, Pm.19-20. If the value falls below the limit value, the AUTO_WAIT state, Em.3.8-3.11 = 9, changes and the duration of the state is monitored by the Q_low-Timer. If the limit value

is undershot by the time limit set with the auto controller delay time parameter, Q_{low} -Timer, it switches to the state AUTO_HOLD, Em.3.8-3.11 = 10. In this state, if the shut-off valve is still open, the setpoint pressure is set to auto normal. If the flow rate reaches or exceeds the auto controller flow rate critical limit value during the AUTO_NORMAL, AUTO_WAIT and AUTO_HOLD states, the flow rate immediately returns to the AUTO_NORMAL state, Em.3.8-3.11 = 8.

To switch the target pressure from auto normal to auto standby in the AUTO_HOLD state, the auto enable output control, Am.0.5 = 1, must be activated. This can be done permanently or by the user depending on the system, e.g. if automatic switching is not permitted due to the situation.

If the auto enable output controller is activated in the AUTO_HOLD status, Am.0.5 = 1, the shut-off valve switches to the shut-off state and the new module status is AUTO_SHUTOFF, Em.3.8-3.11 = 11. As soon as pressure P2 has fallen to the set auto standby setpoint pressure, the module status switches to the AUTO_STANDBY state, Em.3.8-3.11 = 12. The shut-off valve is open again and the pressure regulating valve regulates to the auto standby setpoint pressure.

A change from the AUTO_STANDBY module state with auto standby setpoint pressure to the AUTO_NORMAL module state with auto normal setpoint pressure is only possible after reset of the Q_{low} -Timers.

While the pressure is increasing the function is in the AUTO_RISE module status, Em.3.8-3.11 = 13. In this state, the slope of the pressure rise is limited to the value set with the setpoint pressure rise limitation parameter, Pm.28.4-28.6.

The following figure gives an overview of the relevant measurement, control and status signals of the automatic pressure regulation and blocking function. In order to reset the Q_{low} -Timers, the Q_{low} -Timer-Reset output, Am.0.2, is set as signal source.

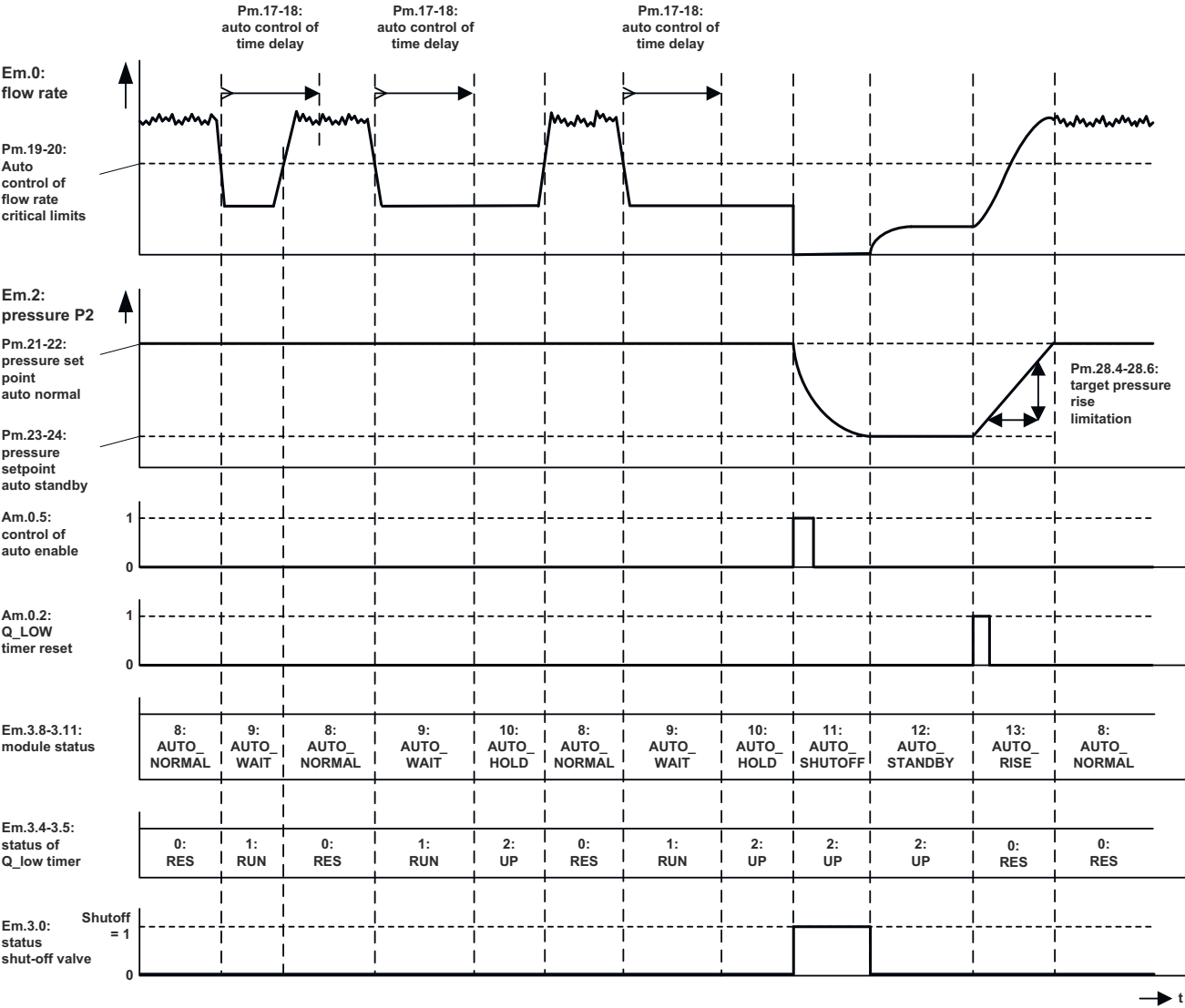


Fig. 13: Automatic pressure control and blocking operation

6.1.5.4 Functional states

The current functional state is displayed in the input module state, Em.3.6-3.9. The table shows an overview of the possible functional states in all operating modes.

Em.3.8-3.11 Module status	Functional status	Functional mode	Meaning
0	USER_RISE	USER	Pressure increase until the target pressure set by the user is reached
1	USER_PON	USER	Pressure regulation to set power-on setpoint pressure
2	USER_MIN	USER	Pressure regulation at minimum setpoint pressure, 0.25 MPa (2.5 bar; 36.3 psi)
3	USER_REGOFF	USER	Electronic pressure regulation is deactivated
4	USER_VAR	USER	Pressure regulation to set setpoint pressure according to Am.2
5	USER_SHUTOFF	USER_	Module in blocking status
7	OFF_24VA	USER/AUTO	No load voltage supply; Pressure control and blocking function not active
8	AUTO_NORMAL	AUTO	Pressure regulation at parameterised auto normal setpoint pressure
9	AUTO_WAIT	AUTO	Pressure regulation at parameterised auto normal setpoint pressure, Q _{low} -Timer expired, automatic pressure regulation and blocking function not activated
10	AUTO_HOLD	AUTO	Pressure regulation at parameterised auto normal setpoint pressure, Q _{low} -Timer expired, automatic pressure regulation and blocking function not activated
11	AUTO_SHUTOFF	AUTO	Module in blocking status, Q _{low} -Timer expired, automatic pressure regulation and blocking function activated
12	AUTO_STANDBY	AUTO	Pressure regulation at parameterised auto standby setpoint pressure
13	AUTO_RISE	AUTO	Pressure increase up to the parameterised auto normal setpoint pressure

Tab. 6: Possible functional states in all operating modes

6.1.5.5 Function structure

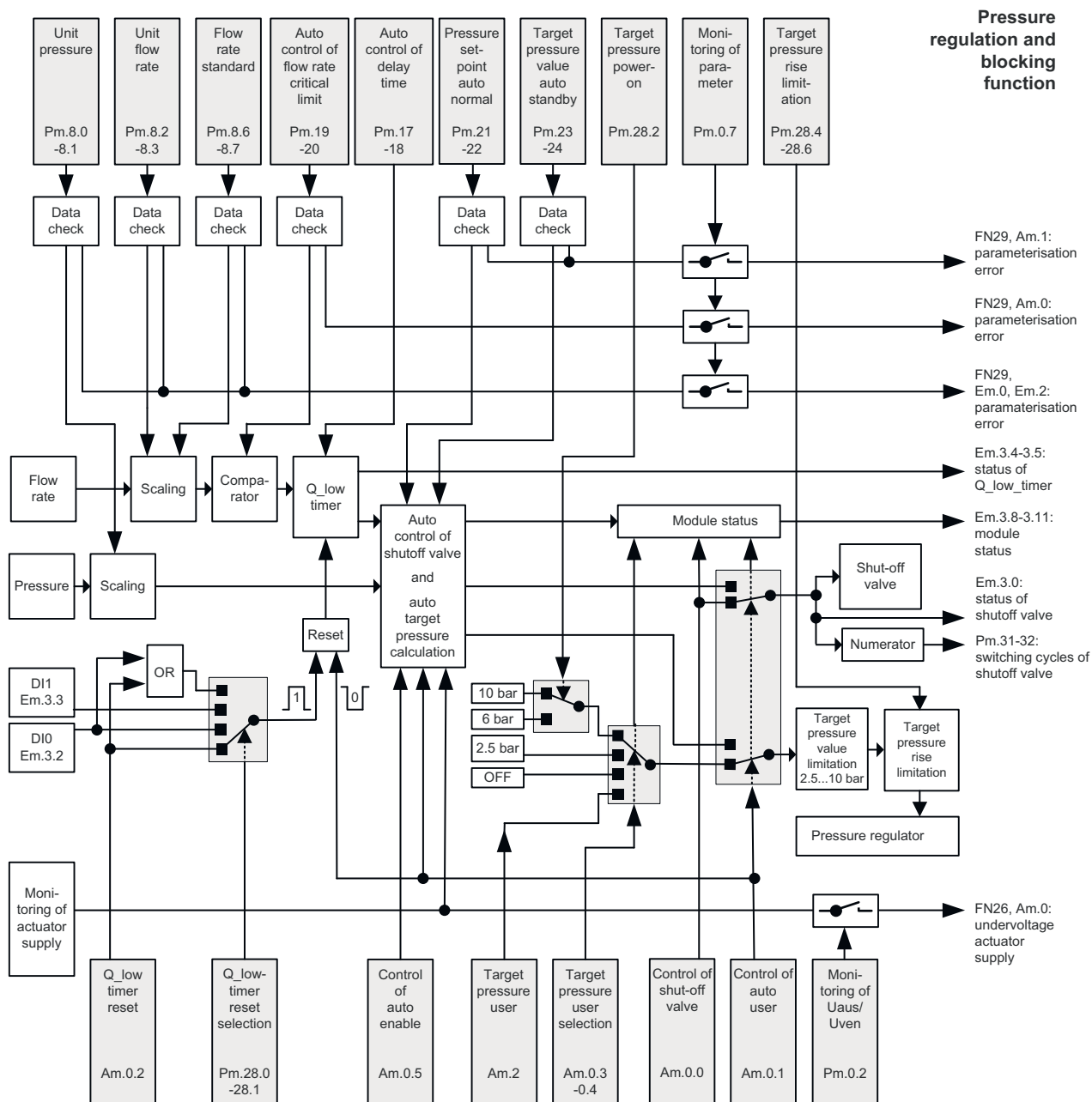


Fig. 14: Block diagram of the pressure control and blocking function

Q_low-Timer

The Q_{low}-Timer function continuously compares the processed flow rate measured value with the auto-controller flow rate critical limit parameter. If the critical limits are undershot, the Q_{low}-Timer is started. The Q_{low}-Timer enters the UP status if the flow rate limit value is undershot for the time parameterised in the auto-controller delay time parameter, Pm.17-18.

The timer status is displayed in the status input Q_low-Timer, Em.3.4-3.5, and can have the following values:

- 0 = RES: the timer is reset and not started.
- 1 = RUN: the timer has been started and is running.

The timer has not yet exceeded the auto-controller delay time parameter value, Pm.17-18.

- 2 = UP: the Timer has expired.

The timer has overshoot the auto-controller delay time parameter value, Pm.17-18.

The Q_{low}-Timer is reset in the following cases:

- in the AUTO_WAIT module status, Em.3.8-11 = 9, and
in the AUTO_HOLD module status, Em.3.8-11 = 10, if the auto-controller flow rate limit value is overshoot, Pm.19-20.
- by a reset control signal, 1 = active. The signal can be selected with the Q_{low}-Timer-Reset selection parameter, Pm.28.0-28.1:
 - output Q_{low}-Timer-Reset, Am.0.2
 - electrical input DI0
 - electrical input DI1
 - logic operation: electrical input DI0 OR output Q_{low}-Timer-Reset, Am.0.2

Module status

The module status results from the status or status of sub-functions of the pressure regulation and blocking function and is displayed in input, Em.3.8-3.11. The individual module states are described in the Function states chapter.

Shut-off valve

Depending on the setting of auto user output control, Am.0.1, the shut-off valve is controlled either by the user or by the shut-off valve auto-controller partial function.

The switching status of the shut-off valve is determined by the input Status shut-off valve input status, Em.3.0.

The number of shut-off valve switching cycle is returned in different types and data formats:

- 16-bit or 32-bit input value via selectable inputs Em.5 and/or Em.6
- 16 bit parameter value, Pm.31-32

Pressure regulator

Depending on the setting of auto user output control, Am.0.1, the setpoint pressure for the pressure regulator is determined as follows:

- by the target pressure value set by the user
- by the setpoint pressure value specified by the auto setpoint pressure sub-function.

Before forwarding to the pressure regulator, the setpoint value is limited to values between 2.5 ... 10.0 bar within the module. The rise is limited to the set parameter value when the target pressure is increased.

Monitoring parameters

The unit pressure, Pm.8.0-8.1, flow rate unit, Pm.8.2-8.3, standard flow rate, Pm.8.6-8.7, auto-controller flow rate limit value, Pm.19-20, re checked for permissible on input. In case of error, the appropriate error message is generated if parameterisation error monitoring is activated, Pm.0.7.

Actuator supply monitoring

This function is used to monitor the actuator supply for undervoltage. In case of error, the corresponding error message is generated with activated monitoring, Pm.0.2.

6.1.6 Electrical inputs

The electrical inputs function is fitted with 2 digital inputs, which can also be used to reset the Q_{low}-Timers of the pressure regulation and blocking functions with applicable parameterisation.

Input signals

The signals of electrical inputs 0 and 1 are processed according to the debounce time DI, Pm.27.4-27.5, and signal extension time DI, Pm.27.2-27.3, parameters. The times are valid for both channels. The activation of the signal extension is

set channel by channel with the signal extension channel DI0, Pm.27.0, and signal extension channel DI1, Pm.27.1, parameters. The input signals are provided as electrical input DI0, Em.3.2, and electrical input DI1, Em.3.3.

Status indicators

The status of the electrical inputs is indicated channel by channel by status LEDs. When the LED is lit, a logic 1 is present at the input, when the LED is not lit, a logic 0.

Sensor supply

The sensor supply voltage U_{SEN} is supplied at the connections for the electrical inputs. The sensor supply voltage U_{SEN} is internally protected against short-circuit/overload. The parameter Behaviour after short-circuit/overload sensor supply, Pm.27.6, is used to set whether the sensor supply is switched on again after short-circuit/overload end or remains switched off. If the diagnostics are activated with the monitoring short-circuit supply, overload supply, sensor supply, Pm.0.0, parameter, the corresponding error message is generated in the event of an overload.

m = module number (0)

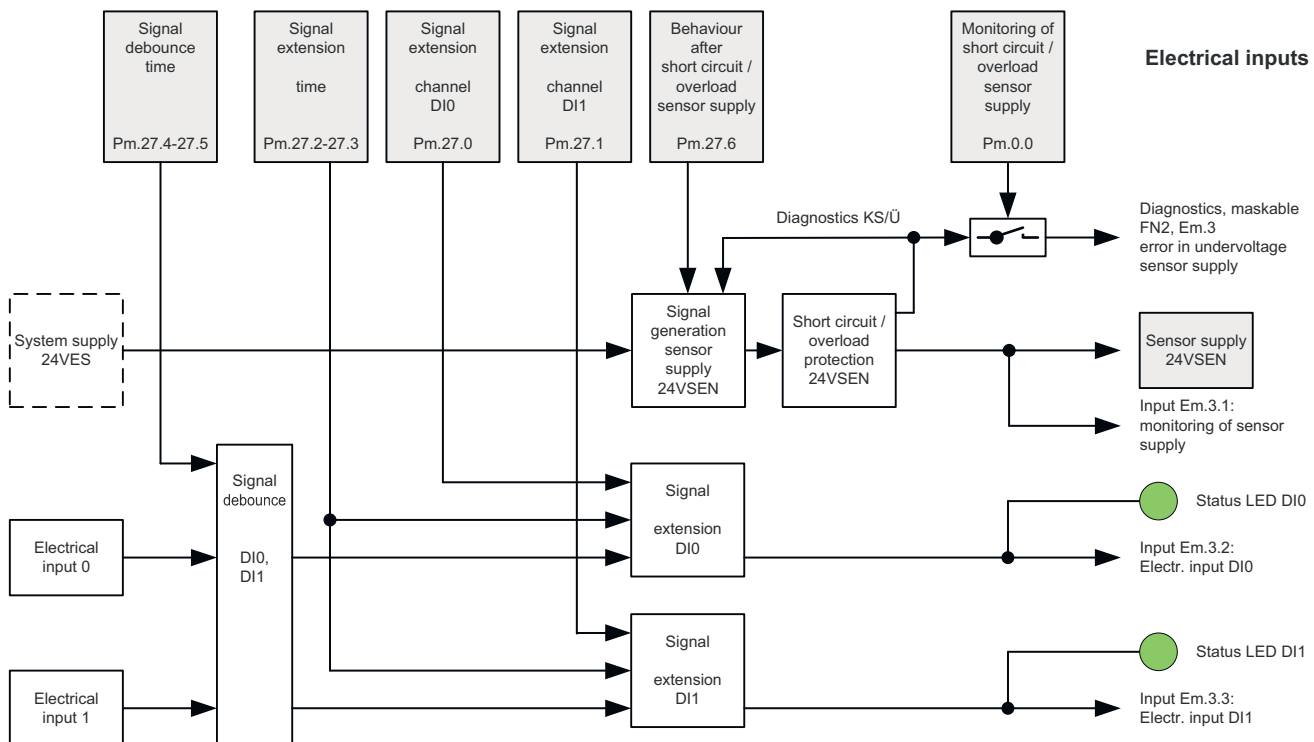


Fig. 15: Block diagram, electrical inputs

6.1.7 Electrical outputs

The electrical outputs function is equipped with 2 digital outputs, one of which can be used alternatively for the output of the consumption measurement pulse.

