CALMS d.o.o.

Installation and operation manual

CALMS FLOW CONTROLLER

CFC

CALMS FLOW CONTROLLER USER MANUAL

Proper installation and handling of the device are essential to ensure safe and reliable operation. Only qualified personnel should perform installation and maintenance procedures as described in this manual.

Product:	CALMS flow controller (CFC)
Version:	4.0.0
Release date:	May 2025

Table of contents

1. Important notices

Please read this manual carefully and completely before installing, operating, or maintaining the device. Follow all safety notes, warnings, and instructions to ensure safe and proper use.

The manufacturer cannot be held liable for any damage or injury resulting from failure to comply with the instructions in this manual.

Tampering with the device in any way not described or authorized in this manual will void the warranty and release the manufacturer from any liability.

This product is designed and intended exclusively for the application described in this manual. Use in any other context, or in conditions not specified by the manufacturer, constitutes improper handling and will also void the warranty. The manufacturer shall not be responsible for any consequences arising from improper use.

This manual must be read and understood by all personnel involved in the installation, operation, or maintenance of the device. It should be stored together with the product and made available to users as needed.

By installing or using this product, you acknowledge that you have read, understood, and agreed to comply with the terms and instructions set forth in this manual.

2. Warnings

	**Installation, maintenance, and repair** of the flow controller and actuator must be carried out **only by qualified personnel**. Improper handling may cause system malfunction, equipment damage, or personal injury.
	**Disconnect the electrical supply** before installation, maintenance, or repair. Failure to do so may result in **electric shock**.
	The system operates under **high-pressure compressed air**. Always depressurize the system before service. Use appropriate **PPE** and follow local safety regulations.
	Before powering up the device, **verify all electrical connections** are correct and secure to avoid malfunction or damage.
	Operate the device only within the specified **temperature range**. Exceeding limits may cause permanent damage or unreliable operation.

3. Short introduction

Congratulations!

You are now the owner of a powerful, reliable, and easy-to-integrate flow controller — designed to give you full control over your system's flow dynamics with maximum precision and minimal hassle.

The CALMS Flow Controller combines smart differential pressure measurement, accurate flow calculation, and precise actuator control — all in one compact unit. With this manual, you'll be up and running in no time, whether you're a first-time user or an experienced technician.

Before installation, please check the contents of the package. If anything is missing or damaged during transport, report it immediately to the carrier and contact us via info@calms.com.

We are constantly improving our products and software. If you're using older versions, some features or screenshots in this manual may differ. If you'd like to stay updated with the latest improvements, get in touch with us for update and service options.

Do you like our product or have feedback about this manual?

Let us know! Your input helps us improve both the device and the experience. Contact us at info@calms.com.

Enjoy using your CALMS Flow Controller!

4. Product overview

The **CALMS Flow Controller (CFC)** is a smart, efficient, and compact solution for regulating compressed air systems. It serves as a dynamic interface between the supply side (compressors and air treatment equipment) and the demand side (production lines or end users), maintaining a **stable system pressure** regardless of consumption fluctuations — a key factor in improving overall system efficiency.

Designed for energy savings, easy integration and remote control, the CFC combines flow and pressure control, actuator-driven regulation, and real-time monitoring in one compact unit — offering a unique, all-in-one solution for modern air system management.

4.1. Key benefits

✓ Energy efficiency	Reduces artifical demand and leakage losses by lowering and stabilizing system pressure on the demand side – leading to **average savings of 6 %**, with **potential savings of 10 %** and even more. Maintains lowest acceptable system pressure and shortens compressors load and unload cycles for maximum efficiency.
✓ Reliable and stable operation	Maintains constant outlet pressure using an advanced **PI(D) control algorithm**, independent of variations in system demand.
✓ Isolation of supply and demand side	Physically separates compressors and air treatment equipment from end users, enhancing storage capacity and preventing pressure peaks from reaching production equipment.
✓ Fail-safe design	Normally-open valve position with optional on-off bypass valve ensures air delivery even in fault conditions.
✓ Compact and easy to install	Slim **wafer-type construction** with minimal space requirements and low noise operation. Suitable for new installations or retrofits, including multiple lines and **custom configurations**.

✓	Full integration with CALMS energy management platform	Real-time trending, online monitoring and remote control via CALMS system. Enables easy setting of optimal plant pressure, programmable schedules and remote diagnostics.

4.2. Performance capabilities

✓	Pressure control range	2 to 40 barg (30-580 psig)
✓	Setpoint resolution	0.08 bar (1 psi)
✓	Operating pressure	up to 40 bar (580 psi)
✓	High differential pressure control	Efficient regulation using small actuators
✓	Valve type	Electrically regulated butterfly disc valve
✓	Construction	Space-saving wafer-type design
✓	Form factor	Compact design with lowest possible size

4.3. Control and regulation

✓	Control modes	Flow based or pressure based regulation
✓	Self adapting behavior	Automatically adjusts to system chnages
✓	Flow calibration	All valves come pre-configured with flow calibration
✓	Programmable setpoints	Schedules available for multiple CFC valves

4.4. Installation and integration

✓	Multiple units	Multiple CFC valves can be connected to a single CAL-PM control box
✓	Remote connectivity	Full integration with CALMS for trending, monitoring and control
✓	Dry air not required	No external pneumatic supply needed
✓	Quiet operation	Low operating noise level
✓	Easy installation	Designed for fast customer-side installation

5. TECHNICAL SPECIFICATIONS

Model	Description	Pipe diameter	Design flow	Design pressure	Pressure SP resolution
		mm / inch	m3/min	Bar / PSI	Bar /PSI
CFC-50	CALMS Flow Controller DN50 (2") with CALMS online connection	DN50 / 2"	2-25	10 / 145	0.05 / 1
CFC-65	CALMS Flow Controller DN65 (2 ½") with CALMS online connection	DN65 / 2.5"	2-34	10 / 145	0.05 / 1
CFC-80	CALMS Flow Controller DN80 (3") with CALMS online connection	DN80 / 3"	5-45	10 / 145	0.08 / 1
CFC-100	CALMS Flow Controller DN100 (4") with CALMS online connection	DN100 / 4"	5-89	10 / 145	0.08 / 1
CFC-150	CALMS Flow Controller DN150 (6") with CALMS online connection	DN150 / 6"	5-120	10 / 145	0.08 / 1
CFC-200	CALMS Flow Controller DN200 (8") with CALMS online connection	DN200 / 8"	12-177	10 / 145	0.08 / 1

