ANALYT MESSTECHNIK



OPERATING MANUAL

358 Series MC Mass Flow Controllers

Installation, operation, control tuning and maintenance of 358 Series MC mass flow controllers.

AMTC-MN-0005

Rev. 2 · October 2026

www.analyt-mtc.com

About this manual

This manual is for everyone who installs, operates or maintains a 358 Series MC mass flow controller: mounting and connecting it, reading the display, giving set points, selecting the gas, tuning the control loop and keeping it in calibration.

If the controller is new to you, read Safety (p. 7) and Installation (p. 14) first, then First power-up (p. 18). If you control the instrument from a computer or programmable logic controller (PLC), Communication (p. 35) explains what is specific to the controller; the full command reference is the *358 Series serial interface (RS-232/RS-485) — Communication guide* (AMTC-CG-0002), and the Modbus registers are in the *358 Series Modbus RTU and Modbus TCP/IP — Communication guide* (AMTC-CG-0001).

Which options your controller has — display type, totalisers, barometer, output signals, connector — is recorded on the calibration sheet shipped with it. Sections that apply only to an option say so.

Keep this manual for the lifetime of the product. The current revision is on the product page at analyt-mtc.com.

Conventions in this manual:

- Keys, buttons and menu entries are printed like this: **SET**.
- A menu path such as **MENU** › **SETUP** › **Sensor** › **Zero Band** means that you open each entry in turn.
- Commands you send and replies the device returns are set in monospace type, for example `ANCS 500`.

Abbreviations

Abbreviation	Meaning
ASCII	American Standard Code for Information Interchange: text characters used in serial commands
BSPP	British Standard Pipe Parallel: parallel British pipe thread
FKM	Fluoroelastomer
LCD	Liquid-crystal display
LPG	Liquefied petroleum gas
NC	Not connected (pin assignments)
NIST	National Institute of Standards and Technology (USA)
NPT	National Pipe Thread: tapered US pipe thread
NTP	Normal temperature and pressure: normal reference conditions (units starting with N)
PD/PDF	Default control algorithm (PD) with pseudo-derivative feedback (PDF)
PD²I	Control algorithm with proportional (P) and integral (I) terms plus a squared derivative term (D²)
PTFE	Polytetrafluoroethylene
RTU	Remote terminal unit: Modbus transmission mode
RX	Receive: serial input
SAE	Society of Automotive Engineers (fitting standard)
STP	Standard temperature and pressure: standard reference conditions (units starting with S)
TCP/IP	Transmission Control Protocol/Internet Protocol: network protocol

Abbreviation	Meaning
TFT	Thin-film transistor (colour display)
TX	Transmit: serial output
UNC	Unified National Coarse: US coarse screw thread
WEEE	Waste electrical and electronic equipment

Safety notices in this manual

⚠ WARNING

A hazardous situation which, if not avoided, could result in death or serious injury.

NOTICE

Practices not related to personal injury — damage to the product, the process or the sample.

Note
Information that helps understanding; never a hazard.

Tip
A shortcut or recommendation; never a hazard.

Document information

Title	358 Series MC Mass Flow Controllers — Operating manual
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Revision history

Rev.	Date	Change
2	October 2026	Quality programme: new document type, number and identity pages.
1	October 2026	First issue.

Related documents: data sheet for your flow range; calibration sheet

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CHAPTER 1

Safety

Read this page before you connect gas or power. Each point is repeated, with its context, in the section where it applies.

Intended use

The controller measures and controls the flow — or, when configured for it, the pressure — of clean, dry, non-condensing gases within the limits on its calibration sheet and in Specifications (p. 46). Selecting a gas or gas mix only changes how readings are calculated; it does not mix gases. For a gas that is not in the gas list (p. 57), ask Analyt-MTC first.

Rules that protect people

⚠ WARNING

Operating limits. Operating the controller under conditions that exceed its specifications can damage the equipment. It can also cause injury. Keep within the limits of this manual and of the data sheet for your range.

⚠ WARNING

Pressurised systems. A controller disconnected from a system that is still under pressure releases gas, and any hazardous gas left in the system escapes. Before you disconnect the controller, confirm independently that all pressure has been safely released and that hazardous gases have been purged.

NOTICE

Disassembly and repair. Taking the controller apart can damage it further and may void the warranty. Only certified personnel may service the controller. Do not dismantle or repair the controller yourself. Contact Analyt-MTC for any disassembly.