Output signals

The electrical outputs are controlled via the module control Am.0.6 and Am.0.7 outputs during basic setup. Alternatively, the consumption measurement pulse VC can be output at output D00 if the D00 Signal Selection, Pm.28.3, parameter is set accordingly.

The electrical outputs have internal short-circuit and overload protection. The behaviour after short-circuit/overload outputs, Pm.27.7, parameter defines whether the electrical outputs remain switched off after the end of the short-circuit/overload or are automatically switched on again.

Status indicators

The status of the electrical outputs is displayed channel by channel by means of a status LED. When the LED is lit, the output provides a logic 1. If the LED is not lit, the output provides a logic 0.

Monitoring of short circuit/overload

The electrical outputs are monitored channel by channel for short-circuit/overload. The error status is signalled in the module status, Em.3.14 for output 0, Em.3.15 for output 1, input. In addition, with activated diagnostics, setting with parameter Pm.0.1, a group error message is generated for outputs 0 and 1 if at least 1 channel is overloaded.

Actuator supply monitoring

The actuator supply is monitored for undervoltage. In case of error, the corresponding error message is generated with activated monitoring, Pm.0.2.

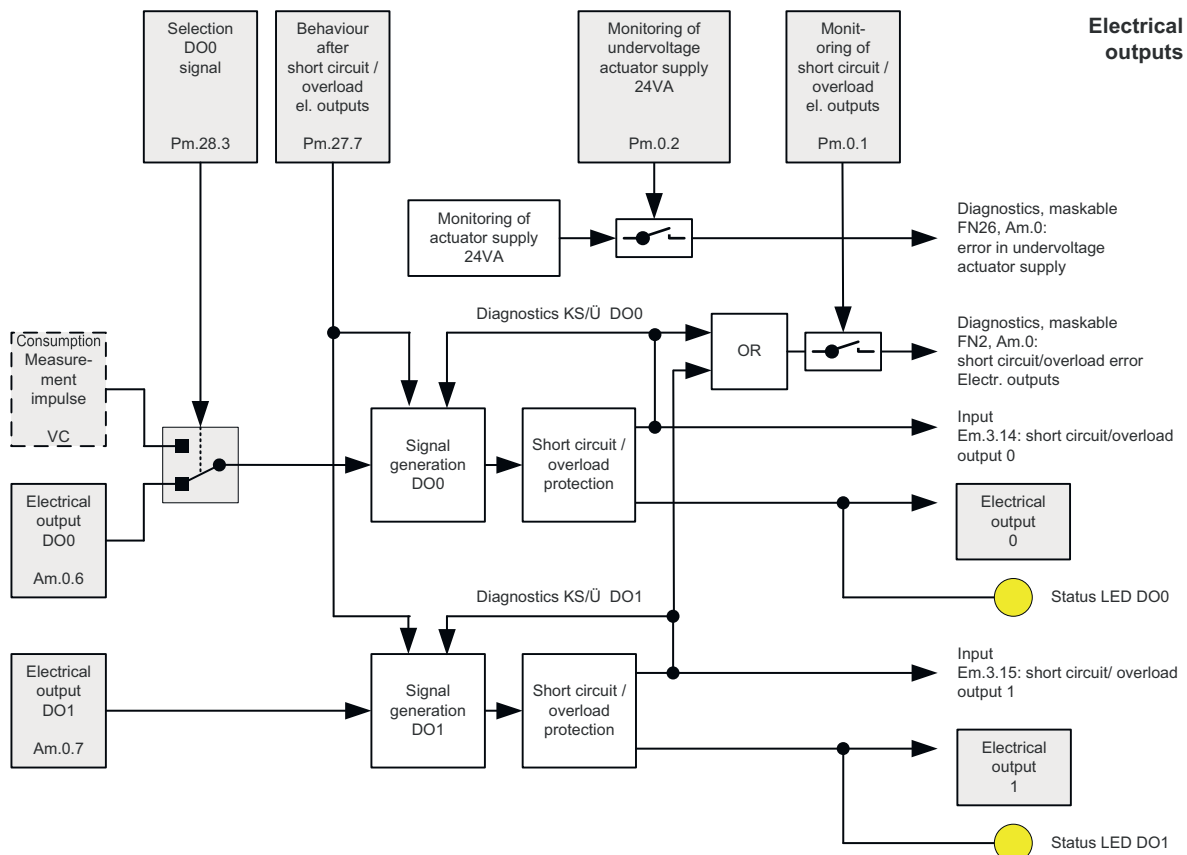


Fig. 16: Block diagram, electrical outputs

6.2 Input/output data

The energy efficiency module has multiple items of functional module data, which can be exchanged with the higher-order controller using the I/O data presented below.

6.2.1 Overview

Data field / function	Input ¹⁾	Output
Flow measurement		
Measured value	Em.0	–
Consumption measurement		
Measured value V0, 16 bit	Em.1 ²⁾	Input address for data selection: Am.1
Measured value V0, 32 bit	Data access via selectable input data: Em.5, Em.6	
Measured value V1, 16 bit		
Measured value V1, 32 bit		

Data field / function	Input ¹⁾	Output
Measurement impulse VC	Em.3.7	–
Status V0	Em.3.12	–
Status V1	Em.3.13	–
Consumption V0 Run	–	Am.0.12
Consumption V0 Reset	–	Am.0.13
Consumption V1 Run	–	Am.0.14
Consumption V1 Reset	–	Am.0.15
Pressure measurement		
Measured value	Em.2	–
Monitoring of lower critical limit	Em.3.6	–
Pressure change measurement		
Measured value	Data access via selectable input data: Em.5, Em.6 → 6.2.3 Selectable input data function.	Input address for data selection: Am.1 → 6.2.3 Selectable input data function.
Pressure regulation and blocking function		
Status of shut-off valve	Em.3.0	–
Status Q_low-Timer	Em.3.4-3.5	–
Module status	Em.3.8-3.11	–
Shut-off valve controller	–	Am.0.0
Auto-user controller	–	Am.0.1
Q_low-Timer-Reset	–	Am.0.2
Selection of user target pressure	–	Am.0.3-0.4
Auto enable controller	–	Am.0.5
User pressure setpoint	–	Am.2
Electrical inputs		
Monitoring Sensor supply	Em.3.1	–
Status of electrical input 0	Em.3.2	–
Status of electrical input 1	Em.3.3	–
Electrical outputs		
Monitoring Electrical output 0	Em.3.14	–
Monitoring Electrical output 1	Em.3.15	–
Controller Electrical output 0	–	Am.0.6
Controller Electrical output 1	–	Am.0.7
Selectable input data		
Input address	Em.4	Am.1
Input data	Em.5 (data bits 0 ... 15)	–
	Em.6 (data bits 16 ... 32)	–

1) m = module number (0)

2) Data access also possible via selectable input data.

Tab. 7: Overview of I/O data

6.2.2 Description of the input data and output data

- The input words and output words of all input data and output data are shown in the MOTOROLA format, MSB-LSB. If the control system uses a different byte order, this must be taken into account in the user program.
- The input words, 2 bytes, 16 bits, are sent to the higher-order controller.
- The output words, 2 bytes, 16 bits, are sent from the higher-order controller.

6.2.2.1 Output word Am.0 module control

The output word Am.0 controls the pressure control function and blocking function as well as the consumption measurement.

Data format of output word 16 bits, right-justified															
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
B15	B14	B13	B12	—	—	—	—	B7	B6	B5	B4	B3	B2	B1	B0
MSB															LSB
Abbreviations used															
B0		Shut-off valve controller													
B1		Auto-user controller													
B2		Q_low-Timer-Reset													
B3, B4		Selection of user target pressure													
B5		Auto enable controller													
B6		Electrical controller output 0													
B7		Electrical controller output 1													
B12		Consumption V0 Run													
B13		Consumption V0 Reset													
B14		Consumption V1 Run													
B15		Consumption V1 Reset													
—		Reserved data bits													
D0 ... D15		16 bit output data field													
MSB/LSB		Most significant bit/least significant bit													

Tab. 8: Data format of output word Am.0

Output data, pressure regulation and blocking function

Data bit B0 has the following values:

- 0 = shut-off valve open, pressurisation state, default
- 1 = shut-off valve closed, blocking state

Data bit B1 has the following values:

- 0 = user-controlled pressure regulation and blocking function active operating mode, default
- 1 = automatic pressure control regulation and blocking function active operating mode

Data bit B2 has the following values:

- 0 = no status change of the Q_low-Timers, default
- 1 = Resetting the Q_low-Timers

Data bits B3 and B4 have the following values:

- 0 = user-controlled setpoint pressure = power-on setpoint pressure, depending on Pm.28.2, default
- 1 = user-controlled target pressure = 2.5 bar
- 2 = electronic pressure regulation not active
- 3 = user-controlled target pressure = target pressure user variable (Am.2)

Data bit B5 has the following values:

- 0 = automatic pressure control function and blocking function not active, default
 - 1 = automatic pressure regulation and blocking function active
- The control signal can be used for user controlled or permanent activation of the automatic pressure control function and blocking function.

Output data, electrical outputs

Data bit B6 has the following values:

- 0 = electrical output 0 sends logic 0, default
- 1 = electrical output 0 sends logic 1

Data bit B7 has the following values:

- 0 = electrical output 1 sends logic 0, default
- 1 = electrical output 1 sends logic 1

Consumption measurement output data

Data bits B12 and B14 have the following values:

- 0 = measurement not active: measurement is stopped, default
- 1 = measurement active: measurement is started or continued

Data bits B13 and B15 have the following values:

- 0 = reset function not active, default
- 1 = reset function active: measured consumption value is reset to value 0

6.2.2.2 Output word Am.1 input address

The output word Am .1 belongs to the selectable input data function and is described in the chapter of the same name.

6.2.2.3 Output word Am.2 pressure setpoint P2

Setting target pressure P2

- in the user-controlled pressure control function and blocking function operating mode, Am.0.1
- with output word P2
- with user-controlled target pressure, Am.0.3 = 3
- in the currently valid pressure unit, Pm.8.0-8.1

Data format of output word sign + 15 bits, right-justified															
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
VZ	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
MSB															LSB
Abbreviations used															
VZ		Sign (for data format sign + 15 bits always = 0, i. e. positive value)													
B0 ... B14		Pressure setpoint P2													
D0 ... D15		16 bit output data field													
MSB/LSB		Most significant bit/least significant bit													
Remarks		Pressure setpoint values are automatically limited within the permissible value range, 0 ... 32767, to the end values of the nominal pressure range within the module, depending on the parameterised pressure unit and without an error message: – mbar: 2500 ... 10000 – kPa: 250 ... 1000 – psi/10: 363 ... 1450													

Tab. 9: Data format of output word Am.2

6.2.2.4 Input word Em.0 flow rate

In the input word Em.0, the flow rate value is displayed in accordance with the parameterised flow rate unit and flow rate standard. The default value of the unit flow rate module parameter is l/min, the default value of the flow rate standard module parameter is DIN 1343.

Data format of input word Sign + 15 bits, right-justified															
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
VZ	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
MSB															LSB
Abbreviations used															
VZ	Sign, for data format sign + 15 bits always = 0, i.e. positive value														
B0 ... B14	Flow rate value														
D0 ... D15	16-bit input data field														
MSB/LSB	Most significant bit/least significant bit														

Tab. 10: Data format of input word Em.0 flow rate

Flow rate	Input value	
[l/min]	[l/min]	[scfm/10]
0	0	0
50	50	18
...	...	...
5000	5000	1766

Tab. 11: Unit-dependent flow rate values

6.2.2.5 Input word Em.1 consumption

In the input word Em.1, the consumption value V0, 16 bits, is displayed in accordance with the parameterised consumption unit and flow rate standard and limited to max. 65535, 16-bit value, independently of the parameterised unit.

The measurement value is also available as a 32-bit value via selectable input data.

The default value of the unit consumption module parameter is l, the default value of the unit flow rate standard module parameter is DIN 1343. If there is a change to the flow rate unit and/or flow rate standard, the consumption is reset to the value 0. If there is a change to the consumption unit, the consumption value remains unchanged and is converted correspondingly.

Data format of input word 16 bits, right-justified															
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
MSB															LSB
Abbreviations used															
B0 ... B15	Consumption value														
D0 ... D15	16-bit input data field														
MSB/LSB	Most significant bit/least significant bit														

Tab. 12: Data format of input word Em.1 "Consumption"

6.2.2.6 Input word Em.2 pressure P2

In the input word Em.0, the pressure value P2 is displayed in accordance with the parameterised pressure unit. The presetting of the module parameter “Unit pressure” is “mbar”.

Data format of input word sign + 15 bits, right-justified															
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
VZ	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
MSB															LSB
Abbreviations used															
VZ	Sign, for data format sign + 15 bit, always=0, positive value														
B0 ... B14	Pressure value P2														
D0 ... D15	16-bit input data field														
MSB/LSB	Most significant bit/least significant bit														

Tab. 13: Data format of input word Em.2 "Pressure P2"

Pressure P2	Input value			
[bar]	[kPa]	[mbar]	[psi/10]	
0	0	0	0	
1	100	1000	145	
4	400	4000	580	
...	...	...	...	
7.36	736	7360	1067	
...	...	...	...	
14	1400	14000	2030	

Tab. 14: Unit-dependent pressure values



The pressure measurement data is presented according to the unit and is rounded off.

Measured value resolution:

- kPa: 2
- mbar: 20
- psi/10: 5

6.2.2.7 Input word pressure change DP2

The value of the pressure change can only be displayed via selectable input data as a signed 16-bit value in the input words Em.5 and/or Em.6 in accordance with the parameterised pressure unit and pressure change measurement time.

Data format of input word sign + 15 bits, right-justified															
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
VZ	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
MSB															LSB
Abbreviations used															
VZ	Prefix														
B0 ... B14	Pressure change value														
D0 ... D15	16-bit input data field														
MSB/LSB	Most significant bit/least significant bit														

Tab. 15: Data format of input word Em.5/Em.6 “Pressure change”

6.2.2.8 Input word Em.3 module status

In the input Em.3 status information and module status information are shown.