5.1. Valve tachnical information

Design	**Wafer-type design for flanges acc. DIN EN 1092-1 form B**
Nominal Sizes	DN 50 - 200, 2" - 8"
Nominal pressure acc. DIN 2401 for flanges with facing type B	PN 40 DN 50 - DN 150
Rangeability	30 : 1
Temperature	from -60°C up to +350°C
Leakage Rate (% of Kvs-value)	sliding unit STN2 < 0,0001
Specific leakage rate shaft and body sealing	ISO FE-BH-CC3-SSA0-t(-40°C/+350°C) - PN40-ISO 15848-1

: All CFC kit are designed and calculated based on application reference condition!

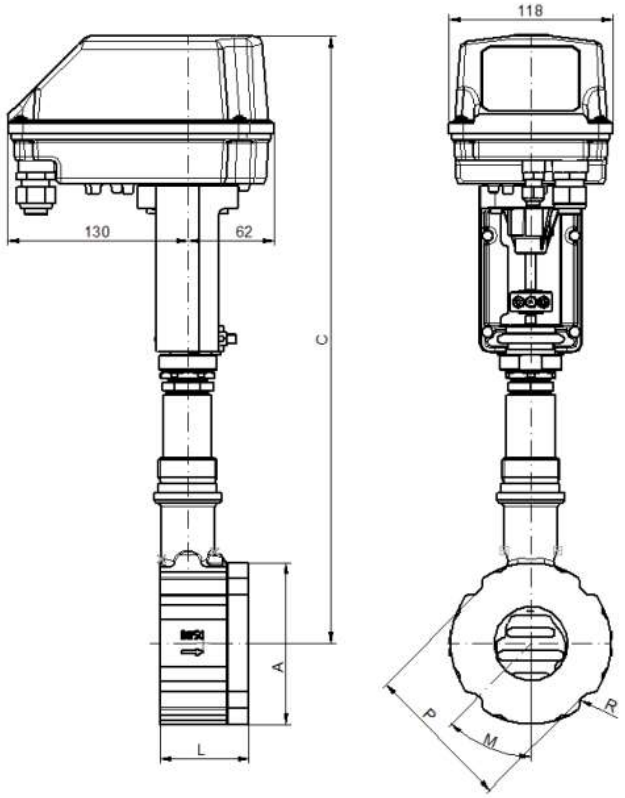
Model selection is based on pressure, flow and temperature specification!

5.2. Actuator technical information

Function	**Control**			
Motor type	CA24C	CA260C	CA24C-R	CA260C-R
Mains connection	24V AC/DC	90-260V AC	24V AC/DC	90-260V AC
Set point range	(0)2-10V / (0)4-20mA			

Feedback	(0)2-10V / (0)4-20mA			
Limit switch	2			
Potentiometer feedback	-			
Max. switching capacity	24V AC/DC 200 mA			
Actuating speed	1.5 / 2 / 3 s/mm (Standard: 2 s/mm)			
Safety functions	Monitoring of tensile force, set point, temperature of the electronics, etc.			
Diagnostic functions	Storage of motor and total operating time, temperature and directional classes, etc.			
Fail Safe position	-	-	freely adjustable	
Load	500 Ω for current set point / 95 kΩ for voltage set point			
Max. input	13 W	12 W	13 W	12 W
Input heating resistor	10 W			
Starting current heating resistor	6 A	2,5 A	6 A	2,5 A
Actuating power	800 N			
Protection class (EN 60529)	IP 65			
Adm. Ambient temperature	-10°C to +60°C			
Duty cycle	100%			

5.3. Dimensions and weight



DN [mm]	A [mm]	C [mm]	L [mm]	Stroke	Weight [kg]
15	64	410	56	6	4
20	72	415	56	6	4
25	82	420	56	6	5
32	89	425	56	6	5
40	99	430	56	6	5
50	116	440	64	8	7
65	138	447	68	8	8
80	153	457	70	8	9
100	184	470	75	9	13
125	212	485	80	8.5	15

6. Calms flow controller (CFC) kit

The **CALMS Flow Controller** is a flow regulation valve designed for use with the CALMS-PM-X control box, enabling precise regulation and online optimization of compressed air systems.

Each CFC kit includes:

✓	**Electrically actuated valve assembly**	Specially designed butterfly disc valve, integrated electric positioner, flow direction indicator
✓	**Pressure transducers**	4...mA analog signal, measuring inlet and outlet pressure
✓	**Junction box**	Connects the components to the CAL-PM device via EtherCAT

ⓘ Connection to a CALMS CAL-PM device is mandatory for proper operation of the CFC!

Product	Description
CFC-50-KIT	CALMS Flow Controller Disc Valve -pipe DN50, Regulation range 2-40 bar,max 42 bar resolution 0.05 bar, range 2-25 m3/min, without on-off bypass valve, CALMS connection
CFC-65-KIT	CALMS Flow Controller Disc Valve pipe DN65, Regulation range 2-40 bar, max 42 bar resolution 0.05 bar, range 2-34 m3/min, without on-off bypass valve, CALMS connection
CFC-80-KIT	CALMS Flow Controller Disc Valve pipe DN80, Regulation range 2-40 bar, max 42 bar resolution 0.05 bar, range 5-45 m3/min, without on-off bypass valve, CALMS connection
CFC-100-KIT	CALMS Flow Controller Disc Valve,pipe DN100, Regulation range 2-40 bar, max 42 bar resolution 0.05 bar, range 5-89 m3/min, without on-off bypass valve, CALMS connection
CFC-150-KIT	CALMS Flow Controller Disc Valve, pipe DN150, Regulation range 2-40 bar,max 42 bar resolution 0.05 bar, range 8-120 m3/min, without on-off bypass valve, CALMS connection