Rules that protect the instrument

NOTICE

Pressure. Pressure beyond the limits can damage the controller: above 13.8 bar a (200 psia) common-mode pressure, or a rapid pressure change of more than 5.17 bar (75 psi) differential pressure. Never exceed these limits (see Pressure limits, p. 15).

NOTICE

Power wiring. Power on pins 1 to 6 of the 8-pin Mini-DIN connector causes permanent damage. Supply power only to pin 7, and switch the supply on only after you have checked that every pin is connected correctly. Pin 2 carries a constant 5.12 V DC and is not the 0–5 V DC analogue output.

NOTICE

4–20 mA outputs. A 4–20 mA output connected to a loop-powered system is damaged beyond repair, and the warranty is void. Never connect a 4–20 mA output to a loop-powered system. To use an existing loop-powered input, insert a signal isolator with its own power supply.

NOTICE

Sealants. Pipe dope and liquid sealants on the process connections can get into the flow stream. There they damage the controller permanently. Do not use pipe dope or liquid sealants on the process connections.

NOTICE

Flow body. Opening the flow body, even to clean it, voids the calibration. Do not open the flow body. If you suspect debris inside, send the controller to Analyt-MTC.

Note
Large-valve controllers must be mounted with the valve upright and vertical.

Settings that can cause an unwanted flow

Lower set point limit (p. 29) above zero	The controller cannot stop the flow until the limit is cleared.
Batch dispensing (p. 26) switched off	The flow restarts at once at the current set point.
Optimising control (p. 30)	The controller moves to several set points, some of them above the present set point; limit them with Max Flow.
Pressure control deadband (p. 33)	No exhaust valve: a pressure above the band is not reduced.
Valve hold (p. 40) active	Set point changes have no effect until the hold is cancelled.

CHAPTER 2

Product description

What the controller does

The controller measures mass flow, volumetric flow, absolute pressure and gas temperature, and controls the flow of a gas to a set point. It takes 1000 readings per second. The main features:

- Gas selection: the controller can be switched to any gas of its built-in list, or to a gas mix you define, without recalibration (see Selecting the gas, p. 22).
- Pressure control: the control loop can be set to control pressure instead of flow, while the flow is still measured (see Control variable, p. 31).
- Live pressure and temperature on the main display, beside the flow.
- Optimising control: the controller tunes its control response to the present process conditions by itself (see Optimising control, p. 30).
- A backlit display with adjustable contrast; in a dimly lit area, press the logo to switch on the backlight.
- Adjustable standard and normal reference conditions for the mass flow (see Reference conditions, p. 24).
- A serial data connection to control the controller from a computer and to log its data (see Communication (p. 35)).

Parts and connections

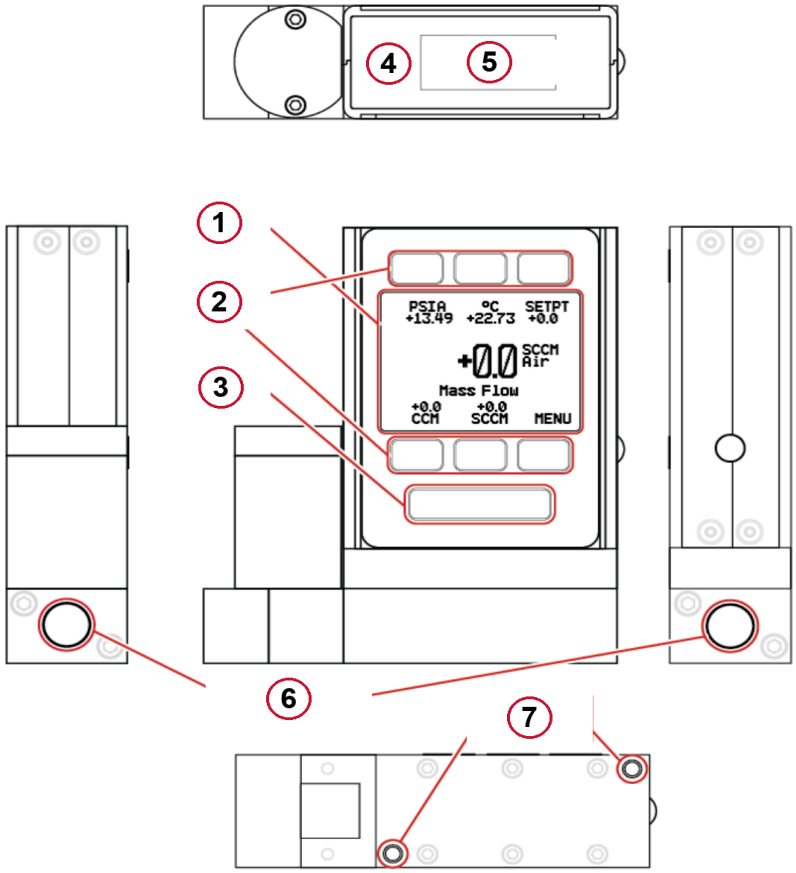


Figure 2-1. A typical controller: top view (above), side views and front view (middle) and bottom view (below). The appearance and connections of your controller can differ.