Data format of input word 16 bits, right-justified															
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
MSB															LSB
Abbreviations used															
B0		Status of shut-off valve													
B1		Monitoring sensor supply													
B2		Status of electrical input 0													
B3		Status of electrical input 1													
B4, B5		Status Q_low-Timer													
B6		Monitoring of lower critical limit pressure P2													
B7		Measurement of impulse consumption VC													
B8 ... B11		Module status													
B12		Status of consumption V0													
B13		Status of consumption V1													
B14		Monitoring of electrical output 0													
B15		Monitoring of electrical output 1													
D0 ... D15		16 bit input data field													
MSB/LSB		Most significant bit/least significant bit													

Tab. 16: Data format of the input word Em.3 module status

Input data, shut-off function

Data bit B0 has the following values:

- 0 = shut-off valve open, pressurisation status
- 1 = shut-off valve closed, blocking state

Data bits B4, B5 indicate the status of the Q_low-Timers and have the following values:

- 0 = RESET: Q_low-Timernot started
- 1 = RUN: Q_low-Timer running
- 2 = UP: Q_low-Timer expired

Data bits B8 ... B11 signal the current function status and have the following values:

- 0 = USER_RISE: pressure increase until user-set setpoint pressure is reached, USER mode
- 1 = USER_PON: pressure regulation to set power-on setpoint pressure, USER mode
- 2 = USER_MIN: pressure regulation to minimum setpoint pressure = 2.5 bar, USER mode
- 3 = USER_REGOFF: electronic pressure regulation deactivated, USER mode
- 4 = USER_VAR: pressure regulation to set setpoint pressure according to Am.2, USER mode
- 5 = USER_SHUTOFF: module in blocking state, USER mode
- 7 = OFF_24VA: no load voltage supply, pressure control function and blocking function not active, USER/AUTO mode
- 8 = AUTO_NORMAL: pressure regulation at parameterised setpoint pressure auto normal, AUTO mode

- 9 = AUTO_WAIT: pressure regulation at parameterised setpoint pressure auto normal during an underrun of the parameter value auto-controller flow rate limit value, Q_{low}-Timer running, AUTO mode
- 10 = AUTO_HOLD: pressure control to the configured auto normal setpoint pressure, Q_{low}-Timer expired, automatic pressure control function and blocking function not activated, AUTO mode
- 11 = AUTO_SHUTOFF: module in lockout state, Q_{low}-Timer expired, automatic pressure control function and lockout function activated, AUTO mode
- 12 = AUTO_STANDBY: pressure regulation to parameterised setpoint pressure auto standby, AUTO mode
- 13 = AUTO_RISE: pressure increase up to the configured setpoint pressure auto normal, AUTO mode

Input data of pressure measurement

Data bit B6 has the following values:

- 0 = pressure P2 is $\geq$ the parameter value Lower pressure critical limit P2
- 1 = pressure P2 is < than the lower pressure critical limit P2 parameter value

Consumption measurement input data

Data bit B7 indicates the measurement impulse of the continuous consumption measurement and has the following values:

- 0 = Idle signal between consumption measurement impulses
- 1 = 100 ms continuous consumption measurement impulse after 200 l with consumption unit l³
- 1 = 100 ms continuous consumption measurement impulse after 10 scf with consumption unit scf

Data bit B12 has the following values:

- 0 = measurement of consumption V0 not active
- 1 = measurement of consumption V0 active

Data bit B13 has the following values:

- 0 = measurement of consumption V1 not active
- 1 = measurement of consumption V1 active

Input data Electrical inputs

Data bit B1 has the following values:

- 0 = sensor supply is switched off (after short-circuit/overload)
- 1 = sensor supply is switched on

Data bit B2 has the following values:

- 0 = signal at electrical input 0 not present (logic 0)
- 1 = signal at electrical input 0 applied (logic 1)

Data bit B3 has the following values:

- 0 = signal at electrical input 1 not present (logic 0)
- 1 = signal at electrical input 1 applied (logic 1)

Input data electrical outputs

Data bit B14 has the following values:

- 0 = no short-circuit/overload at electrical output 0
- 1 = short-circuit/overload at electrical output 0

Data bit B15 has the following values:

- 0 = no short-circuit/overload at electrical output 1
- 1 = short-circuit/overload at electrical output 1

6.2.3 Selectable input data function

The input and output words of all I/O data are shown in the MOTOROLA format, MSB-LSB.

The selectable input data function allows a special read access to functional module data. By setting an address in the output word Am.1, depending on the address value in the input words Em.5 and Em.6, 2 16-bit values or one 32-bit value can be read at the same time. In the input word Em.4, the address of the currently shown input value is displayed. With invalid address values, the error bit is set (Em.4, B15 = 1).

6.2.3.1 Procedure

The extended read access must be performed by the user as follows:

1. Set the desired address in the output word, Am.1.
2. Compare input word Em.4, the current input address, and output word Am.1, set address.
3. Distinguish between the following cases:
 - The addresses are identical.
 - ➔ read in valid data from input words Em.5 and Em.6.
 - The addresses are different, Em.4, B15, ERR = 0.
 - ➔ Input data of the new address not yet available. Repeat the address comparison.
 - The addresses are different, Em.4, B15, ERR = 1.
 - ➔ The set address is not available. Set the valid address value.

As long as the set address remains unchanged, a comparison of the addresses and an evaluation of the error bit is not necessary. The data are updated cyclically. If an invalid or unsupported input address is set in, Am.1, the set address value is imported into, Em.4, selected input address, and bit 15, ERR, in, Em.4, is set to 1 at the same time. The selected input data words 0 and 1 in Em.5 and Em.6 each have the value 0.

6.2.3.2 Output word Am.1 input address

The address of the desired input value is transmitted.

Data format of input word 16 bits, right-justified															
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
MSB															LSB
Abbreviations used															
B0 ... B14		Address of the requested input value													
B15		Output bit with fixed value 0													
D0 ... D15		16-bit output data field													
MSB/LSB		Most significant bit/least significant bit													

Tab. 17: Data format of output word Am.1

6.2.3.3 Input word Em.4 selected input address

The address of the current input value is transmitted. In the basic setting, the address value 0 is set.

Data format of input word 16 bits, right-justified															
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
MSB															LSB
Abbreviations used															
B0 ... B14		Address of the input value shown													
B15		Error bit. ERR = 1: invalid/unsupported address													
D0 ... D15		16-bit input data field													
MSB/LSB		Most significant bit/least significant bit													

Tab. 18: Data format of the input word Em.4

6.2.3.4 Input word Em.5 selected input data word 0

The input data of the currently set address is transmitted.

Data format of input word 16 bits, right-justified															
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
MSB															LSB
Abbreviations used															
B0 ... B15		Input data word 0 of the currently set address													
D0 ... D15		16-bit input data field													
MSB/LSB		Most significant bit/least significant bit													

Tab. 19: Data format of the input word Em.5

6.2.3.5 Input word Em.6 selected input data word 1 'Selected input data word 1'

The input data of the currently set address is transmitted.

Data format of input word 16 bits, right-justified															
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
MSB															LSB
Abbreviations used															
B0 ... B15		Input word 1 of the currently set address													
D0 ... D15		16-bit input data field													
MSB/LSB		Most significant bit/least significant bit													

Tab. 20: Data format of the input word Em.6

6.2.3.6 Selectable 32-bit input data with permanently assigned address

The selectable 32-bit input data with fixed addresses are represented at a fixed position in the input words Em.5 and Em.6.

Input address	Selected input data		
Output word Am.1	Input word Em.6	Input word Em.5	—
Input address 'Input address'	Selected input data word 1 'Selected input data word 1'	Selected input data word 0 'Selected input data word 0'	—

Input address		Selected input data		
decimal	hexadecimal	Value	Value	Description
10000	0x2710	Consumption V0 B31 ... B16	Consumption V0 B15 ... B0	Consumption value V0 with 32-bit limit
10001	0x2711	Consumption V1 B31 ... B16	Consumption V1 B15 ... B0	Consumption value V1 with 32-bit limit
10002	0x2712	Module time of operation B31 ... B16	Module time of operation B15 ... B0	Module time of operation with 32- bit limit
10003	0x2713	Shut-off valve switching cycles B31 ... B16	Shut-off valve switching cycles B15 ... B0	Switching cycles Shut-off valve with 32-bit limitation

Tab. 21: Selectable input data with permanently assigned address

6.2.3.7 Selectable, freely combinable 16-bit input data with address to be calculated

The freely combinable 16-bit input data are values that can be displayed by the user in both Em.5 and in Em.6. The requires the address value to be calculated and displayed as follows in Am.1:

Input in hexadecimal display:

- Am.1, High Byte: Address of data in Em.6
- Am.1, Low Byte: Address of data in Em.5

Input in decimal display:

- Address value = address value of data in Em.6, x 256 + address of data in Em.5



An address value is only valid if the individual address values, low-byte value, high-byte value, are valid.

Available selectable individual data

Input address		Selected input data	
Low byte and/or high byte Address value in output word Am.1		Input word Em.5 or Em.6	
decimal	hexadecimal	Value	Description
0	0x00	Pressure change P2	Pressure change DP2 during the parameterised pressure change sample time
1	0x01	Fixed value 0	Reserved
2	0x02	Consumption V0	Consumption measure- ment value V0 with 16-bit limit
3	0x03	Consumption V1	Consumption measure- ment value V1 with 16-bit limit
4	0x04	Module time of operation	Module time of operation with 16-bit limit
5	0x05	Shut-off valve switching cycles	Shut-off valve cycles with 16-bit limitation

Input address		Selected input data	
6	0x06	Current module error	Current module error, only errors for which monitoring is activated and are reported: Low byte, 8 bits: Error number High byte, 8 bit: Error channel ¹⁾ , Em.x, Am.x continuous
7	0x07	All module errors	All module errors, independent of parameterised activation: Low byte, 8 bits: Error number high byte, 8 bit: Error channel ¹⁾ , Em.x, Am.x continuous

1) Error channel specification in consecutive counting: 0 ... 6: Em.0 ... Em.6.; 7 ... 9: Am.0 ... Am.2

Tab. 22: Available selectable individual data

Examples of addressing

Output word Am.1		Input word Em.6	Input word Em.5
Input address		Selected input data word 1	Selected input data word 0
'Input address'		'Selected input data word 1'	'Selected input data word 0'
decimal	hexadecimal	Value	Value
256 * 0 + 0 = 0 Default	0x000	Pressure change DP2	Pressure change DP2
256 * 6 + 0 = 1536	0x0600	Current module error	Pressure change DP2
256 * 3 + 2 = 770	0x0302	Consumption V1	Consumption V0
256 * 2 + 3 = 515	0x0203	Consumption V0	Consumption V1

Tab. 23: Examples of addressing

7 Assembly

The product is intended for wall mounting, e.g. on mounting plates. The mounting brackets are integrated and must not be removed.

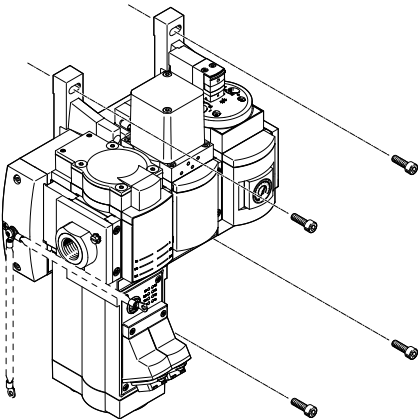


Fig. 17: Typical assembly

Prerequisite: the mounting surface is flat and can support the weight of the product.

1. Adjust the product to a vertical position, $\pm 5^\circ$.
2. Mount the product using the mounting brackets and 2 screws each. Screw size: M6. If necessary, use washers.

Dimensions

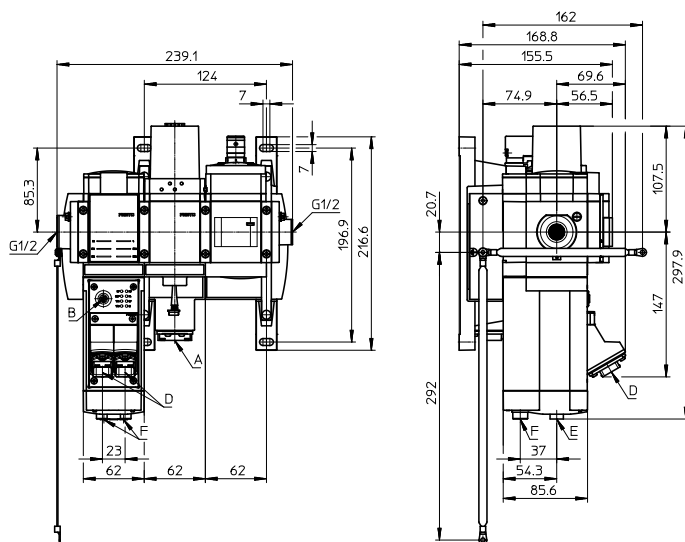


Fig. 18: Dimensions, example MSE6-C2M-5000-FB44-DM-RG-BAR-AMI-AGD

8 Installation

8.1 Pneumatic installation

Requirements:

- The product is mounted.
- The connection surfaces are clean. ➔ leakage and contact errors are avoided.

1. Connect pneumatic connections 1 and 2.
2. Mount a silencer or the exhaust air duct at pneumatic port 3.

8.2 Electrical installation

⚠ WARNING

Risk of Injury due to Electric Shock.

- For the electric power supply, use only PELV circuits that ensure a reliable electric disconnection from the mains network.
- Observe IEC 60204-1/EN 60204-1.
- The unit must be powered by a power source that fulfils the requirements of an energy-limited circuit in accordance with IEC 61010-1/EN 61010-1.

NOTICE

Damage to internal electronics.

Damage to components and malfunctions due to incorrect handling.

- Observe the handling specifications for electrostatically sensitive devices.

The following applies for the MSE6-C2M-...-M with CPX-Extension series 1 connection:

NOTICE**Material damage as a result of changing the connecting cable when the supply voltage is switched on**

- Connect and remove the CPX-Extension connecting cable only when the supply voltage is switched off for the control extension series 1 device.
- Only use pre-assembled connecting cables.

Electrical protection

The maximum permissible current load of the system supply for the MSE6-C2M-...-M with CPX-Extension is 6 A.

- Use a fuse with maximum 6 A for the operating voltage 24 V DC $U_{EL/SEN}$.
- Use a fuse with maximum 6 A for the load voltage supply 24 V DC U_{OUT} .

Installation

1. Connect the earth connection.
2. Connect the CPX-Extension connecting cable, only for MSE6-C2M-...-M
→ Tab. 27 CPX-Extension.
3. Connect the fieldbus cable.
4. Connect the power supply and electrical inputs and outputs.

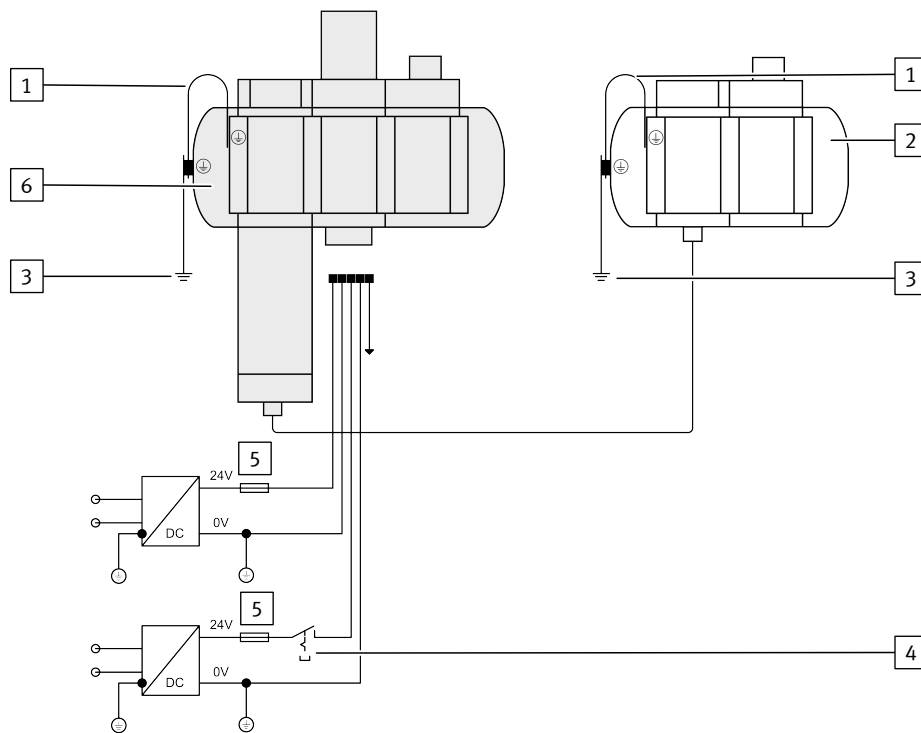
Electrical connection example

Fig. 19: Power supply with separate circuits and equipotential bonding

- | | |
|---|--|
| 1 Equipotential bonding between the earth terminal of the left-hand pneumatic connecting plate and the left end plate of the electrical linkage | 4 Supply for actuator technology/outputs that can be switched off separately |
| 2 MSE6-D2M | 5 External fuses |
| 3 Equipotential bonding of functional earth (FE) | 6 MSE6-C2M-...-M |

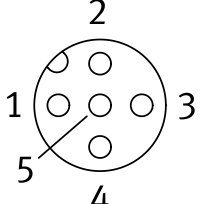
8.2.1 Connecting elements

Electrical inputs and electrical outputs

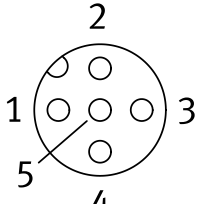
The energy efficiency module has two electrical inputs and two electrical outputs.

Connection	Position	Plugs
Electrical outputs	Connections on the cover under the bus node	Design: socket, M12, 5-pin Identification: X1
Electrical inputs	Connections on the cover under the bus node	Design: socket, M12, 5-pin Identification: X2

Tab. 24: Electrical inputs, electrical outputs

Connection X1	Pin	Function	Description
	1	–	Not assigned
	2	Output-1	Output 1
	3	0 V U _{Out}	Mass
	4	Output-0	Output 0
	5	FE	Functional earth

Tab. 25: Electrical outputs DO0 and DO1

Connection X2	Pin	Function	Description
	1	24 V DC U _{Sen}	Sensor supply voltage
	2	Input-1	Input 1
	3	0 V U _{Sen}	Earth for sensors
	4	Input-0	Input 0
	5	FE	Functional earth

Tab. 26: Electrical inputs DI0 and DI1

Bus node

The energy efficiency module has one of the following bus nodes:

- CPX-FB36, EtherNet/IP connection → 9.3.1 Interfaces and display components
- CPX-FB37, EtherCAT connection see description for bus node → 1 Applicable documents
- CPX-FB43, PROFINET RJ45 connection → 9.5.1 Interfaces and display components
- CPX-FB44, PROFINET M12 connection → 9.5.1 Interfaces and display components

CPX extension, energy efficiency module MSE6-C2M-...-M only

The energy efficiency module has a CPX-Extension series 1 connection.