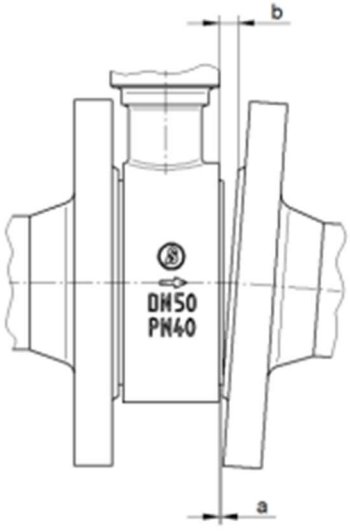
7. Mechnical installation

Remove all packaging materials from the valve.

Before installation, check the pipework for contamination and impurities and clean if necessary.

The control valve must be installed in the pipeline in accordance with the flow direction. The flow direction is indicated by an arrow on the body. The sliding gate valve shuts off the medium only in the direction of flow (arrow direction). If operating conditions exist in which the inlet pressure falls below the outlet pressure, we recommend the use of check valves in the outlet pipe.

Gaskets according to to EN 1514-1 or ANSI B16.21 in the respective nominal pressure level must be used as flange gaskets. Serrated metal gaskets, spiral wound gaskets or other gaskets with metal rings are not suitable. We recommend flange gaskets made of pure graphite with a stainless steel inlay. Before installing the valve between the flanges, it must be checked whether the flanges are aligned with and parallel to the connection flanges. Flanges that are not aligned / not parallel can generate inadmissible stresses in the pipeline and thus damage the valve and cause leaks. The following deviations for the parallelism of the flanges must not be exceeded:



DN	a-b [mm]
15 – 25	0.4
32 – 150	0.6
200 – 250	0.8

Austenitic nuts and bolts must be used for valves with stainless steel bodies. Tempered steel nuts and bolts must be used for valves with bodies made of carbon steel. The use of expansion bolts, e.g. conforming to DIN 2510, is recommended in the case of wide variations in temperature and temperatures exceeding 300 °C. Stud bolts should not be reused after the connection has been loosened as this can lead to overstretching of the bolts.

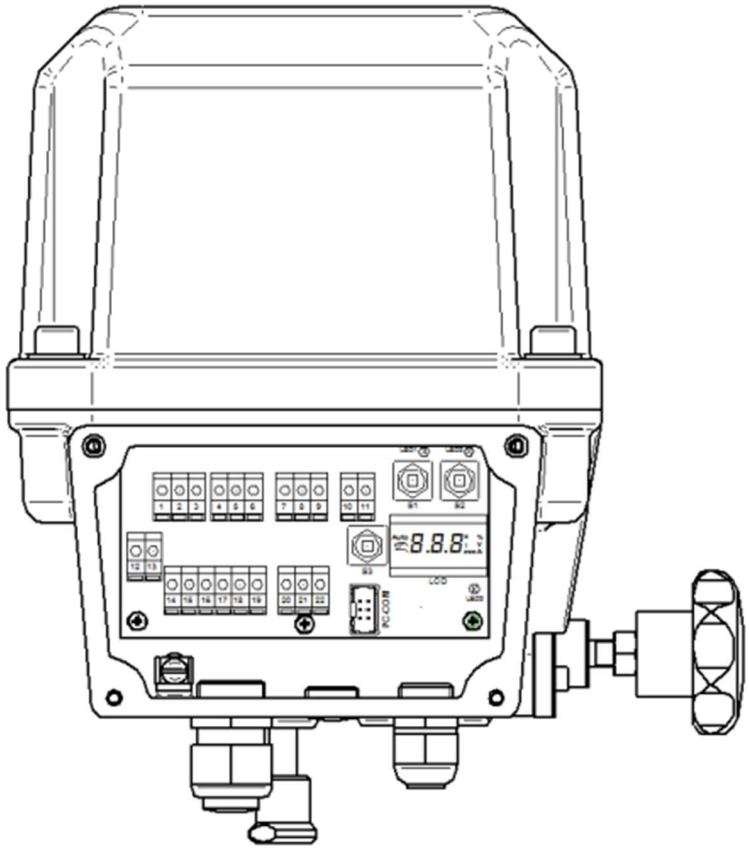
The threads of the bolts must be greased. The bolts must be tightened crosswise. Apply 30% of the nominal tightening torque with the first tightening sequence, 60% with the second and 100% with the third. The procedure should then be repeated with 100% of the nominal tightening torque until the nuts cannot be turned any further when applying the nominal tightening torque. With regard to the flange mounting, the guidelines of the VCI (Verband der Chemischen Industrie e.V.) for the respective application must be referred to.

The function of the fully installed valve must be checked before commissioning the system. The proper function of the completely mounted valve has to be checked prior to putting the installation into service.

8. Electrical installation

The electrical connection is made at the terminal box integral with the actuator.