#	Part
1	Display
2	Buttons (their function is shown on the display beside them)
3	Backlight button (logo)
4	Power jack
5	Multi-pin connector for power and signals
6	Process connections
7	Mounting holes

Accessories for the controller, such as a bench-top baseplate and communication cables, are listed in Table 11-2 (see Accessories (p. 52)).

The main display

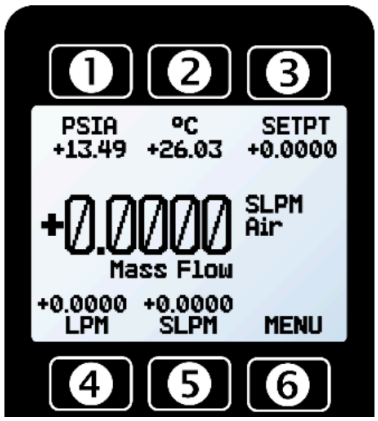


Figure 2-2. Main display of a controller measuring the mass flow of air. Button 7, the logo, sits below the display.

The large number in the centre is the highlighted reading — mass flow, unless you choose another. Around it the display shows absolute pressure, temperature, set point, volumetric flow and mass flow at the same time, each in its engineering unit. The selected gas appears below the unit on the right.

The controller measures 1000 times per second and refreshes the display 10 times per second, so it shows fluctuations that slower instruments average away.

#	Button
1	Highlights pressure in the centre
2	Highlights temperature in the centre
3	Opens the set point screen
4	Highlights volumetric flow
5	Highlights mass flow
6	Opens the menu, or moves to the next screen
7	The logo switches the backlight on and off

The main display of a mass flow controller has no tare button: tare the flow through the menu (see Taring, p. 21). Pressing an unused button does nothing. What the buttons do can be changed; a reading's button can instead open a small actions menu that also lets you change that reading's unit (see Display settings, p. 19).

Status messages

When something needs your attention, a three-letter status message appears to the right of the highlighted reading. The same codes are appended to the serial data frame.

Code	Meaning
ADC	Analogue-to-digital converter error
COM	The digital connection has been idle too long (see Set point when the connection is idle, p. 28)
EXH	Exhaust mode active
GTA	Control optimisation in progress (see Optimising control, p. 30)
HLD	Valve hold active (see Holding the valve, p. 40)
LCK	Front panel locked (see Locking the front panel, p. 20)
MOV	Mass flow above the range of the controller
OVR	Totaliser has reached its maximum count (see Totaliser limit, p. 26)
POV	Pressure above the range of the controller
TMF	Totaliser missed flow that was out of range
TOV	Temperature above the range of the controller
VOV	Volumetric flow above the range of the controller

Data screens

Depending on its settings the controller has up to four data screens. **NEXT** moves from one to the next; which of them are shown is set under Display settings (p. 19).

- **Live screen** — the default screen, with every reading of the controller (main display (p. 11)).
- **Min/Max screen** — the selected reading with its minimum and maximum since the last reset. **RESET** sets minimum and maximum to the present value, **SHOW VALUE** chooses the reading, **SETPT** shows the set point and lets you change or clear it, and **NEXT** moves to the totaliser screen if it is switched on. Switch the screen on under **MENU** › **SETUP** › **Display** › **Data Screens** › **Min/Max Screen** (Show).
- **Totaliser 1 and Totaliser 2 screens** — the total amount of gas since the last reset, with batch dispensing (see Totalisers and batch dispensing (p. 25)).

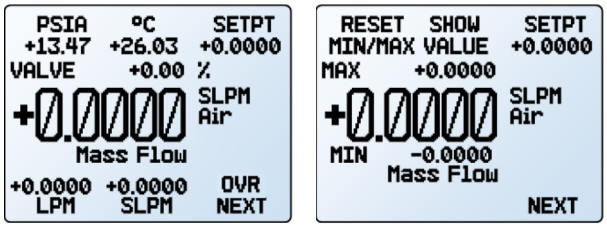


Figure 2-3. Live screen (left) and Min/Max screen (right).