Use only the preassembled extension connecting cables from Festo

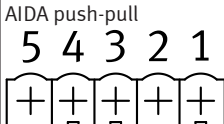
→ www.festo.com/catalogue.

Connection	Position	Plugs
CPX-Extension	Connections on the cover under the bus node	Design: M12, hybrid, 8-pin Identification: none

Tab. 27: CPX-Extension

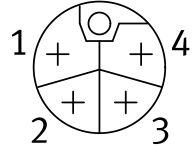
System supply

The energy efficiency module is supplied with power via an AIDA push-pull connector or an M12 connector.

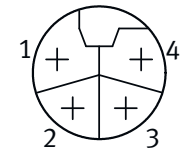
Plugs	Pin	Function	Description
	1	24 V DC U _{El/Sen}	Operating voltage supply for electronics and sensors
	2	0 V U _{El/Sen}	Earth for electronics and sensors

Plugs	Pin	Function		Description
AIDA push-pull 5 4 3 2 1 	3	24 V DC	$U_{Out/A}$	Load voltage supply for actuators, outputs and valves
	4	0 V	$U_{Out/A}$	Earth for actuators, outputs and valves
	5	FE	–	Functional earth

Tab. 28: Pin allocation system supply AIDA push-pull connector, MSE6-C2M-...-AMI

Plug, 5-pin	Pin	Function		Description
M12, L-coded FE 	1	24 V DC	$U_{El/Sen}$	Operating voltage supply for electronics and sensors
	2	0 V	$U_{Out/A}$	Earth for actuators, outputs and valves
	3	0 V	$U_{El/Sen}$	Earth for electronics and sensors
	4	24 V DC	$U_{Out/A}$	Load voltage supply for actuators, outputs and valves
	FE	FE	–	Functional earth

Tab. 29: Pin allocation system supply M12 connector, L-coded, MSE6-C2M-...-M12L5

Plug, 4-pin	Pin	Function		Description
M12, L-coded 	1	24 V DC	$U_{El/Sen}$	Operating voltage supply for electronics and sensors
	2	0 V	$U_{Out/A}$	Earth for actuators, outputs and valves
	3	0 V	$U_{El/Sen}$	Earth for electronics and sensors
	4	24 V DC	$U_{Out/A}$	Load voltage supply for actuators, outputs and valves

Tab. 30: Pin allocation system supply M12 connector, L-coded, MSE6-C2M-...-M12L4

9 Commissioning

9.1 Safety

The product is equipped with a pneumatically-piloted proportional-pressure regulator and a downstream shut-off valve.

When input pressure P1 is applied, the proportional-pressure regulator automatically regulates the outlet pressure in the following cases to the last parameterised power-on setpoint pressure, factory setting 1 MPa; (10 bar, 145.03 psi):

- Switch on of operating voltage until the connection is successfully made with the high-order controller.
- Interruption of the network communication with correspondingly set system parameters
- Stopping of the higher-order controller, see manufacturer's specifications, e.g. in the case of transmission of control programs, parameters, configuration data

In the event of undervoltage in the operating voltage or the load voltage, the electronic pressure regulation is inactive when the shut-off valve is open. If prolonged, this can lead to an undefined drop in the outlet pressure.

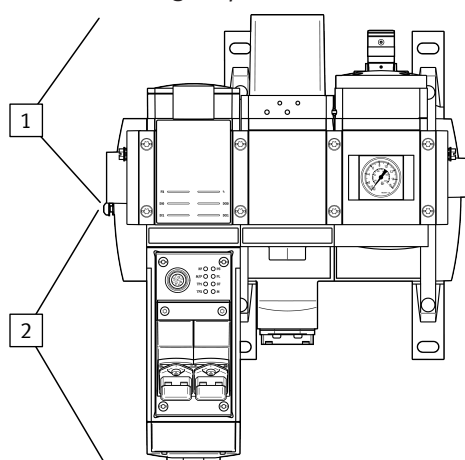
The product is equipped with a pneumatically-piloted shut-off valve. If there is pressure at pneumatic connection 1, the shut-off valve is open in the normal position.

With preset parameters and applied input pressure P1 the shut-off valve automatically switches to the pressurise state in the following cases:

- Switch-off of the operating voltage or the load voltage
 - Interruption of the network communication with correspondingly set system parameters
 - Stopping of the higher-order controller (see manufacturer's specifications), e.g. in the case of transmission of control programs, parameters, configuration data
- If the shut-off valve was previously closed and the system was exhausted, the system is suddenly pressurised. Take this response into account in the design of the system.

9.2 Commissioning the product

In order to avoid connection and addressing errors, you should carry out the commissioning steps as follows.



- 1 Step 1: check the connected pneumatic application
- 2 Step 2: commissioning on bus node with testing of the address allocation

Fig. 20: Commissioning steps

Preparing for commissioning

1. Check the pneumatic tubing.
2. Check the electrical wiring.
3. Check the earth terminal.
4. Check the settings of the DIL switches.



The characteristics of the energy efficiency module can be adapted to various requirements.

You can carry out important settings as follows:

- with the DIL switch directly on the bus node.
- with parameterisation.



The energy efficiency module is delivered with preset DIL switches and parameters.

Information on DIL switches → www.festo.com/sp.

NOTICE

Unauthorised Access to the Device Can Cause Damage or Malfunction.

- When connecting the device to a network, protect the network from unauthorised access.

Standards for security in information technology can be used for network protection measures, e.g. IEC 62443, ISO/IEC 27001.

For MSE6-C2M-...-HB

The energy efficiency module can be switched and locked with the manual override AHB-... (accessory).



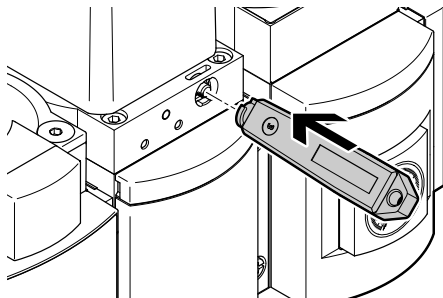
- Pressurise the input with low pressure p1. The rise in pressure p2 occurs instantly.
- Pressure p2 at the output corresponds to pressure p1 at the input.

Locking manual override

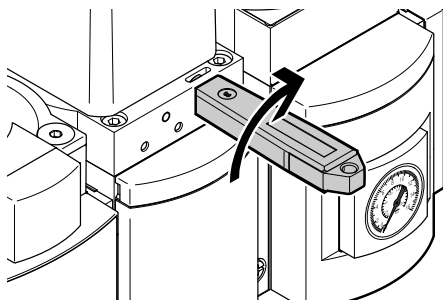
Requirement:

– The energy efficiency module is de-energised.

1. Pressurise the energy efficiency module with pressure p1.
2. Slowly press the manual override into the designated port to the stop.



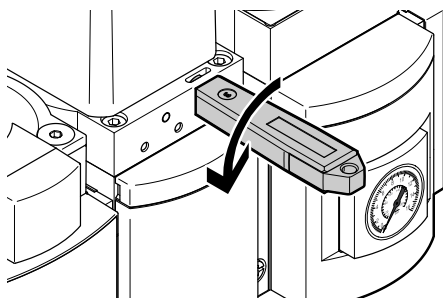
3. Turn the manual override clockwise to the stop.



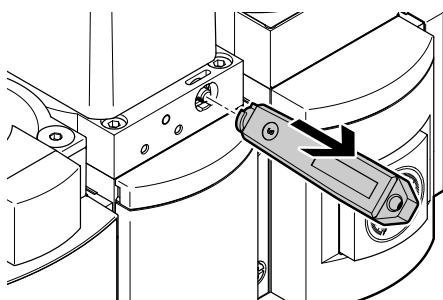
⇒ The energy efficiency module switches and remains in the switching position.

Unlocking manual override

1. Exhaust pressure p1 at the energy efficiency module.
2. Turn the manual override anti-clockwise to the stop.



3. Remove the manual override.



9.3 Commissioning with bus node CPX-M-FB36

This section describes the interfaces, DIL switches and display elements of the bus node mentioned and provides an overview of the configuration and commissioning with this bus node.

- i

For detailed information on the bus node, see the documentation on the bus account → 1 Applicable documents.
- i

A configuration for the energy efficiency module can be created using the software ‘Festo Maintenance Tool’, CPX-FMT → 9.3.4 Commissioning and configuration.

9.3.1 Interfaces and display components

Interfaces and display components on the bus node CPX-M-FB36

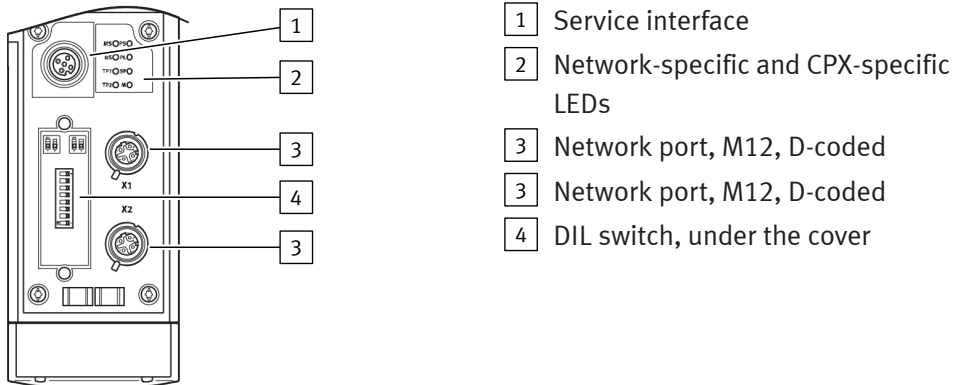


Fig. 21: Interfaces and display components on the bus node CPX-M-FB36

LED displays on the bus node CPX-M-FB36

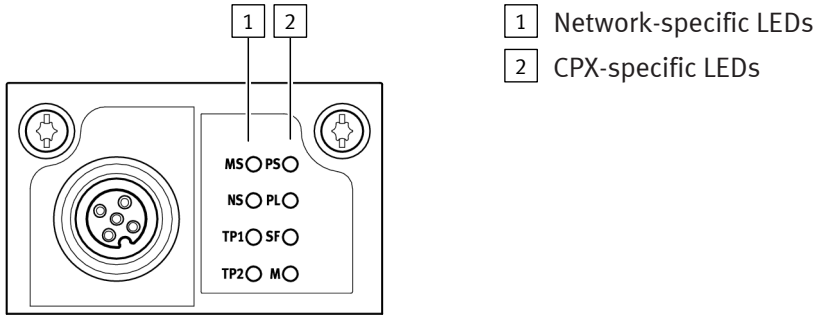


Fig. 22: LED displays on the bus node CPX-M-FB36

Network-specific LEDs		CPX-specific LEDs ¹⁾	
MS	Module status, red, green	PS	Power system, green
NS	Network status, red, green ²⁾	PL	Power load, green
TP1	Link/Traffic 1, green	ST	System failure, red
TP2	Link/Traffic 2, green	M	Modify, yellow ³⁾

1) In normal operating status, all green LEDs light up. The yellow and red LEDs are not on
2) The l.v. LED is off without a network connection
3) Parameterisation modified or force active

Tab. 31: LED displays

9.3.2 Connecting to the network

Connection technology The network is connected at the bus node CPX-FB36 with the following connection technology:

Connection technology	Network connectors
2 sockets, M12, D-coded, 4-pin, according to IEC 61076-2	NECU-M-S-D12G4-C2-ET plug

Tab. 32: Overview of connection technology and network plug connectors



The NECU-M-S-D12G4-C2-ET plug is designed for Ethernet cables with a diameter of 6 ... 8 mm.

Network connections

The network connections are marked with X1 and X2.

Connection X1	Pin	Signal	Explanation
	1	TD+	Transmit Data, TD+
	2	RD+	Receive Data, RD +
	3	TD–	Transmitted data –
	4	RD–	Received data –
	Housing	Shield/FE	Shield/functional earth

Tab. 33: Pin allocation connection X1, EtherNet/IP

Connection X2	Pin	Signal	Explanation
	1	RD+	Receive Data, RD +
	2	TD+	Transmit Data, TD+
	3	RD–	Received data –
	4	TD–	Transmitted data –
	Housing	Shield/FE	Shield/functional earth

Tab. 34: Pin allocation connection X2, EtherNet/IP

- Connecting the energy efficiency module to the network**
1.

2.
- Connect the bus node to the network with the NECU-MS-D12G4-C2-ET plug.
Seal the unused connections with cover caps or blanking plugs to achieve the specified degree of protection.

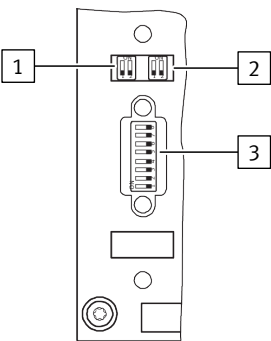
9.3.3 Setting DIL switches

NOTICE

Damage to internal electronics.
Damage to components and malfunctions due to incorrect handling.

- Observe the handling specifications for electrostatically sensitive devices.

- You can set the following parameters with the DIL switches:
- The mode of operation and the protocol; the energy efficiency module only supports the ‘Remote I/O’ operating mode.
 - The diagnostics mode.
 - The IP addressing.



- 1 DIL switch 1: setting operating mode and protocol
- 2 DIL switch 2: diagnostic mode
- 3 DIL switch 3: IP addressing

Fig. 23: DIL switches on bus node CPX-M-FB36

1. Switch off the power supply.
2. Unscrew the retaining screws of the cover.
3. Remove the cover → 3 DIL switches are visible.
4. Use DIL switch 1 to set the operating mode and protocol.
5. Set the diagnostic mode with DIL switch 2.
6. Set the IP addressing with DIL switch 3.
7. Fit the cover.
8. Screw on the retaining screws hand-tight and then tighten to 0.4 Nm ± 10%.

Setting operating mode and protocol, DIL switch 1



The energy efficiency module only supports the Remote I/O operating mode with the bus node CPX-FB36, factory setting.
All 1.1 and 1.2 switch elements of DIL switch 1 must be in the OFF position.

DIL switch 1.1		Setting operating mode
	DIL 1.1: OFF Factory setting	'Remote I/O' operating mode. All functions of the energy efficiency module are controlled directly by the controller or by a higher-level PLC.
	DIL 1.1: ON	Not supported. The 1.1 DIL switch element must be in the OFF position.

Tab. 35: Setting the operating mode with DIL switch 1.1

DIL switch 1.2		Setting the protocol
	DIL 1.2: OFF Factory setting	'EtherNet/IP' protocol. The energy efficiency module uses the 'EtherNet/IP' protocol.
	DIL 1.2: ON	'Modbus TCP' protocol The energy efficiency module uses the 'Modbus TCP' protocol.

Tab. 36: Setting the protocol with DIL switch 1.2

Setting diagnostic mode, DIL switch 2

DIL switch 2		Setting diagnostic mode
	DIL 2.1: OFF DIL 2.2: OFF Factory setting	'I/O diagnostics interface' and status bits are switched off, + 0 byte I/O byte 0.
	DIL 2.1: OFF DIL 2.2: ON	The status bits are switched on, + 1 byte I/O byte A ¹ .

DIL switch 2	Setting diagnostic mode
 DIL 2.1: ON DIL 2.2: OFF	The 'I/O diagnostic interface' is switched on, + 2 bytes I/2 bytes O ²⁾ .
 DIL 2.1: ON DIL 2.2: ON	Reserved for future extensions.

1) The status bits occupy 1 byte address space, 8 I-bits

2) The I/O diagnostic interface occupies 4 bytes of address space, 16 I-bits and 16 O-bits

Tab. 37: Setting diagnostic mode using DIL switch 2

Set IP addressing, DIL switch 3



DIL switches 3.1 ... 3.8 are used to set the type of addressing or the IP address of the energy efficiency module.

DIL switch 3	Setting IP addressing
 DIL 3.1 ... 3.8: OFF	Dynamic/saved addressing. All DIL switches in the OFF position, factory setting. When switched on, the energy efficiency module receives a dynamic or stored IP address via 'DHCP/BOOTP'.
 DIL 3.8: OFF $2^7 = 128$ DIL 3.7: ON $2^6 = 64$ DIL 3.6: OFF $2^5 = 32$ DIL 3.5: ON $2^4 = 16$ DIL 3.4: OFF $2^3 = 8$ DIL 3.3: ON $2^2 = 4$ DIL 3.2: ON $2^1 = 2$ DIL 3.1: OFF $2^0 = 1$	Fixed addressing. The host-ID of the IP address, 4th octet, is binary-coded with DIL switch 3.1 ... 3.8. Permissible value range: 1 ... 254. Example: $2^1 + 2^2 + 2^4 + 2^6 = 2 + 4 + 16 + 64 = 86$ host-ID Set IP address: 192.168.1.86
 DIL 3.1 ... 3.8: ON	Reset all IP parameters to factory settings. All DIL switches in ON position. All IP parameters of the energy efficiency module are reset to the factory settings when device is switched on.