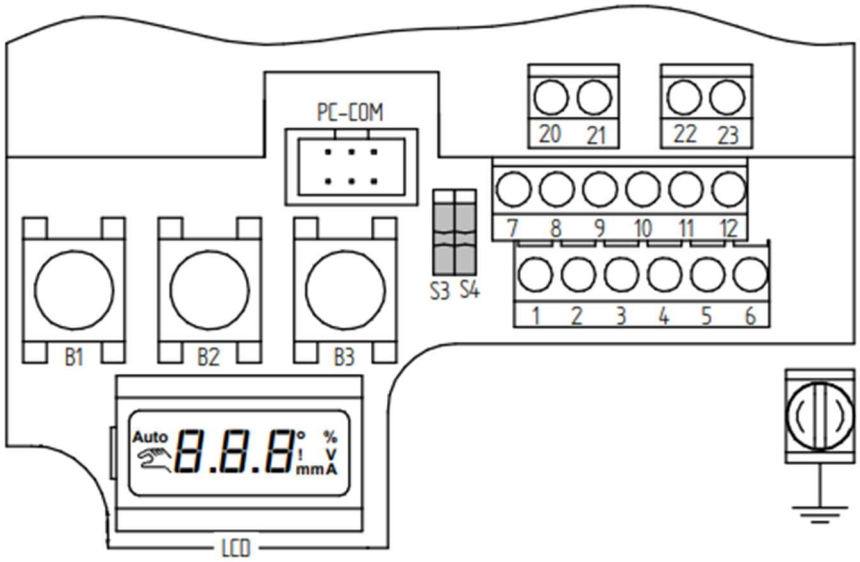
The minimum core cross section for all supply and signal conductors is 0.5 mm² (AWG 21). The terminals are designed for a maximum core cross section of 2.5 mm² (AWG 14). For long supply lines (>5m), a larger core cross section must be used so that the voltage drop does not fall below the specified range of 24V ± 10%. Wire-end sleeves are to be used to ensure a safe contact.



	The electrical installation must only be carried out by qualified personnel. Please note the applicable national safety regulations for installation, start-up and operation of the device. All work has to be carried out isolated from the power supply. Disregarding the relevant regulations may cause serious physical injuries and/or property damage.

8.1. Terminal layout

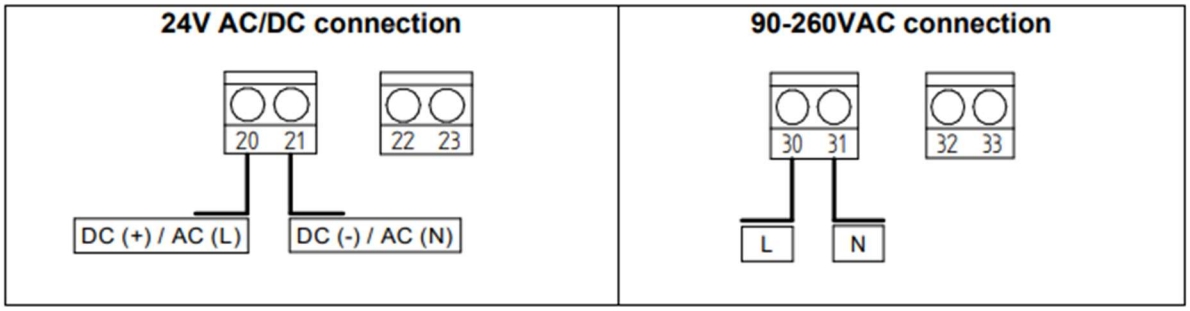
The layout of the terminals is provided on a circuit diagram on the reverse side of the cover for the terminal box. The connection terminals and ground terminal are marked accordingly.



Terminal	Abbreviation	Function
1	I in / U in	Set point input 0(2)-10 V / 0(4)-20 mA
2	0	Set point input (-) (signal ground)
3	I out / U out	Position feedback 0(2)-10 V / 0(4)-20 mA
4	0	Position feedback (-) (signal ground)
5	Bin in	Binary input (+)
6	Bin 0	Binary input (-)
7	S1	Limit switch 1 (lower limit switch)
8	S1 0	Limit switch 1 COM
9	S2	Limit switch 2 (upper limit switch)
10	S2 0	Limit switch 2 COM
11	Alarm	Alarm output
12	Alarm 0	Alarm output COM
20	L +	Voltage supply L for AC, (+) for DC (24V)
21	N -	Voltage supply N for AC, (-) for DC (24V)
22	L +	Heating resistor L for AC, (+) for DC (24V)
23	N -	Heating resistor N for AC, (-) for DC (24V)
30	L	Voltage supply L (90-260V)
31	N	Voltage supply N (90-260V)
32	L	Heating resistor L (110-260V)
33	N	Heating resistor N (110-260V)

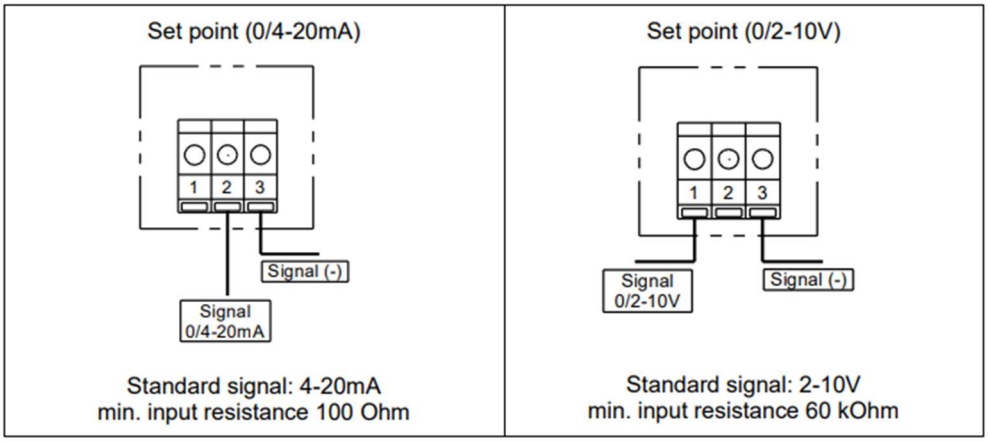
8.2. Supply voltage

The voltage values for the supply voltage can be read off the nameplate of the actuator.