Colour display (option)

A controller with a colour TFT display works exactly like one with the monochrome display. The colours add information:

- **Green** — labels and adjustments that belong to the button directly above or below them.
- **White** — a reading within the specifications of the controller.

- **Red** — a reading above 128 % of the specifications.
- **Yellow** — the menu item ready to be selected (the monochrome display marks it with >).

Press the logo to switch the colour backlight off; the controller keeps working. The colour display draws an extra 40 mA on a 12 V DC supply; all other specifications stay as they are.



Figure 2-4. Colour TFT display: main screen (left) and gas list with air selected in yellow (right).

CHAPTER 3

Installation

Install the controller in four steps: plumb it into the gas line, check that your pressures stay within its limits, wire power and signals, then power it up and tare it. The mistakes that damage a controller are called out in the step where they can happen.

WARNING

Operating the controller under conditions that exceed its specifications can damage the equipment. It can also cause injury. Keep within the limits of this manual and of the data sheet for your range.

Mounting and orientation

The controller needs no straight pipe runs upstream or downstream. It works in any orientation — on its side, on its back or upside down. The only exception are large-valve controllers: their valve must stand vertical and upright, although the flow body can be configured to connect in another direction. The size and position of the mounting holes on the bottom of the controller are given under Dimensions (p. 48).

Note

Mount large-valve controllers with the valve vertical and right side up.

Connecting the gas line

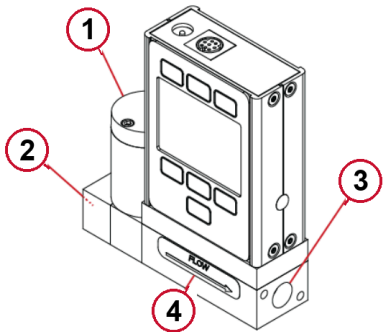


Figure 3-1. Gas connections: 1 control valve (upstream valve shown), 2 inlet connection, 3 outlet connection, 4 flow direction indicator.

1. Mount the controller so that the gas flows through the flow body in the direction of the arrow on it (4), or from left to right if there is no arrow.
2. Remove the plastic plugs from the inlet and outlet ports. The controller is shipped with them so that no dirt enters the flow path; leave them in until you connect the gas line.

NOTICE

Pipe dope and liquid sealants on the process connections can get into the flow stream. There they damage the controller permanently. Do not use pipe dope or liquid sealants on the process connections.

NOTICE

Thread tape on the first two threads can get into the flow stream. There it clogs or damages the controller; a partly blocked controller cannot reach its set point and shows a rising valve drive (p. 25). Leave the first two threads that enter the controller bare.

3. Connect the gas lines to the inlet (2) and outlet (3). On fittings without a face seal, wrap PTFE thread tape around the thread to prevent leaks, leaving the first two threads bare. Face-seal fittings need no tape.
4. Connect the power and signal cables (see Power and signal connections, p. 16).

NOTICE

Power on the wrong pins damages the controller permanently. Check that every pin is connected correctly. Switch on the power only then.

5. Switch on the power. The controller starts as soon as it receives power and is then ready for use.

Filters

Where the extra pressure drop is not a concern, protect the flow body from large particles with an in-line sintered filter upstream of the controller. The largest particle size it should pass depends on the full-scale range:

Full-scale range	Largest particle size
up to 1 smL/min (21.11 °C, 1013.25 mbar)	5 µm
between 1 smL/min and 1 sL/min	20 µm
1 sL/min and above	50 µm

Pressure limits

Two limits protect the internal pressure sensors: the *common-mode* pressure (the absolute pressure in the flow body) and the *differential* pressure across the controller. Damage is possible above 13.8 bar a (200 psia) common-mode pressure, and by a rapid pressure change of more than 5.17 bar (75 psi) differential pressure.

Shut-off valve and bidirectional versions

Controllers with positive shut-off valve

This version has an integrated, pneumatically actuated positive shut-off valve with a 1/8" NPT female pneumatic port. The valve is normally closed. It opens when you apply 60–120 psig of air pressure to it, and closes again when that pressure falls below 60 psig.

A three-way solenoid valve is the usual way to drive it. Air pressure goes to one side of the solenoid valve and the other side is open to atmosphere. When the solenoid is energised, the pressure reaches the shut-off valve and opens it; when the solenoid is released, the air vents to atmosphere and the shut-off valve closes.