Tab. 38: Set IP addressing, DIL switch 3

9.3.4 Commissioning and configuration

Commissioning and configuration of the bus node depend on the higher-order control. In the following section the basic procedure for commissioning and configuration with the 'Festo Maintenance Tool, CPX-FMT' software is explained.



The following steps provide an example for the use of an Allen-Bradley controller and the 'Rockwell Studio 5000' controller software, Version 24, and the 'Festo Maintenance Tool, CPX-FMT' software in English. Detailed information is provided in the documentation for the higher-order controller and the controller software.

Switching on the power supply

If the control and network devices have separate power supplies, they must be switched in the following sequence:

1. Switch on the power supply of the energy efficiency module.
2. Switch on the power supply for the controller.

Addressing the network

The controller uses the following for addressing:

- IP addresses
- Input addresses/output addresses

Basic addressing rules

Bus node:

- The bus node occupies 0 inputs and 0 outputs if the diagnostics mode is not active.
- Active status bits occupy 8 input bits.
- An active I/O diagnostics interface occupies 16 input bits and 16 output bits.

Network:

- The address assignment of the inputs does not depend on the address assignment of the outputs.
- Addressing is carried out in bytes.

Festo Maintenance Tool, CPX-FMT

The energy efficiency module can be configured and parameterised with the 'Festo Maintenance Tool, CPX-FMT' software. The configuration with all required settings, such as I/O data length, IP configuration and module and system parameters are applied and exported into a file. This file is subsequently opened in the automation project.



The current version of the software 'Festo Maintenance Tool' is available on the Festo online portal ➔ www.festo.com/sp.

Setting up automation project

1. Start the controller software.
2. To create a new project, click on the 'New Project' button.
3. Select the control in the 'New Project' dialogue.
4. Enter the project name, e.g. MSE6_E2M_EtherNetIP.
5. To confirm the entry, click on the 'Next' and then 'Finish' buttons.

Configuration with CPX-FMT

1. Start the 'Festo Maintenance Tool' software.
2. Establish the connection between the energy efficiency module and the 'Festo Maintenance Tool' software.
3. Activate the online function with the 'Online' > 'Online' command.
4. Set the desired parameters.
5. Save the configuration for use with 'Rockwell Studio 5000' controller software as an L5K file with the 'File' > 'Export' > 'RSLogix (.L5K)' command.

Importing the configuration into the Rockwell Studio 5000 controller software

1. Open the saved L5K configuration file with the 'File' > 'Open' command.
 2. Confirm the selection by clicking on the 'Open' button.
 3. Select the directory and name for the imported file.
 4. Confirm the entry by clicking on the 'Import' button.
 5. Select the control in the 'Change Controller Type' dialogue.
 6. Confirm the selection by clicking on the 'OK' button.
- ⇒ The configuration, L5K file, is imported into a new project as an Ethernet module.

Integrating the configuration into an existing automation project

1. Copy the imported Ethernet module by right-clicking on 'Ethernet-Modul' under 'Ethernet', e.g. ETHERNET MODULES Festo_CPX and the 'Copy' command.

2. Open the desired project for integration.
3. Integrate the Ethernet module into the project with by right-clicking on 'Ethernet' and 'Paste'.
⇒ All settings are applied to the project.

Transmit configuration • Send the configuration to the controller.

9.3.5 Faultless commissioning, normal operating status

After faultless commissioning, specific LED displays on the bus node light. The other LEDs are for diagnostics and error handling → 11.1 Diagnostics.

LED displays	Description	Operating status
MS   PS NS   PL TP1   SF TP2   M	The following LEDs are green: – PS – PL – MS – NS – TP1 – TP2	Normal, no error

Tab. 39: Normal operating status of the energy efficiency module on the bus node CPX-FB36

LEDs TP1 and TP2 are steady or flashing if the port is in use.

– A steady light means the network connection is OK.

– Flashing means data transfer is in progress.

The SF LED is not on.

The M LED lights or flashes if parameterisation has been changed or forcing is active.

9.4 Commissioning with bus node CPX-M-FB37



For detailed information on commissioning with bus node CPX-FB37, see the documentation for the bus account → 1 Applicable documents.

9.5 Commissioning with bus nodes CPX(-M)-FB43/FB44

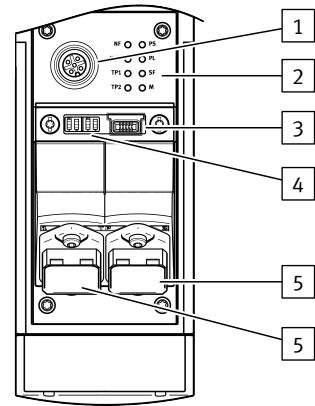
This section describes the interfaces, DIL switches and display elements of the bus node mentioned and provides an overview of the configuration and commissioning with this bus node.



For detailed information on the bus node, see the documentation on the bus account → 1 Applicable documents.

9.5.1 Interfaces and display components

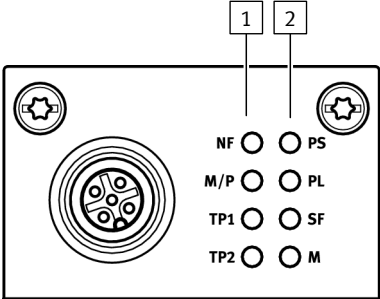
Interfaces and display components on the bus node CPX-M-FB43 and CPX-M-FB44



- 1 Service interface
- 2 Network-specific and CPX-specific LEDs
- 3 Memory card, under a cover
- 4 DIL switch, under a cover
- 5 Network connection, example CPX-FB44
- 5 Network connection, example CPX-FB44

Fig. 24: Interfaces and display components on the bus node e.g. CPX-M-FB44

LED displays on the bus node CPX-M-FB43 and CPX-M-FB44



- 1 Network-specific LEDs
- 2 CPX-specific LEDs

Fig. 25: LED display on the bus node CPX-M-FB43 and CPX-M-FB44

Network-specific LEDs ¹⁾		CPX-specific LEDs ²⁾	
NF	Network failure, red	PS	Power system, green
M/P	Maintenance/PROFenergy, green	PL	For MSE6-C2M without function.
TP1	Link 1, green	ST	System failure, red
TP2	Link 2, green	M	Modify, yellow ³⁾

- 1) Without network connection, the LED NF flashes.
- 2) In normal operating status, all green LEDs light up. The yellow and red LEDs are not on.
- 3) Parameterisation modified or force active.

Tab. 40: LED displays

9.5.2 Using the memory card

The memory card is used as a carrier of configuration data for PROFINET addressing and thus simplifies bus node replacement:

- PROFINET I/O device name
- IP address

NOTICE

Malfunction or Damage to the Memory Card.
Inserting or removing the memory card while the power supply is switched on can result in malfunctions of or damage to the memory card.

- Disconnect the power supply before you insert or remove the memory card.



Data stored on the memory card has priority over other configuration data which is stored, e.g. in the bus node memory or in the higher-order controller.

1. Switch off the power supply.
2. Unscrew the retaining screws of the cover.
3. Remove the cover.
4. Insert the memory card.
5. Fit the cover.
6. Tighten the retaining screws of the cover. Tightening torque: 0.4 Nm ± 10%.

9.5.3 Connecting to the network

The bus node is connected to the network by a specific connection technology.

Bus node	Connection technology	Network connectors
CPX(-M)-FB43	2 sockets, M12, D-coded, 4-pin, according to IEC 61076-2	NECU-M-S-D12G4-C2-ET plug
CPX(-M)-FB44	2x RJ45 bushing, push-pull, AIDA-compliant, corresponding to IEC 60603, IEC 61076-3	FBS-RJ45-PP-GS plug

Tab. 41: Connection technology and network connectors

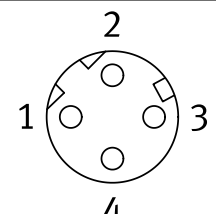


The NECU-M-S-D12G4-C2-ET plug is designed for Ethernet cables with a diameter of 6 ... 8 mm.

The FBS-RJ45-PP-GS plug is designed for Ethernet cables with a diameter of 5 ... 8 mm.

Network connections on the bus node CPX(-M)-FB43

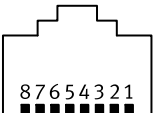
The network ports are labelled TP1 and TP2.

Connection TP1, TP2	Pin	Signal	Explanation
	1	TD+	Transmit Data, TD+
	2	RD+	Receive Data, RD +
	3	TD-	Transmitted data –
	4	RD-	Received data –
	Housing	Shield/FE	Shield/functional earth

Tab. 42: Pin allocation of network interface TP1 and TP2, PROFINET

Network connections on the bus node CPX(-M)-FB44

The bus node has 2 RJ45 push-pull sockets for connection to the network, AIDA-compliant

RJ45 bushing	Pin	Signal	Explanation
	1	TD+	Transmit Data, TD+
	2	TD-	Transmitted data –
	3	RD+	Receive Data, RD +
	4	n.c.	Not connected
	5	n.c.	Not connected
	6	RD-	Received data –
	7	n.c.	Not connected
	8	n.c.	Not connected
	Housing	Shield/FE	Shield/functional earth

Tab. 43: Pin allocation of the network interfaces RJ45, PROFINET

Connecting the energy efficiency module to the network

- 1. Connect the bus node to the network with the NECU-MS-D12G4-C2-ET or FBS-RJ45-PP-GS connector.
- 2. Seal the unused connections with cover caps or blanking plugs to achieve the specified degree of protection.

9.5.4 Setting DIL switches

You can set the following parameters with the DIL switches:

- The operating mode. The energy efficiency module only supports the Remote I/O operating mode in conjunction with the bus node CPX(-M)-FB44.
- The diagnostics mode.

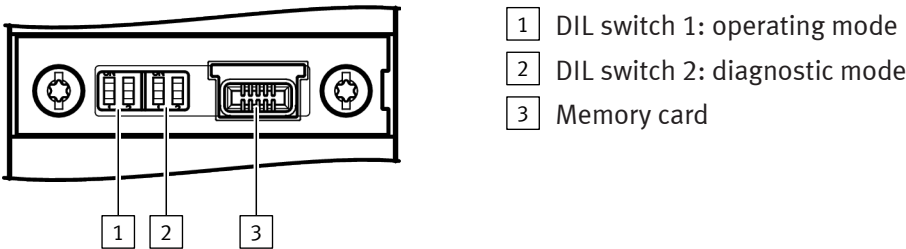


Fig. 26: DIL switches on bus node CPX-M-FB44

- 1. Switch off the power supply.
- 2. Unscrew the retaining screws of the cover.
- 3. Remove the cover → 2 DIL switches are visible.
- 4. Use DIL switch 1 to set the operating mode.
- 5. Set the diagnostic mode with DIL switch 2.
- 6. Fit the cover.
- 7. Tighten the retaining screws of the cover. Tightening torque: 0.4 Nm ± 10 %.

Setting operating mode, DIL switch 1



All switch elements of the DIL switch 1 must be in the OFF position.

DIL switch 1		Setting operating mode
	DIL 1.1: OFF DIL 1.2: OFF (factory setting)	Remote I/O operating mode All functions of the energy efficiency module are controlled directly by the controller or by a higher-level PLC.
	DIL 1.1: ON DIL 1.2: OFF	Not supported by the energy efficiency module. DIL switch elements 1.1 and 1.2 must be in the OFF position.
	DIL 1.1: OFF DIL 1.2: ON	
	DIL 1.1: ON DIL 1.2: ON	

Tab. 44: Setting the operating mode with DIL switch 1

Setting diagnostic mode, DIL switch 2

DIL switch 2	Setting operating mode, in remote I/O operating mode
 DIL 2.1: OFF DIL 2.2: OFF (factory setting)	The 'E/A-Diagnose-Interface' and status bits are switched off or the diagnostic mode is set by the hardware configuration of the controller software ¹⁾ , + 0 bytes I/O bytes O
 DIL 2.1: OFF DIL 2.2: ON	The status bits are switched on, + 1 byte I/O bytes O ²⁾
 DIL 2.1: ON DIL 2.2: OFF	The I/O diagnostic interface is switched on, + 2 bytes I/2 bytes O ³⁾
 DIL 2.1: ON DIL 2.2: ON	Reserved for future extensions

1) from revision 21

2) Status bits occupy 1 byte address space, 8 I-bits

3) I/O diagnostic interface occupies 4 bytes address space, 16 I-bits and 16 O-bits

Tab. 45: Setting diagnostic mode using DIL switch 2

9.5.5 Commissioning and configuration

Commissioning and configuration of the bus node depend on the higher-order control.



The steps described below are examples of using the 'Siemens SIMATIC S7-315' controller and the 'Siemens STEP 7' controller software, version 5.5 with Service Pack SP 3, with the English language version → Documentation of the higher-level controller and controller software.

Switching on the power supply

If the control and network devices have separate power supplies, they must be switched in the following sequence:

1. Switch on the power supply of the energy efficiency module.
2. Switch on the power supply for the controller.

Addressing the network

The controller uses the following for addressing:

- Device names, short device names
- IP addresses, optional MAC ID
- Input addresses/output addresses, I/O addresses

Basic addressing rules

Bus node:

- The bus node occupies 0 inputs and 0 outputs if no diagnostic message is active.
- Active status bits occupy 8 input bits.
- 1 active I/O diagnostics interface occupies 16 input bits and 16 output bits.

Network:

- The address assignment of the inputs does not depend on the address assignment of the outputs.
- Addressing is carried out in bytes.

Device description file, GSDML file

A device description file, GSDML file, is needed for configuration and parameterisation of the bus node. The device description file contains all information required to integrate the module into the higher-order controller.

Device description file → www.festo.com/sp.

Setting up automation project and controller

1. Start the controller software.
2. Create a new project: 'File' > 'New...'
3. Enter a project name, e.g. MSE6-C2M, PROFINET.

	4. Add the controller: 'Insert' > Station, e.g. 'SIMATIC 300 Station'. 5. Expand the project tree and select the controller. 6. Open the hardware configuration window: 'Edit' > 'Open Object'.
Installing the device description file	1. Open the Festo Support Portal ➔ www.festo.com/sp. 2. Enter the search term GSDML MSE. 3. Select, save and unpack the current device description file in the Software tab. 4. Install the device description file: 'Options' > 'Install GSD File...'. Select the file path of the device description file: 'Browse'. Select and install the file: 'Install'. 5. Update the hardware catalogue: 'Options' > 'Update Catalog'. ⇒ All available CPX modules are shown in the hardware catalogue under: \PROFINET IO\Additional Field Devices\Valves\Festo MSE Air Supply
Setting up automation project and controller	1. Open the hardware catalogue with the 'View' > 'Catalog' command. 2. Expand the controller in the hardware catalogue, e.g. 'SIMATIC 300' and the folder structure. 3. Expand the 'RACK-300' folder. 4. Add the profile rail of the controller. 5. Reproduce the controller configuration using the components from the rack rail table in the hardware catalogue. Row 1, 'Slot 1', is reserved, e.g. or a fixed power supply.
Creating a PROFIBUS network	1. Open the 'Properties...' dialogue. Right-click on the interface, e.g. select X2 and 'Object Properties'. 2. Switch to the 'General' tab. 3. Click the 'Properties' button to open the 'Properties Ethernet...' dialogue. 4. Create a new network: click on the 'New' button and adjust specific settings. 5. Right-click on interface, e.g. X2 and 'Insert PROFINET IO System'.
Add PROFINET station	• Drag the status symbol MSE6-C2M-5000-FB44 from the hardware catalogue to the bus line of the PROFINET-IO system. \PROFINET-IO\Additional Field Devices\Valves\Festo MSE Air Supply – MSE6-C2M-5000-FB44
Assign device names, Device Name	1. Assign the device name with the 'PLC' > 'Ethernet' > 'Assign Device Name' command. 2. Find a device: click on the 'Update' button. 3. Select the device. Click on the 'Assign name' button.
Sending hardware configuration	• Translate the hardware configuration and send it to controller.

9.5.6 Faultless commissioning, normal operating status

After faultless commissioning, specific LED displays on the bus node light. The other LEDs are for diagnostics and error handling → 11.1 Diagnostics.

LED displays		Description	Operating status
NF	  PS	The following LEDs are green: – PS – PL – TP1 – TP2	Normal, no error
M/P	  PL		
TP1	  SF		
TP2	  M		

Tab. 46: Normal operating status of the energy efficiency module with bus node CPX(-M)-FB44

LEDs TP1 and TP2 light when the port is in use. On means that the network connection is OK.

The M LED lights or flashes if parameterisation is changed or Force is active.

The following LEDs are off:

- NF
- M/P
- SF

10 Parameterisation

10.1 Options for parameterisation

Overview

The parameters can be set via the fieldbus interface or service interface. The parameterisation can be set at the service interface with the ‘Festo Maintenance Tool, CPX-FMT’ or the ‘Festo Automation Suite’ software.