8.3. Control signal (setpoint)

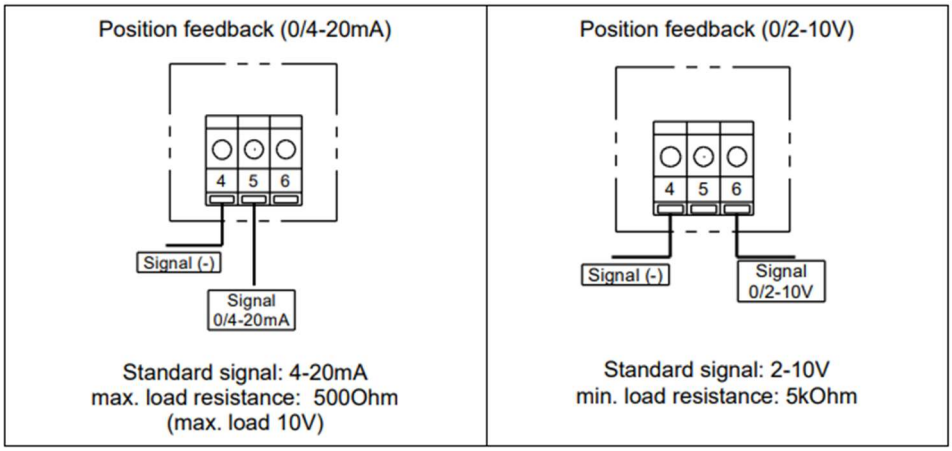
The actuator can be operated by a setpoint represented both by a current signal (0/4...20mA) as well as by a voltage signal (0/2-10V).



ⓘ The signal range can be changed!

8.4. Position feedback (actual value)

The actuator can feed back its actual position both by a current signal (0/4-20mA) as well as by a voltage signal (0/2-10V).



The signal range can be changed!

Terminal numbers may vary depending on the type of selected valve. For accurate electrical connections, please refer to the wiring diagram included in valve's technical documentation!

8.5. Electrical connections CFC - CAL-PM device

Terminal blocks and individual terminal markings may vary depending on the selected CFC type, which is why wiring diagrams **are customised**!

A tailored wiring diagram is included in the package with the oredered CFC.

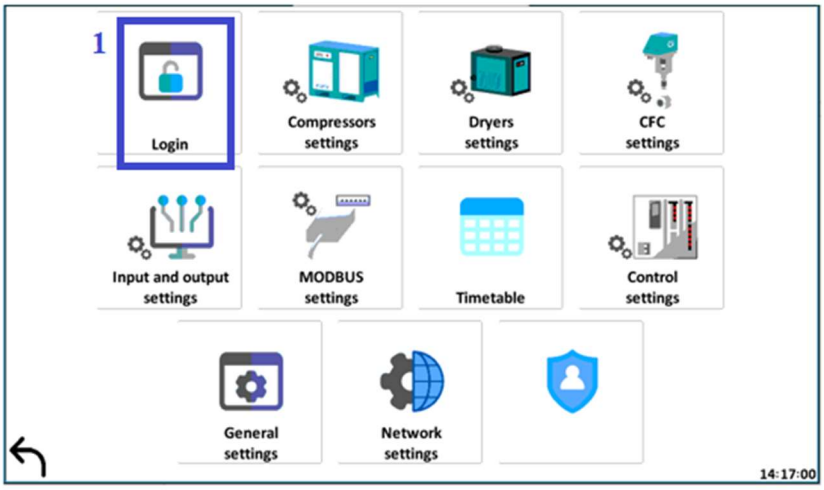
9. CFC configuration

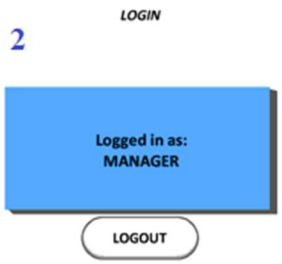
This section describes the configuration of the CFC via operator panel / HMI located on the CAL-PM device. The interface allows switching between Manual and Auto modes and adjusting key control parameters.

LOGIN CREDENTIALS

On the home screen of the HMI, press the SETUP button to open configuration menu. Access to configuration settings requires MANAGER access.

	USERNAME	MANAGER
	PASSWORD	321





9.1. List of terms

CFC	CALMS Flow Controller
CFC inlet pressure	The pressure sensed on inlet side od CFC. Measured by pressure transducer PT.01
CFC outlet pressure	The pressure sensed on the outlet side of CFC. Measured by pressure transducer PT.02. Outlet pressure is usually system pressure.
CFC position feedback	A signal that indicates the current position od the valve.
CFC control signal	A signal that regulates the CFC valve position.
Pressure setpoint	Target value for CFC outlet pressure
Close position	The valve opening percentage at which it is considered closed.
Close pressure	If the inlet pressure stays below threshold for 10 seconds, the CFC closes automatically. CFC will reopen once the inlet pressure remains above the setpoint for at least 3 seconds.
Fade speed	Defines how quickly the CFC adjusts during the »stabilization« function.
Noise reduction	

9.2. CFC regulation algorithm

The system continuously monitors the CFC outlet pressure and compares it to the defined **setpoint** (target pressure value). Based on this comparison:

- If the outlet pressure is **lower** than the setpoint, the system **opens** the CFC valve to increase pressure.
- If the outlet pressure is **higher** than the setpoint, the system **closes** the CFC valve to reduce pressure.

Regulation is managed by a PID controller. When the outlet pressure enters the defined **deadband zone**, the PID output is held (frozen) to avoid unnecessary valve movement. The system resumes active control only when the pressure exits the deadband.

The deadband is a predefined tolerance range around the setpoint value in which no corrective action is taken by PID controller. It's purpose is to prevent unnecessary valve movements caused by minor pressure fluctations that do not significantly impact system performance.

Using a deadband improves system stability, reduces wear on the valve actuator and avoids constant small adjustments that could lead to oscillations.

9.2.1. PID regulator parameters

The CFC controller uses a Proportional + Integral (PI) control algorithm to regulate outlet pressure. The following parameters define how the system responds to deviations from the desired setpoint.

- Proportional gain (Kp)

Proportional gain determines the ration of the controller's output response to the error signal (the difference between the measured and desired pressure). In general:

- Increasing Kp speeds up the system response.
- A higher gain is useful for systems where outlet pressure fluctates frequently, as it allows faster reaction.
- For more stable systems, a lower gain can be used to avoid excessive valve movement.

However, gain is directly related to valve wear and indirectly related to valve cycling: higher Kp means more frequent valve movements and shorter valve life, while lower Kp means slower response but extended valve longevity.