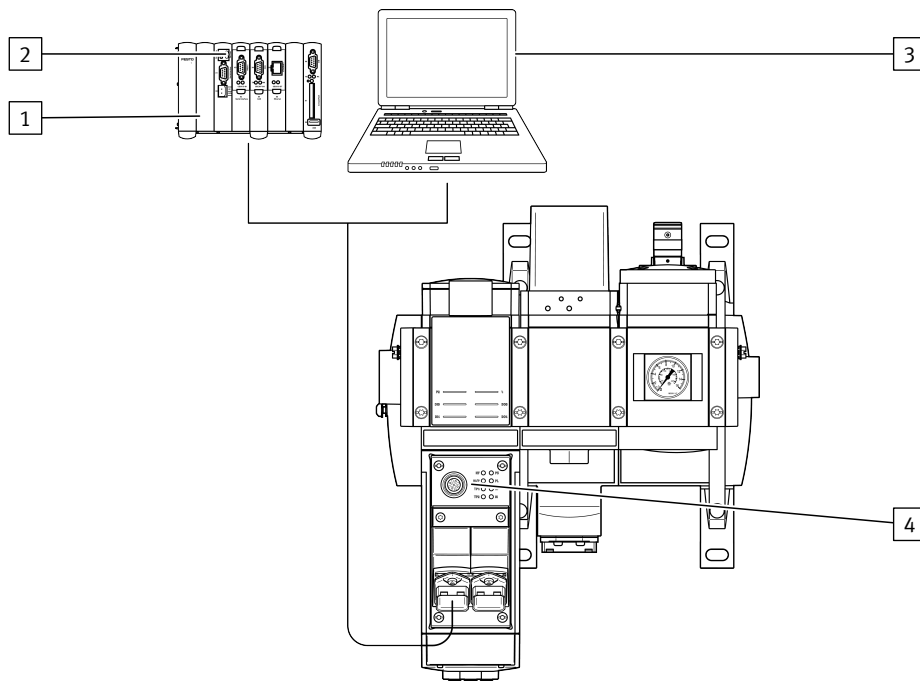


Fig. 27: Parameterisation of the MSE6-C2M

- | | |
|---|--|
| <p>1 Interface module or network scanner/bus master; the desired parameterisation can be guaranteed e.g. in the start-up phase or after fieldbus interruptions.</p> <p>2 User program in the machine controller; parameters can be modified during operation.</p> | <p>3 Network-specific configurators; parameters can be modified during the commissioning phase or during troubleshooting.</p> <p>4 Service interface</p> |
|---|--|

10.2 Notes on parameterisation



This documentation describes the module parameters of the energy efficiency module. For a detailed description of the system parameters, diagnostic memory parameters, data and application principles, see CPX system description → 1 Applicable documents

Time behaviour with parameter changes

Due to calculations that are required in some cases, modified parameters are not valid until they have been thoroughly checked and saved. After a change of value valid input data will not be available for up to a maximum 30 ms, depending on the parameter.

Avoiding parameterisation errors

To avoid errors during parameterisation, the sequence described in the example below must be observed when changing the units parameter and the upper limit value x parameter.

Example: sequence for initial or start-up parameterisation, energy efficiency module in delivery status, parameterisation error monitoring active

1. Set the desired unit in the units module parameter.
2. Set the upper and lower limit values in the pressure limit values module parameter.

Example: sequence for modifying the parameterisation

1. Deactivate the monitoring for parameterisation errors in the monitoring module parameter.
2. Parameterise the energy efficiency module as follows:
 - Set the upper limit value in the limit values module parameter to 32767.
 - Set the desired unit in the unit pressure module parameter.
 - Set upper and lower limit values in the limit values module parameter if required.
3. Activate the monitoring for parameterisation errors in the monitoring module parameter.

10.3 Overview of module parameters

The module parameters are distinguished as follows:

- Modifiable module parameters
- Read-only module parameters



Detailed information on parameterisation → 1 Applicable documents.

The functions of the energy efficiency module are identified as follows in the following overview of the modifiable module parameters:

Identification	Function
Q	Flow measurement
V	Consumption measurement
P2	Pressure measurement
DP2	Pressure change
REG	Regulation and blocking function
DI	Digital inputs
DO	Digital outputs

Tab. 47: Identification of the functions in the overview of the modifiable module parameters

Function number m = module number 0	Changeable module parameters	Function						
		Q	V	P2	DP2	REG	DI	DO
4828 + m * 64 + 0	Pm.0: monitoring							
	Bit 0: SCS, short-circuit/overload in sensor supply	–	–	–	–	–	■	–
	Bit 1: SCO, short circuit/overload at outputs	–	–	–	–	–	–	■
	Bit 2: undervoltage U _{Out/A}	–	–	–	–	■	–	■
	Bit 6: critical limits	■	–	■	■	–	–	–
	Bit 7: parameters	■	■	■	■	■	–	–
4828 + m * 64 + 7	Pm.7: limit value startup	■	–	■	–	–	–	–
4828 + m * 64 + 8	Pm.8: units							
	Bit 0 ... 1: pressure	–	–	■	■	■	–	–
	Bit 2 ... 3: flow rate	■	–	–	–	■	–	–
	Bit 4 ... 5: consumption	–	■	–	–	–	–	–
	Bit 6 ... 7: flow rate standard	■	■	–	–	■	–	–
4828 + m * 64 + 9	Pm.9: energy-save functions, are not currently supported							
	Bit 0: energy-save function DO0	–	–	–	–	–	–	–
	Bit 1: energy-save function DO1	–	–	–	–	–	–	–
	Bit 2: energy-save function 24VS	–	–	–	–	–	–	–
	Bit 3: energy-save function status LEDs	–	–	–	–	–	–	–
	Bit 4: energy-save function display	–	–	–	–	–	–	–

Function number	Changeable module parameters	Function						
		Q	V	P2	DP2	REG	DI	DO
m = module number 0								
4828 + m * 64 + 10	Pm.10: pressure change sample time	–	–	–	■	–	–	–
4828 + m * 64 + 11 ... 12	Pm.11 ... 12: flow rate, upper limit value	■	–	–	–	–	–	–
4828 + m * 64 + 13 ... 14	Pm.13 ... 14: upper limit value pressure	–	–	■	–	–	–	–
4828 + m * 64 + 15 ... 16	Pm.15 ... 16: pressure change, upper limit value	–	–	–	■	–	–	–
4828 + m * 64 + 17 ... 18	Pm.17 ... 18: auto-control time delay	–	–	–	–	■	–	–
4828 + m * 64 + 19 ... 20	Pm.19 ... 20: auto-control flow rate limit value	–	–	–	–	■	–	–
4828 + m * 64 + 21 ... 22	Pm.21 ... 22: pressure setpoint value auto normal	–	–	–	–	■	–	–
4828 + m * 64 + 23 ... 24	Pm.23 ... 24: pressure setpoint value auto standby	–	–	–	–	■	–	–
4828 + m * 64 + 25 ... 26	Pm.25 ... 26: lower limit value pressure P2	–	–	■	–	–	–	–
4828 + m * 64 + 27	Pm.27: module control, byte 0							
	Bit 0: signal extension channel digital input 0	–	–	–	–	–	■	–
	Bit 1: signal extension channel digital input 0	–	–	–	–	–	■	–
	Bit 2 ... 3: signal extension time digital inputs	–	–	–	–	–	■	–
	Bit 4 ... 5: debounce time digital inputs	–	–	–	–	–	■	–
	Bit 6: behaviour of sensor supply U _{SEN/EL} after short circuit/overload	–	–	–	–	–	■	–
	Bit 7: behaviour of digital outputs after short circuit / overload	–	–	–	–	–	–	■
4828 + m * 64 + 28	Pm.28: module control, byte 1							
	Bit 0 ... 1: Q _{low} -Timer Reset selection	–	–	–	–	■	–	–
	Bit 2: target pressure power on	–	–	–	–	■	–	–
	Bit 3: selection for digital output 0	–	–	–	–	–	–	■
	Bit 4 ... 6: target pressure rise limit	–	–	–	–	■	–	–

Tab. 48: Overview - modifiable module parameters

Function number ¹⁾	Read-only module parameters
4828 + m * 64 + 29 ... 30	Pm.29 ... 30: module time of operation
4828 + m * 64 + 31 ... 32	Pm.31 ... 32: shut-off valve switching cycles

1) m = module number (0)

Tab. 49: Overview - read-only module parameters

10.4 Modifiable module parameters

Module parameter: Monitor	
Function number	$4828 + m * 64 + 0$ m = module number 0
Description	The monitoring of single errors can be independently activated, deactivated or suppressed for the energy efficiency module. Activation of the monitoring function causes the following: – The error is sent to the bus node. – The error is displayed via the module error LED.
Bit	Meaning
0	Monitoring SCS, short circuit/overload sensor supply
1	Monitoring SCO, short circuit/overload outputs
2	Undervoltage monitoring $U_{Out/A}$
6	Monitoring of limit values
7	Monitoring of parameters
Values	0 = not active 1 = active, default
Comment	Monitoring of parameters: Some parameters are checked for non-permitted values during parameterisation, e.g. – Limit value monitoring startup – Units of measure – Limit values – Pressure setpoints

Tab. 50: Monitor module parameter

Module parameter: monitor limit value startup	
Function number	$4828 + m * 64 + 7$ m = module number 0
Description	Specifies the time after the supply voltage has been switched on, during which the limit value monitoring is deactivated.
Bit	Bit 0 ... 7: limit value monitoring startup
Values	Meaning
0	0 s
1	3 s
2	5 s
3	10 s, default
4	30 s
5	60 s
6	120 s
7	300 s
8 ... 255	Not permissible
Comment	If parameter monitoring is active, Pm.0.7, invalid values will result in parameterisation error FN29 → 11.2 Error numbers.

Tab. 51: Monitor limit value module parameter startup

Units module parameter [Units]

The parameter determines the unit for pressure, flow rate, consumption and flow rate standard and applies for all the related input and output values as well as parameter values.

The data width is 8 bits, 1 byte. The pressure, flow rate, consumption and flow rate standard each occupy 2 bits in the units module parameter.

Module parameter: unit pressure		
Function number	4828 + m * 64 + 8	m = module number 0
Description	Specifies the unit for all pressure-related data.	
Bit	Bit 0, 1: Unit pressure All other bits are reserved.	
Bit	1 0	Value
	0 0	0
	0 1	1
	1 0	2
	1 1	3
Comment	If parameter monitoring is active, Pm.0.7, invalid values will result in parameterisation error FN29 → 11.2 Error numbers. When the unit pressure module parameter is changed, the values of other pressure-related module parameters remain unchanged and are not adjusted automatically.	

Tab. 52: Unit pressure module parameter

Module parameter: unit flow rate		
Function number	4828 + m * 64 + 8	m = module number 0
Description	Specifies the unit for all flow-related data.	
Bit	Bit 2, 3: unit flow rate All other bits are reserved.	
Bit	3 2	Value
	0 0	0
	0 1	1
	1 0	2
	1 1	3
Comment	If parameter monitoring is active, Pm.0.7, invalid values will result in parameterisation error FN29 → 11.2 Error numbers. When the unit flow rate module parameter is changed, the values of other flow-related module parameters remain unchanged and are not adjusted automatically.	

Tab. 53: Unit flow rate module parameter

Module parameter: unit consumption		
Function number	4828 + m * 64 + 8	m = module number 0
Description	Specifies the unit for all consumption-related data.	
Bit	Bit 4, 5: unit consumption All other bits are reserved.	
Bit	5 4	Value
	0 0	0
	0 1	1
	1 0	2
	1 1	3
Comment	If parameter monitoring is active, Pm.0.7, invalid values will result in parameterisation error FN29 → 11.2 Error numbers.	

Tab. 54: Unit consumption module parameter

Module parameter: unit flow standard		
Function number	4828 + m * 64 + 8	m = module number 0
Description	Sets the flow rate standard for all flow-related and consumption-related data.	
Bit	Bit 6, 7: flow rate standard All other bits are reserved.	
Bit	7 6	Value
	0 0	0
	0 1	1
	1 0	2
	1 1	3
Meaning		
	DIN 1343, default	
	ISO 2533	
	ISO 6358	
	Not permissible	
Comment	If parameter monitoring is active, Pm.0.7, invalid values will result in parameterisation error FN29 → 11.2 Error numbers. When the unit flow rate standard module parameter is changed, the values of other module parameters related to the flow rate remain unchanged and are not adjusted automatically.	

Tab. 55: Flow rate standard module parameter

Module parameter: energy-save functions		
Function number	4828 + m * 64 + 9	m = module number
Description	Defines the setting for all energy-save functions. This parameter is reserved for later products models and is not supported in current products. Settings of values have no effect on the behaviour of the module.	
Bit	Description	
0	Energy-save function D00	
1	Energy-save function D01	
2	Energy-save function 24VS	
3	Energy-save function status LEDs	
4	Energy-save function display	
Values	0 = inactive (default) 1 = active	
Comment	Parameter is not currently supported. The parameter may appear in software tools for product parameterisation.	

Tab. 56: Energy-save functions module parameters

Pressure change sample time module parameter

The parameter specifies the time of the measuring interval, during which the pressure values for the calculation of the pressure change are determined. The set time corresponds to the parameterised value, multiplied by 100 ms. The data width is 8 bits, 1 byte.

Module parameter: pressure change sample time		
Function number	4828 + m * 64 + 10	m = module number 0
Description	Specifies the time interval between two pressure measurements, from whose measured values the pressure change is calculated.	
Bit	Bit 0 ... 8: Time interval between 2 measurements	
Values	1 ... 255	100, default ... 25500 ms
Comment	If parameter monitoring is active, Pm.0.7, invalid values will result in parameterisation error FN29 → 11.2 Error numbers.	

Tab. 57: Pressure change sample time module parameter

Critical limits module parameter

The limit values module parameter can be used to specify the specific upper limit value pressure, upper limit value flow rate and upper limit value pressure change limit values. The data width is 16 bits, 2 bytes.



If the unit is changed, the data for the critical limits is not changed and may need to be adjusted separately.

Module parameter: upper limit value flow rate		
Function number	4828 + m * 64 + 11 (low byte) 4828 + m * 64 + 12 (high byte)	m = module number 0
Description	An upper flow limit value can be set for the module.	
Values	2-byte value: low byte + 256 * high byte Default: 32767, low byte = 255; high byte = 127 Permissible values: 0 ... 32767	
Comment	If parameter monitoring is active, Pm.0.7, invalid values will result in parameterisation error FN29 → 11.2 Error numbers. If the flow rate set according to the parameterised unit exceeds the parameterised upper limit value, the diagnostic message FN10 is output if the monitor limit values parameter is active. The monitoring of limit value violation only becomes active after the expiry of the time set in the monitor critical limit values parameter startup. The time is active even after shifting to the pressurise state.	

Tab. 58: Upper limit value flow rate module parameter

Module parameter: upper pressure limit value		
Function number	4828 + m * 64 + 13 (low byte) 4828 + m * 64 + 14 (high byte)	m = module number 0
Description	An upper pressure limit can be set for the module.	
Values	2-byte value: low byte + 256 * high byte Default: 32767, low byte = 255; high byte = 127 Permissible values: 0 ... 32767	
Comment	If parameter monitoring is active, Pm.0.7, invalid values will result in parameterisation error FN29 → 11.2 Error numbers. If the pressure P2 according to the parameterised unit exceeds the parameterised upper critical limit, the diagnostic message FN10 is output if the monitor limit values parameter is active. The monitoring of limit value violation only becomes active after the expiry of the time set in the monitor critical limit values parameter startup.	

Tab. 59: Upper pressure limit value module parameter

Module parameter: upper limit value pressure change		
Function number	4828 + m * 64 + 15 (low byte) 4828 + m * 64 + 16 (high byte)	m = module number 0
Description	An upper limit value for the pressure change can be set for the module.	
Values	2-byte value: low byte + 256 * high byte Default: 32767, low byte = 160 = 0xA0; high byte = 15 = 0x0F Permissible values: 0 ... 32767	
Comment	If parameter monitoring is active, Pm.0.7, invalid values will result in parameterisation error FN25 → 11.2 Error numbers. If the amount of the pressure change set according to the parameterised unit exceeds the parameterised critical limit, the diagnostic message FN10 is output if the monitor limit values parameter is active. The monitoring of limit value violation only becomes active after the expiry of the time parameterised in the diagnostics limit value parameter startup. The monitoring function is only active if the shut-off valve is in the blocking state, Em.3.0 = 1.	

Tab. 60: Upper limit value pressure change module parameter

Module parameter: auto-control delay time		
Function number	4828 + m * 64 + 17 (low byte) 4828 + m * 64 + 18 (high byte)	m = module number 0
Description	Time in minutes after which an uninterrupted underrun of the auto-control flow rate limit value parameter value switches to the expired state, UP, in the automatically controlled blocking operating mode, Am.0.1 = 1, of the Q_low-Timer. With the auto enable active output, Am.0.5 = 1, the energy efficiency module automatically switches to the blocking state.	
Values	2-byte value: low byte + 256 * high byte Default: 10, low byte = 10; high byte = 0 Permissible values: 0 ... 65535	
Comment	Changes to the parameter value are always effective immediately. With an expired Q_low-Timer, i.e. status Q_low-Timer = 2, UP, extending the delay time no longer affects the status. In other words, there is no status change from UP to RUN.	