NOTE: A proportional-only controller cannot reach the exact setpoint value due to steady-state error. Therefore, an integral component is added to eliminate this offset and ensure accurate regulation.

- Integral time (Tn)

Integral time is used to eliminate the steady-state error produced by proportional gain. It works by continously adjusting the controller output to drive the pressure error toward zero.

Integral time defines how quickly the controller corrects error over time. It is expressed in seconds between reset actions. A shorter Ti (faster integral action) allows tighter control over pressure but results in more valve activity. A longer Ti (slower integral action) reduces valve cycling and increases valve life but may respond too slowly in dynamic systems.

Integral and proportional parameters **must be tuned to match system characteristics**. Tuning is typically a trial-and-error process and should be re-evaluated if major system changes occur.

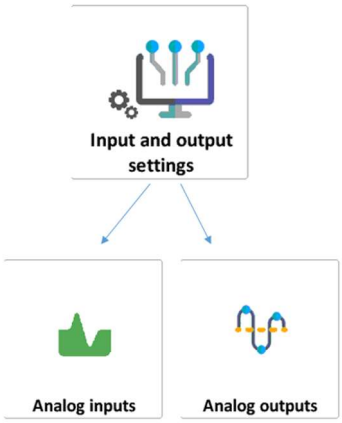
- Derivative time (Tv)

Derivative time is typically not used in CFC regulation. It is intended to predict future errors based on the rate of change, but for most air applications, it offers limited benefit and may introduce unnecessary complexity.

9.3. Input and output configuration

After logging in, begin with the configuration of **analog inputs and outputs**.

On the home screen of the HMI, press the SETUP button to open input and output settings.

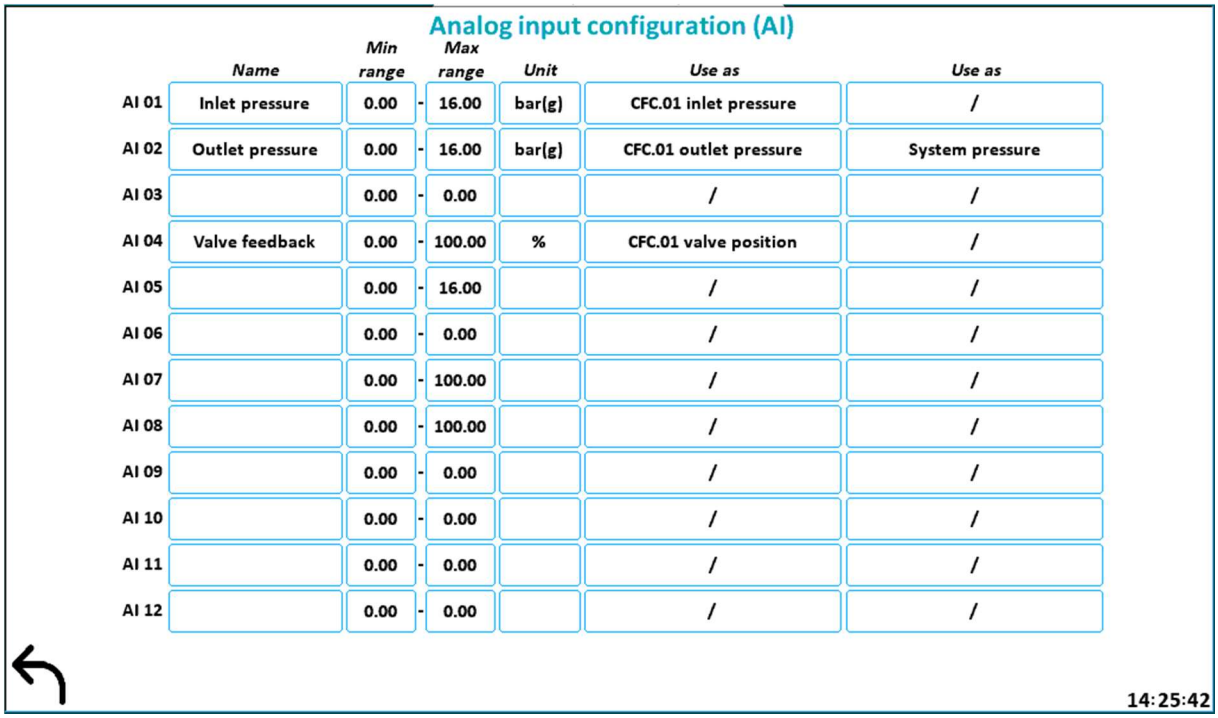


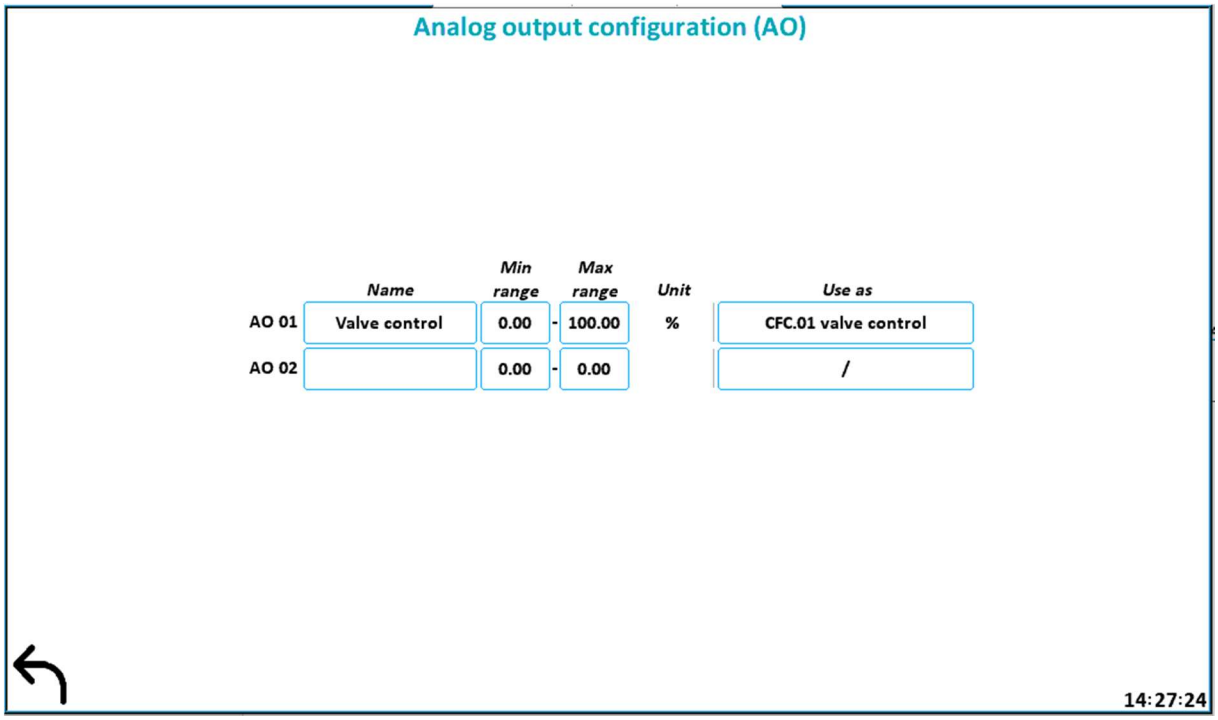
This includes:

- Labeling/Naming**:** Assign a descriptive name to each parameter.
- Range Settings**:** Define the appropriate signal range (minimum and maximum values).

- Unit Selection: Set the measurement unit (e.g., bar, °C, A).

All parameters must be configured correctly to ensure proper system functionality.





9.4. CFC settings

On the home screen of the HMI, press the SETUP button to open CFC settings.

The CFC valve operates in two modes:

- Manual mode

The valve remains fixed at a user-defined opening percentage (0-100 %) and does not respond to pressure changes or the setpoint. This mode is intended primarily for testing and system initialization.

- Automatic mode (AUTO)

The valve continuously adjusts its position to maintain the desired outlet pressure. It compares the outlet pressure with the setpoint:

- If the outlet pressure is higher than setpoint, the valve begins to close.
- If the outlet pressure is lower than setpoint, the valve begings to close.

⚠ **Accurate regulation in AUTO mode depends on proper tuning of the PID parameters!**

Operation profiles

- Default profile

The standard operational mode where the valve adjusts automatically to maintain the setpoint.

- Closed profile

The valve remains closed in the closed position, with no pressure adjustments.

- Night shift profile

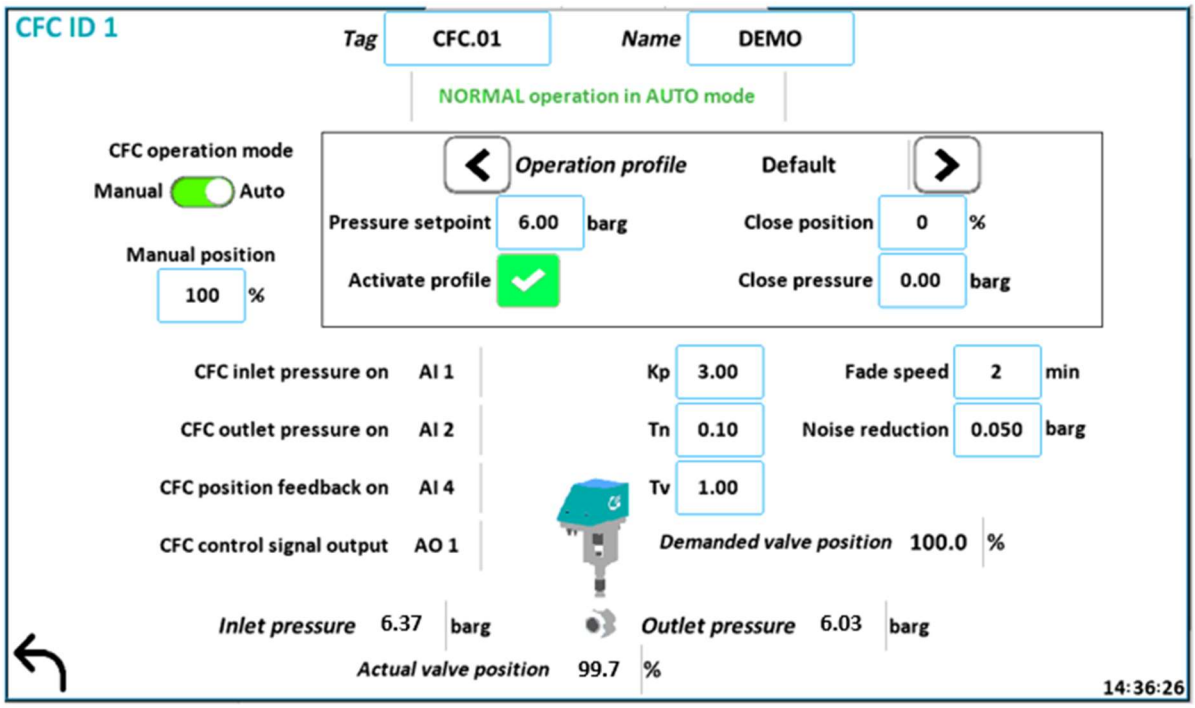
Designed for low activity periods, reducing valve response to conserve energy.

- Custom profiles

Allow users to create tailored profile for specific requirements.

Each profile requires you to configure the setpoint, close pressure and close position.

Activation: Press button Activate profile to activate profile.