Tab. 61: Auto-control delay time module parameter

Module parameter: auto-control flow rate limit value		
Function number	4828 + m * 64 + 19 4828 + m * 64 + 20	m = module number 0
Description	Flow rate limit value that must be underrun in the automatically controlled blocking operating mode, Am.0.1 = 1, on an uninterrupted basis for the parameterised duration of the auto-control delay time, Pm.17-18, so the Q_low-Timer switches to the expired status, UP. With the auto enable active output, Am.0.5 = 1, the energy efficiency module automatically switches to the blocking state.	
Values	2-byte value: low byte + 256 * high byte Default: 0, low byte = 0; high byte = 0 Permissible values: 0 ... 32767	
Comment	Changes to the parameter value are always effective immediately. If the shut-off valve is already in the automatic blocking state, i.e. module status = AUTO_SHUTOFF, Em.8-11 = 11, this status will not change if there is a change to the flow rate limit value. If parameter monitoring is active, Pm.0.7, invalid values will result in parameterisation error FN29 → 11.2 Error numbers.	

Tab. 62: Auto-control flow rate limit value module parameter

Module parameter: pressure setpoint value auto normal		
Function number	4828 + m * 64 + 21 (low byte) 4828 + m * 64 + 22 (high byte)	m = module number 0
Description	The parameter determines the setpoint pressure that applies when the automatic pressure regulation and blocking function is activated in the AUTO_NORMAL, AUTO_WAIT and AUTO_HOLD module states, Em.3.8-3.11 = 8, 9, 10.	
Values	2-byte value: low byte + 256 * high byte Default: 10000, low byte = 16; high byte = 39 Permissible values: 0 ... 32767 Pressure setpoint value auto normal parameter value, Pm.21-22, must be greater than pressure setpoint value auto standby parameter value, Pm.23-24.	
Comment	If parameter monitoring is active, Pm.0.7, invalid values will result in parameterisation error FN29 → 11.2 Error numbers. The parameterised pressure setpoint values are automatically limited within the permissible value range, depending on the parameterised pressure unit, to the end values of the nominal pressure range within the module without an error message: – mbar: 2500 ... 10000 – kPa: 250 ... 1000 – psi/10: 363 ... 1450	

Tab. 63: Pressure setpoint Auto Normal module parameter

Module parameter: pressure setpoint value auto standby		
Function number	4828 + m * 64 + 23 (low byte) 4828 + m * 64 + 24 (high byte)	m = module number 0
Description	The parameter determines the setpoint pressure that applies when the automatic pressure regulation and blocking function is activated in the AUTO_STANDBY module state, Em.3.8-3.11 = 12.	
Values	2-byte value: low byte + 256 * high byte Default: 4000, low byte = 160; high byte = 15 Permissible values: 0 ... 32767 Pressure setpoint value auto normal parameter value, Pm.21-22, must be greater than pressure setpoint value auto standby parameter value, Pm.23-24.	
Comment	If parameter monitoring is active, Pm.0.7, invalid values will result in parameterisation error FN29 → 11.2 Error numbers. The parameterised pressure setpoint values are automatically limited within the permissible value range, depending on the parameterised pressure unit, to the end values of the nominal pressure range within the module without an error message: – mbar: 2500 ... 10000 – kPa: 250 ... 1000 – psi/10: 363 ... 1450	

Tab. 64: Pressure setpoint value auto standby module parameter

Module parameter: lower pressure limit value P2		
Function number	4828 + m * 64 + 25 (low byte) 4828 + m * 64 + 26 (high byte)	m = module number 0
Description	A lower limit value for the module can be set for output pressure P2.	
Values	2-byte value: low byte + 256 * high byte Default: 4000, low byte = 160; high byte = 15 Permissible values: 0 ... 32767	
Comment	If parameter monitoring is active, Pm.0.7, invalid values will result in parameterisation error FN24 → 11.2 Error numbers. The pressure P2 prepared according to the parameterised unit is continuously compared with the parameterised lower limit value. The result is indicated in input Em.3.6 and with the status LED P2. Detailed description → 6.1.3 Pressure.	

Tab. 65: Lower pressure limit value P2 module parameter

Module parameter: signal extension channel DI0		
Function number	4828 + m * 64 + 27	m = module number 0
Description	The parameter determines whether the signal extension for the electrical input 0 is active or not.	
Bit	Bit 0	
Values	0 = not active, default 1 = active	

Tab. 66: Signal extension channel DI0 module parameter

Module parameter: signal extension channel DI1		
Function number	4828 + m * 64 + 27	m = module number 0
Description	The parameter determines whether the signal extension for the electrical input 1 is active or not.	
Bit	Bit 1	
Values	0 = not active, default 1 = active	

Tab. 67: Signal extension channel DI1 module parameter

Module parameter: signal extension time DI			
Function number	4828 + m * 64 + 27		m = module number 0
Description	The parameter defines the signal extension time for the electrical inputs 0 and 1 of this module. Signal statuses accepted as logical input signals usually remain valid at least until the specified signal extension time, minimum signal duration, has expired. Signal changes within the extension time are ignored.		
Bit	Bit 2, 3		
Bit	3 2	Value	Meaning
	0 0	0	5 ms
	0 1	1	15 ms, default
	1 0	2	50 ms
	1 1	3	100 ms
Comment	If a higher-order controller has long cycle times, there is the danger that short signals cannot be detected by this controller. A signal extension time can be set in order for signals of this type to be considered in the control sequence → CPX system description. The signal extension time defined with this parameter applies to the electrical inputs of this module and can be activated channel by channel with separate module parameters.		

Tab. 68: Signal extension time DI module parameter

Module parameter: debounce time DI			
Function number	4828 + m * 64 + 27		m = module number 0
Description	The parameter determines when an edge change of the electrical inputs is to be accepted as a logical input signal for this module.		
Bit	Bit 4, 5		
Bit	5 4	Value	Meaning
	0 0	0	1 ms
	0 1	1	3 ms, default
	1 0	2	10 ms
	1 1	3	20 ms
Comment	Input debounce times are set to eliminate interference from signal edge changes during switching operations, bouncing of the input signal. The setting applies to the electrical inputs of this module. Further information on this parameter → CPX system description.		

Tab. 69: Debounce time DI module parameter

Module parameter: behaviour after SCS			
Function number	4828 + m * 64 + 27		m = module number 0
Description	The parameter determines whether the voltage remains switched off after a short-circuit/overload of the sensor power supply 24 V DC U _{SEN} or is switched on again automatically.		
Bit	Bit 6		
Values	0 = leave switched off 1 = switch on again, default		
Comment	If the setting is leave switched off, Power Off/On is required to restore the power. – Check which setting is required for the safe operation of the system		

Tab. 70: Behaviour after SCS module parameter

Module parameter: behaviour after SCO		
Function number	$4828 + m * 64 + 27$	m = module number 0
Description	The parameter determines whether the corresponding voltage remains switched off or is switched on again automatically after a short-circuit/overload of the electrical outputs in this module.	
Bit	Bit 7	
Values	0 = leave switched off, default	
	1 = switch on again	
Comment	If the setting is leave switched off, Power Off/On or Reset/Setting of the corresponding output is required to restore power. – Check which setting is required for the safe operation of the system.	

Tab. 71: Behaviour after SCO module parameter

Module parameter: Q_low-Timer reset selection			
Function number		4828 + m * 64 + 28	m = module number 0
Description		The parameter defines the signal source for resetting the Q_low-Timers when automatic pressure regulation and blocking functions are activated.	
Bit		Bit 0, 1	
Bit	1 0	Value	Meaning
	0 0	0 = Am.0.2, default	Output Am.0.2
	0 1	1 = DI0	Electrical input 0
	1 0	2 = DI1	Electrical input 1
	1 1	3 = Am.0.2 OR DI0	Logical OR signal: Output Am.0.2 OR Electrical input 0 Logic 1, if Am.0.2 = 1 or electrical input 0 = 1

Tab. 72: Q_low-Timer reset selection module parameter

Module parameter: setpoint pressure power-on		
Function number	4828 + m * 64 + 28	m = module number 0
Description	The parameter is used to define the setpoint pressure when the supply voltage is switched on, power-on, if the module is in the user-controlled pressure regulation and blocking function.	
Bit	Bit 2	
Values	0 = 10 bar, default	1000 kPa; 1450 psi/10
	1 = 6 bar	600 kPa; 870 psi/10
Comment	The parameter value is permanently stored in the module and is the valid value for the next power-on. A change in the parameter value is effective immediately and can be used in the user-controlled pressure regulation and blocking function to set a fixed setpoint pressure value.	

Tab. 73: Setpoint pressure power-on module parameter

Module parameter: output D00 selection		
Function number	$4828 + m * 64 + 28$	m = module number 0
Description	The parameter defines the signal to be output at electrical output 0.	
Bit	Bit 3	

Module parameter: output DO0 selection		
Values	0: DO0 = Am.0.6, default	Signal source for the electrical output 0 is the output value Am.0.6
	1: DO0 = VC_PULSE	Signal source for the electrical output 0 is the measuring pulse signal of the continuous consumption measurement VC

Tab. 74: Output DO0 selection module parameter

Module parameter: setpoint pressure rise limitation		
Function number	$4828 + m * 64 + 28$	m = module number 0
Description	The parameter defines the slope as the setpoint pressure increases. The limitation is effective for both automatic and user-controlled operation, including power-on. The set rise limitation also applies when the operating mode is changed.	
Bit	Bit 4 ... 6	
Bit	6 5 4	Value
	0 0 0	0 = OFF, default
	0 0 1	1 = 10 bar/s
	0 1 0	2 = 5 bar/s
	0 1 1	3 = 2.5 bar/s
	1 0 0	4 = 1 bar/s
	1 0 1	5 = 0.5 bar/s
	1 1 0	6 = 0.25 bar/s
	1 1 1	7 = 0.125 bar/s
Comment	The setpoint pressure can deviate up to 15% from the ideal value during the target pressure increase. The parameter value is permanently stored in the module and is the valid value for the next power-on. A change of the parameter value is effective immediately.	

Tab. 75: Setpoint pressure rise limitation module parameter

Module parameter: user measure select		
Function number	$4828 + m * 64 + 28$	m = module number 0
Description	Defines the setting for all measuring functions. This parameter is reserved for later products models and is not supported in current products. Settings of values have no effect on the behaviour of the module.	
Bit	Bit 7	
Values	0 = controller with Am.0.8-9, default	
	1 = controller with DI1	
Comment	Parameter is not currently supported. The parameter may appear in software tools for product parameterisation.	

Tab. 76: User measure select module parameter

10.5 Read-only module parameters

Module parameter: module time of operation		
Function number	4828 + m * 64 + 29, low byte 4828 + m * 64 + 30, high byte	m = module number 0
Description	The operating time of the function module in hours. The operating time is the duration for which the module was supplied with electrical energy.	
Values	Unsigned binary number with the decimal value range: 0 ... 65535 hours, low byte + 256 * high byte	
Comment	The operating time is limited to a maximum value of 65535. The operating hours counter is increased by 1 every time the operating voltage is switched on and then when every additional hour elapses. If the operation takes place more often than 65535 times, the parameter remains at this value. This parameter can only be read.	

Tab. 77: Module time of operation module parameter

Module parameter: shut-off valve switching cycles 'Shut off valve cycles'		
Function number	4828 + m * 64 + 31 (low byte) 4828 + m * 64 + 32 (high byte)	m = module number 0
Description	Counts the switching cycles of the shut-off valve.	
Values	Unsigned binary number with the decimal value range: 0 ... 65535 cycles, low byte + 256 * high byte	
Comment	The switching cycles counter is limited to a maximum value of 65535. If the operation takes place more often than 65535 times, the parameter remains at this value. This parameter can only be read.	

Tab. 78: Shut-off valve switching cycles module parameter

10.6 Parameterisation examples

10.6.1 Automatic shut-off function example



Every system must be set individually. The sample values are only intended as general orientation.

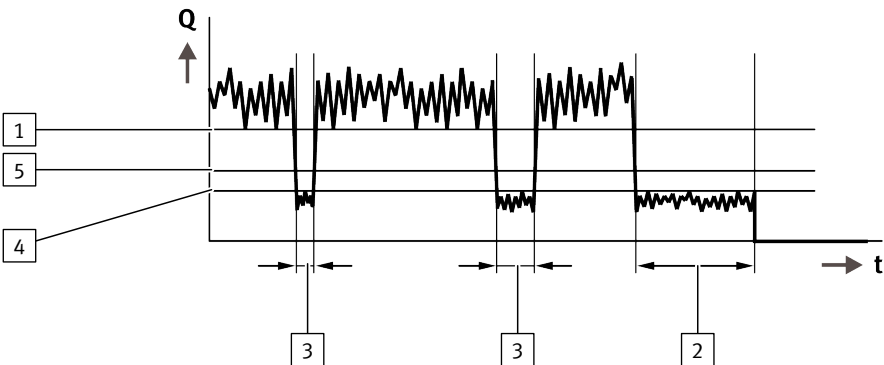


Fig. 28: Commissioning of the automatic pressure regulation and blocking function

- 1

Minimum flow rate in production operation
- 2

Auto-control delay time
- 3

Short-time production downtime
- 4

Maximum flow for production downtime
- 5

Auto-control flow rate critical limit

Recommended procedure for determining the auto-control flow rate limit values and auto-control delay time parameters

1. Record relevant function-specific production data.
The following data of the downstream system is required to be able to set the parameters for the automatic blocking function of the energy efficiency module correctly:
 - The minimum flow rate in production operation
 - The system in pneumatic and electric operation.
 - The actuators in action.
 - The maximum time at continuous minimum flow rate, e.g. short-term production downtime, automatic blocking is not wanted in this period.
 - The maximum flow rate during production standstill.
 - pneumatic and electrical in operation
 - The actuator technology not in action

Sample values in the pressurise state:

 - The minimum flow rate in production operation: 250 l/min
 - The maximum pause time in production operation: 2 min
 - The maximum flow rate during production standstill: 80 l/min
2. Set the parameters for the automatic pressure control function and blocking function.



Additional tolerances and safety additions must be taken into account during parameterisation.

- The module must be in the user-controlled blocking operating mode, $Am.0.1 = 0$, for parameterisation and the automatic shut-off valve controller must be deactivated, $Am.0.5 = 0$.
This ensures that the Q_{low} -Timer is reset for activating the automatic blocking function and the shut-off valve does not unintentionally switch to the blocking state.
- Set the auto-control delay time parameter, Pm.17-18. Set a higher value than the actual production pause time to prevent unwanted blocking during production operation, e.g. to 10 min.
- Set the auto-control flow rate limit value parameter, Pm.19-20. The parameter value must be greater than the maximum flow rate for production downtime but less than the minimum flow rate in production operation. In the example, a parameter value between 90 ... 240 l /min can be set.

3. Activate the automatic pressure control and blocking function.
 - When switching to the automatic pressure control and blocking operation by setting the output, $Am.0.1 = 1$, and reset of the Q_{low} -Timer reset function by $Am.0.2 = 0$ the parameterised flow rate monitoring by the Q_{low} -Timer is started.

The Q_{low} -Timer status is indicated at input $Em.3.4-3.5$. When Q_{low} -Timer has expired, the automatic pressure control and blocking function with blocking of the supply air and subsequent regulation to the auto standby setpoint pressure is set if the auto-enable control output is set, $Am.0.5 = 1$. This means that unexpected blocking of the supply air and reduction of the outlet pressure when Q_{low} -Timer expires is prevented.

If the flow rate of the system exceeds the set auto-control flow rate limit value when output $Am.0.5$ is not yet set, the Q_{low} -Timer is reset. The auto-controller delay time restarts. It continues to regulate to the auto normal setpoint pressure, even if the auto-enable output control is set, $Am.0.5 = 1$. As soon as the module is in the $AUTO_SHUTOFF$ state, shut-off state, or $AUTO_STANDBY$ state, control to pressure setpoint auto standby, only the user can exit this state.
4. Switch the module from the blocking state, $AUTO_SHUTOFF$, or auto standby pressure regulation state, $AUTO_STANDBY$, back to the auto normal pressure regulation state.
 - The Q_{low} -Timer status is UP, $Em.3.4-3.5 = 2$, and the module status is $AUTO_SHUTOFF$, $Em.3.8-3.11 = 11$, or $AUTO_STANDBY$, $Em.3.8-3.11 = 12$.
 - To switch to the $AUTO_NORMAL$ auto normal pressure regulation state, $Em.3.8-3.11 = 8$, the Q_{low} -Timer reset output must be reset first, $Am.0.2 = 1$, and then reset again, $Am.0.2 = 0$.
5. Check the set values over multiple production cycles.



Changes to system parameters can lead to a change in the determined production data.

- If necessary, check whether the set parameter values are still valid.

- The current module status at any time can be tracked in input $Em.3.8-3.11$. The status of the Q_{low} -Timers in input $Em.3.4-3.5$ and the switching position of the shut-off valve in input $Em.3.0$.

10.6.2 Example of pressure drop monitoring



Every system must be set individually. The sample values are only intended as general orientation.

Recommended procedure for determining the upper critical limit pressure change and pressure change sample time parameters

1. At output pressure setpoint $P2$, $Am.2$, set the parameterised setpoint pressure value auto normal, $Pm.21-22$. Switch the shut-off valve at the shut-off valve control output to the pressurise state, $Am.0.1 = 0$. Activate the user-controlled pressure control function and blocking function operating mode at the auto-user control output, $Am.0.1 = 0$.

2. Set the pressure change sample time parameter, Pm.10.



If the system has a high pressure drop, start with a setting of 100 ms, corresponding to $Pm.10 = 1$. If the pressure drop is low, increase the pressure change sample time, e.g. to 1 s, $Pm.10 = 10$, so the pressure change per 1 s is displayed. Vary the parameter value until you have determined a suitable value for the system.

3. Switch the shut-off valve to the blocking state, Am.0.1 = 1.
4. Record pressure change values as long as the output pressure is greater than the parameterised pressure setpoint auto standby, Pm.23-24. The values are available as selectable input data in the inputs Em.5 or Em.6. The corresponding input address must first be set in Am.1. E.g. Am.0 = 0 indicates the pressure change in both Em.5 and Em.6.



The pressure change is a signed value. When the pressure falls, the values are correspondingly negative.

5. Generate the value of the pressure change. With positive values, accept the input value, with negative values, reverse the sign, e.g. -10 becomes 10.
6. Determine the value of the greatest pressure change value during the blocking state.
7. Determine the greatest pressure change value in the shut-off state in terms of amount by repeatedly switching the shut-off valve from the pressurise to the shut-off state with the pressure setpoint unchanged.



If you have obtained very low values, it may be wise to increase the value for the pressure change sample time parameter, Pm.10.

8. Set the derived value, with an added safety tolerance, for the upper critical limit pressure change parameter, Pm.15-16. This will avoid unwanted error messages.

Sample values:

- Pressure change sample time parameter: 1 s
- Upper limit pressure change parameter:
 - Specified, amount of maximum pressure change value: 160 mbar
 - Set limit value including safety tolerance: 200 mbar



The pressure change is only monitored in the blocking state and with critical limit monitoring activated, Pm.0.6 = 1.

11 Malfunctions

11.1 Diagnostics

The energy efficiency module offers extensive diagnostics options and error handling via the fieldbus or diagnostics interface.

Diagnostics		Description	Information
1	On-site with LED indicators	The LEDs on the module indicate the status of the outlet pressure p2, the status of the electrical inputs and outputs and module errors.	➔ 5.4 Display components.
2	On site via the bus node diagnostics interface and operation with the help of CPX-FMT, Festo Maintenance Tool or Festo Automation Suite	- Shows current error messages in plain text - Offers access to the diagnostic memory	➔ 1 Applicable documents.
3	System status scanning via the network, status bits scanning	8 status bits display common diagnostic messages, global error message.	CPX system description ➔ 3 Additional information, ➔ 4 Cyber security measures.
	System diagnostics with the network, via the I/O diagnostics interface	Internal diagnostics data can be read via the I/O diagnostics interface. In this way, detailed diagnostic information can be accessed, even if the network used does not offer any extensive network-specific diagnostic functions. The I/O diagnostics interface offers: - Access to the current error message - Access to the diagnostic memory - Read access to internal parameters and data	
	Network-specific diagnostic functions	Diagnostic functions or communication services e.g. DPV1, PRO-FIBUS	

Tab. 79: Diagnostics options

11.2 Error numbers

Possible errors of the energy efficiency module are divided into three error classes with different priorities depending on the seriousness of the error. If an error occurs, the system error SF LED will flash depending on the error class.

SF LED, system error			
LED	Sequence	Meaning	Action
 flashing red	ON  OFF	Minor error/information, error class 1	An overview of all error numbers with allocation of their error classes can be found in the CPX system description ➔ 1 Applicable documents.
	ON  OFF	Error, error class 2	
	ON  OFF	Serious error, error class 3	
 off	ON  OFF	No error	–

Tab. 80: SF LED, system error

If several errors occur simultaneously, the error with the highest priority will have precedence. This means that:

- the system error LED flashes according to the higher priority
- the number of the error with the higher priority will be entered in the system diagnostic data under function number 1938, error number.

Within an error class, errors of modules with a lower module number have higher priority. For example, errors from module number 0 have the highest priority within an error class and errors from module number 1 have the second highest priority.



Detailed information regarding the module-specific error numbers can be found in the table below.

The “Enable parameter” column shows whether the specific error message can be deactivated and which parameter can be used.

Error channel	Meaning	Remedy	Activation parameter
m = module number 0			
Error number 0, no error or end of a message status			
–	–	–	Cannot be deactivated
Error number 2, short circuit/overload			
Em.3	Short circuit/overload sensor supply 24V DC U _{SEN}	– Clear short circuit/overload, check connected sensors if necessary. – Depending on the set parameter value, behaviour according to SCS, Pm.27.6: – Setting 1 = switch on again: sensor supply voltage is automatically switched on again after elimination of short-circuit/overload. – Setting 0 = leave switched off. Switching on the sensor supply voltage again: power off/on necessary. - or – Change parameter response after SCS, Pm.27.6 auf 1 = switch on again	Pm.0.0 Monitoring Short circuit/overload Sensor supply
Am.0	Short circuit/overload at electrical outputs on at least one electrical output	– Clear short-circuit/overload, check connected actuators if necessary. The number of the faulty channel is signalled in the Em.3.14, DO0 and Em.3.15 inputs, DO1. – Depending on the set behaviour according to SCO parameter, Pm.27.7: – Setting 1 = switch on again: output is automatically switched on again after elimination of short-circuit/overload. – Setting 0 = leave off: output remains reset to 0. Switch the output back on: set the output to 0 and then back to 1. - or – Change behaviour after SCO parameter, Pm.27.7, to 1 = switch on again.	Pm.0.1 Monitoring Short circuit/overload Electrical outputs
Error number 10, upper limit value exceeded; Depending on the parameterisation, the module reports the error when monitoring is activated. Input signals will, however, still be processed.			
Em.0	Upper flow rate limit value exceeded	– Check the flow rate. – Check the parameterised limit value. – If necessary, adjust the monitoring limit value parameter startup.	Pm.0.6: Monitoring of limit values
Em.2	Upper pressure limit value exceeded	– Check the pressure. – Check the parameterised limit value. – If necessary, adjust the monitoring limit value parameter startup.	
Em.3	Upper pressure change limit value exceeded	– Check the pressure change. – Check the parameterised limit value. – If necessary, adjust the monitoring limit value parameter startup. – Check the system for leakage.	

Error channel	Meaning	Remedy	Activation parameter
m = module number 0			
Error number 15, module/channel failed; All electrical module functions are stopped.			
Em.0	Flow sensor defective	– Power off/on necessary. – Replace the device if this error occurs repeatedly.	Cannot be deactivated
Em.2	Pressure sensor P2 defective	– Power off/on necessary. – Replace the device if this error occurs repeatedly.	
Error number 24, error with the parameterisation of the lower limit value			
Em.2	An error has occurred in the setting of the lower limit value pressure P2 parameter	– Check the parameterisation and carry out the parameterisation again with correct parameters.	Pm.0.7: Monitoring of parameters
Error number 25, error with the parameterisation of the upper limit value; Depending on the parameterisation, the module reports the error when monitoring is activated. Input signals will, however, still be processed. The parameter values entered will be ignored. The module operates internally with the last valid parameter values.			
Em.0	An error has occurred in the setting of the upper limit value flow rate parameter	– Check the parameterisation and carry out the parameterisation again with correct parameters.	Pm.0.7: Monitoring of parameters
Em.2	An error has occurred in the setting of the upper limit value pressure parameter		
Em.3	An error has occurred in the setting of the upper limit value pressure change parameter		
Error number 26, actuator power supply undervoltage; Depending on the parameterisation, the module reports the error when monitoring is activated. Input signals will, however, still be processed.			
Am.0	Undervoltage in load voltage supply 24 V DC	– Check the load voltage supply 24 V DC and increase if necessary. – Check the load voltage supply wiring and repair if necessary.	Pm.0.2: Monitoring U _{OUT/A}
Error number 29, error in parameterisation; Depending on the parameterisation, the module reports the error when monitoring is activated. Input signals will, however, still be processed. The parameter values entered will be ignored. The module operates internally with the last valid parameter values.			
Em.0	Error in setting the parameter: – Unit flow rate – Flow standard	– Check the parameterisation and carry out the parameterisation again with correct parameters.	Pm.0.7: Monitoring of parameters
Em.1	An error has occurred in the setting of the unit consumption parameter		

Error channel	Meaning	Remedy	Activation parameter
m = module number 0			
Em.2	An error has occurred in the setting of the unit pressure parameter	– Check the parameterisation and carry out the parameterisation again with correct parameters.	Pm.0.7: Monitoring of parameters
Em.3	An error has occurred in the setting of the pressure change sample time parameter		
Em.5	An error has occurred in the setting of the monitor limit values parameter startup		
Am.0	Error in setting the auto-control flow rate limit value parameter		
Am.2	Error when creating the parameters: – Auto setpoint pressure normal and/or – Auto setpoint pressure Standby		

Tab. 81: Module-specific error numbers

12 Removal



The settings are not saved in the product. Save the settings if necessary, e.g. on the higher-level controller.

Disassemble the product in the following sequence:

1. De-energise the compressed air supply and power supply.
2. Exhaust the energy efficiency module.
3. Disconnect the pneumatic ports.
4. Disconnect all electrical cables.
5. Loosen the screws from all mounting brackets, one after the other. Start with the screws beneath the product.
6. Remove the entire product.

13 Technical data

13.1 Technical data, general

MSE6-C2M	
Certificates, declaration of conformity	➔ www.festo.com/sp
Mounting position	Horizontal ± 5°
Degree of protection in accordance with EN 60529	IP65 ¹⁾
Storage temperature [°C]	−10 ... +60
Ambient temperature [°C]	0 ... +50
Product weight [g]	≤ 4550
Vibration and shock, in accordance with IEC 60068 ²⁾	
Vibration, part 2-6	Severity level 1
Shock, part 2-27	Severity level 1

1) Plug connector inserted or fitted with protective cap

2) Explanations of the severity levels ➔ table below

Tab. 82: Technical data, general

Vibration load		
Frequency range [Hz]	Acceleration [m/s ²]	Deflection [mm]
Severity level 1	Severity level 1	Severity level 1
5 ... 8	–	± 3.5
8 ... 41	10	–
41 ... 58	–	± 0.15
58 ... 160	20	–
160 ... 200	10	–

Tab. 83: Values for vibration and shock in accordance with IEC 60068

Shock load		
Acceleration [m/s ²]	Duration [ms]	Shocks per direction
Severity level 1	Severity level 1	Severity level 1
± 150	11	5

Tab. 84: Values for vibration and shock in accordance with IEC 60068

Continuous shock load		
Acceleration [m/s ²]	Duration [ms]	Shocks per direction
± 150	6	1000

Tab. 85: Values for vibration and shock in accordance with IEC 60068

13.2 Technical data, pneumatic

MSE6-C2M		
Pressure ranges		
Operating pressure P1	[MPa]	0.5 ... 1.1
	[bar]	5 ... 11
	[psi]	72.5 ... 159.5
Output pressure P2	[MPa]	0.25 ... 1
	[bar]	2.5 ... 10
	[psi]	36.25 ... 145

MSE6-C2M		
Medium		
Operating medium		Compressed air to ISO 8573-1:2010 [7:4:4]
		Nitrogen
Note		Lubricated operation not possible
Temperature of medium	[°C]	0 ... 50
Flow rate		
Standard nominal flow rate 1 → 2 in main flow direction	[l/min]	7000; measured at p1 = 1 MPa (10 bar; 145 psi) and p2 = 0.6 MPa (6 bar; 87 psi); Δp = 0.1 MPa (1 bar, 14.5 psi)
Pressure sensor ¹⁾		
Pressure measuring range	[MPa]	0 ... 1.4
	[bar]	0 ... 14
	[psi]	0 ... 203
Pressure resolution	[kPa]	2
	[mbar]	20
	[psi/10]	5
Accuracy	[%FS]	± 3
Repetition accuracy	[%FS]	± 0.3
Flow sensor ¹⁾²⁾		
Flow direction		Unidirectional P1 → P2
Flow measuring range	[l/min]	50 ... 5000
Accuracy of flow rate		± 3% of the measured value, + 0.3% FS
Repetition accuracy, zero point	[%FS]	± 0.2
Repetition accuracy, margin	[%FS]	± 0.8
Temperature coefficient, margin	[%FS/K]	Typically ± 0.1
Pressure-dependent margin	[%FS/MPa]	± 5
	[%FS/bar]	± 0.5
	[%FS/psi]	± 0.0345
Pressure regulation ¹⁾		
Pressure regulation range P2 ³⁾	[MPa]	0.25 ... 1 Condition: Operating pressure P1 ≥ target pressure + 0.1 MPa
	[bar]	2.5 ... 10 Condition: Operating pressure P1 ≥ target pressure + 1 bar
	[psi]	36.26 ... 145 Condition: Operating pressure P1 ≥ setpoint pressure + 14.5 psi
Linearity error	[%FS]	2
Repetition accuracy	[%FS]	3
Pressure hysteresis	[MPa]	0.03
	[bar]	0.3
	[psi]	4.35
Overall accuracy	[MPa]	± 0.035
	[bar]	± 0.35
	[psi]	± 5.08

MSE6-C2M		
Shut-off valve		
Switch-on pressure	[MPa]	≤ 0.35
	[bar]	≤ 3.5
	[psi]	≤ 50.75
Switch-off pressure	[MPa]	< 0.1
	[bar]	< 1
	[psi]	< 14.5
Residual pressure	[MPa]	< 0.1
	[bar]	< 1
	[psi]	< 14.5

1) % FS = percent of the measurement value range end value (full-scale)

2) Typical accuracy under nominal conditions (0.6 MPa (6 bar, 87.02 psi), 23 °C and horizontal mounting position)

3) measured at ambient temperature 23 °C ± 5 °C and temperature of medium 18 °C ± 5 °C

Tab. 86: Technical data, pneumatic

13.3 Technical data, electrical

MSE6-C2M		
Operating voltage supply for electronics and sensors, U _{El/Sen}		
Nominal voltage	[V DC]	24 ± 25 %
Nominal voltage range	[V DC]	18 ... 30
Intrinsic current consumption at 24 V	[mA]	Max. 350
Additional current consumption via sensor supply at electrical inputs	[mA]	Max. 1000
Only MSE6-...-M: Additional current consumption via connected modules at extension interface		Description of the connected modules, MSE6-D2M, CPX-I/O modules
Residual ripple	[%]	≤ 10, within the nominal voltage range
Cable length	[m]	Max. 30
Load voltage supply for actuator technology, U _{Out/A}		
Nominal voltage	[V DC]	24 – 10 %/+ 20 %
Nominal voltage range	[V DC]	21.6 ... 28.8
Intrinsic current consumption at 24 V	[mA]	Max. 260
Additional current consumption via load current at electrical outputs	[mA]	Max. 1000
Only MSE6-...-M: additional current consumption via connected modules at extension interface		➔ documentation of the connected modules, MSE6-D2M, CPX-I/O modules
Residual ripple	[%]	≤ 10, within the nominal voltage range
Cable length	[m]	Max. 30
Electrical inputs		
Number of digital inputs		2
Switching logic at inputs		Positive logic, PNP
Input characteristics		In accordance with IEC 61131-2

MSE6-C2M	
Switching level, inputs	Signal 0: $\leq 5\text{ V}$ Signal 1: $\geq 11\text{ V}$
Electrical isolation channel – channel	No
Electrical isolation channel – internal bus	No
Power rating of sensor supply [A]	Max. 1
Fuse protection (short circuit) sensor supply	Internal electronic fuse
Cable length, inputs [m]	Max. 30
Electrical outputs	
Number of digital outputs	2
Switching logic at outputs	PNP, positive switching
Characteristic curve, outputs	Based on IEC 61131-2
Electrical isolation channel – channel	No
Electrical isolation channel – internal bus	Yes
Power rating per channel out-puts [A]	Max. 1, 12 W lamp load, in compliance with the max. permitted resultant current
Resultant current of outputs [A]	Max. 1
Fuse protection (short circuit) outputs	Internal electronic fuse per channel
Cable length, outputs [m]	Max. 30
CPX-Extension connection	
Connectable modules	1 MSE6-D2M or up to max. 3 CPX I/O modules
Permitted CPX I/O modules	– CPX-4DE, 4 digital inputs – CPX-8DE, 8 digital inputs – CPX-4DA, 4 digital outputs – CPX-8DA, 8 digital outputs – CPX-8DE/-8DA, 8 digital inputs and 8 digital outputs – CPX-4AE-U-I, 4 analogue inputs – CPX-2AA-U-I, 2 analogue outputs
Connecting cable length [m]	Max. 2
Electromagnetic compatibility	
Interference emission	➔ Declaration of conformity ➔ www.festo.com .
Immunity to interference	

Tab. 87: Technical data, electrical

Festo SE & Co. KG

Ruiter Straße 82

73734 Esslingen

Germany

Phone: +49 711 347-0

www.festo.com