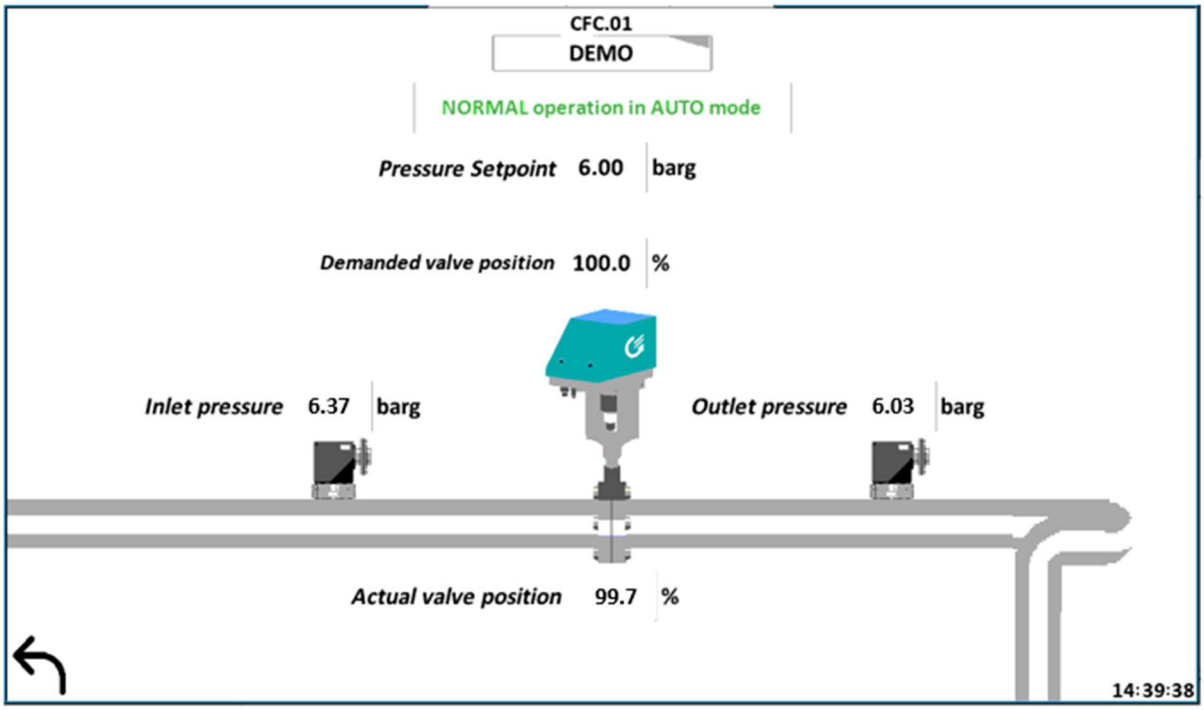
10. CFC status

On the home screen of the HMI, press the STATUS button to open CFC status.

The status page provides a real-time overview of the system's performance:

Operation mode	Indicates the current operational mode.
Inlet pressure	Displays the current pressure at valve's inlet.
Outlet pressure	Shows the current pressure at valve's outlet.
Demanded valve position	Shows the desired valve position based on control settings.
Actual valve position	Displays the current actual position of the valve.

This page allows easy monitoring and ensures that all key parameters are visible at a glance.


CFC.01
DEMO
NORMAL operation in AUTO mode
Pressure Setpoint 6.00 barg
Demanded valve position 100.0 %
Inlet pressure 6.37 barg
Outlet pressure 6.03 barg
Actual valve position 99.7 %
14:39:38

11. Service

To ensure safe and efficient servicing of the CALMS Flow Controller (CFC), follow these guidelines:

- **Mounting location:**

Install the CFC valve in a location that is easily accessible for maintenance and service. Avoid placing the valve in tight or obstructed areas, as regular access may be required for inspection, cleaning, or part replacement.

- **Visual inspection:**

Periodically inspect the valve for visible signs of wear, dirt buildup, or damage. Check electrical connections, wiring, and mounting for any looseness or corrosion.

- **Valve operation check:**

Monitor the valve's response in both Manual and Automatic modes to ensure it operates smoothly and within the expected range.

- **Software updates:**

Keep the CFC controller software up to date to ensure optimal performance and compatibility with CALMS monitoring systems. Updates may include bug fixes, performance improvements, or new features. Software updates are provided by CALMS technical support.

12. Troubleshooting

You may encounter some issues during the commissioning or operation of the CALMS Flow Controller (CFC). Below are common problems and suggested solutions. For any issues not listed here, please contact your CFC supplier.

12.1. Commissioning troubles

12.1.1. CFC inlet/outlet pressure shows 0 bar(g), although pressure is present

- Check the wiring of the PT.01 and PT.02 sensors inside the CAL-PM device.
- Verify and adjust the analog input minimum and maximum range settings for the inle and outlet pressure transducers.
- Test for a faulty analog input by connecting to another input channel.

12.1.2. Actual valve position does not change, even though the valve is moving

- Check wiring of the CFC feedback signal inside the CAL-PM device.
- Measure the 4–20 mA feedback loop using a milliamp meter.
- If needed, test another analog input to rule out a fault.

12.2. Operation troubles

12.2.1. CFC not responding to manual position request

Check if the **“Demanded valve position”** matches the manual request:

- **YES**

Measure the analog output signal (4–20 mA) from the main box to the CFC. If the mA signal **changes** when adjusting the manual position, the issue is likely wiring or a faulty valve.

- **NO**

If the mA signal **does not change**, the analog output is likely faulty. Contact your supplier.

12.2.1.1. CFC not responding although outlet pressure is above / below setpoint

- Confirm the controller is in **AUTO mode**.
- Check the **deadband** setting — if too wide, regulation will pause.
- Review the **PID parameters** and restore to default values if needed.
- Measure the analog output signal (4–20 mA) from the CAL-PM device to the CFC:

- If the mA signal **changes correctly** with outlet pressure and setpoint, suspect wiring or valve fault.
- If the mA signal **does not change**, the analog output is likely faulty. Contact your supplier.

13. Contact and support

If you experience any issues that cannot be resolved using this manual, please contact your CFC supplier or system integrator.

For technical assistance, software updates, or spare parts, provide the following information when reaching out:

- Product name
- Serial number (located on the device label)
- Description of the issue
- Error messages (if any)
- Steps already taken to resolve the issue

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