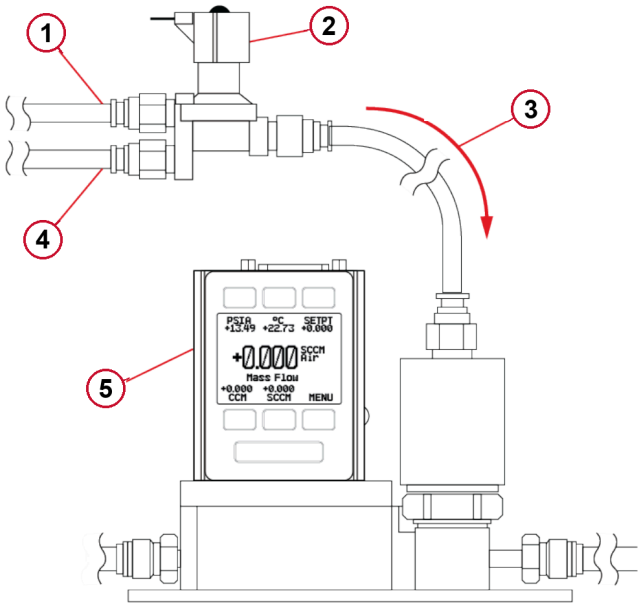


Figure 3-2. Typical installation: 1 air supply, 60–120 psig; 2 three-way solenoid valve; 3 air pressure opens the shut-off valve; 4 vent; 5 mass flow controller.

Bidirectional controllers

A bidirectional controller measures and controls flow in both directions. A negative set point selects the reverse direction (see Commands most used with a controller, p. 39), a flow limit applies symmetrically in both directions (see Limiting the flow, p. 33), and the totalisers can count negative or net flow (see Totaliser mode, p. 25).

Power and signal connections

Power the controller either through the power jack or through the multi-pin connector on top of the device. The supply voltage and current depend on the analogue configuration and the valve — see Electrical data (p. 47).

The standard connector is an 8-pin Mini-DIN. Controllers can instead have a 6-pin locking industrial connector, an 8-pin M12, or a 9-pin or 15-pin D-sub (ask Analyt-MTC); their pinouts are in Appendix C (p. 60). Which output signals your controller has depends on the options ordered and is noted on its calibration sheet.

8-pin Mini-DIN connector

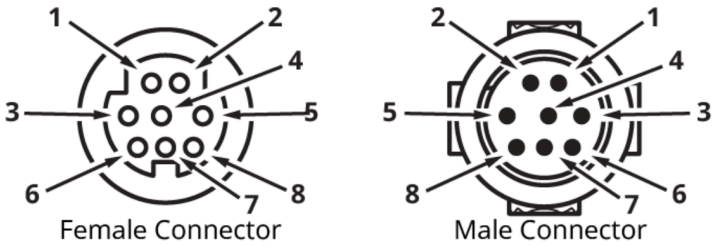


Figure 3-3. 8-pin Mini-DIN pin numbering. Left: female connector. Right: male connector.

Table 3-1 8-pin Mini-DIN pinout

Pin	Standard	Option
1	Not connected	4–20 mA primary output

Pin	Standard	Option
2	Constant 5.12 V DC	Secondary analogue output (4–20 mA, 0–5 V DC, 1–5 V DC or 0–10 V DC) or alarm
3	Serial input (receive): RS-232 RX / RS-485 B(+)	
4	Analogue set point input	
5	Serial output (send): RS-232 TX / RS-485 A(−)	
6	0–5 V DC primary output	1–5 V DC or 0–10 V DC primary output
7	Power in	
8	Ground, common to power, digital communication, analogue signals and alarms	

NOTICE

Power on pins 1 to 6 can damage the controller permanently. Pin 2 is easily mistaken for the 0–5 V DC output, but it carries a constant 5.12 V DC. Connect power only to pin 7. The primary voltage output is pin 6.

Analogue signals

The **primary analogue output** is linear over its whole range. Full scale is the top of the range: 5 V DC on a 0–5 V DC output, 20 mA on a 4–20 mA output. On ranges that start at 0 V DC, zero flow reads about 0.010 V DC rather than exactly zero.

An optional **secondary analogue output** is on pin 2 of the Mini-DIN connector, for both voltage and current. It can be a different signal type from the primary output; the calibration sheet shipped with the controller tells you which signals were ordered.

A controller with a 4–20 mA primary or secondary output needs a supply of at least 12 V DC.

NOTICE

A 4–20 mA output connected to a loop-powered system is damaged beyond repair, and the warranty is void. Never connect a 4–20 mA output to a loop-powered system. To feed an existing loop-powered input, use a signal isolator with a separate power supply.

Assigning the analogue outputs

Under **`MENU`** › **`SETUP`** › **`Signals`**, select the primary output (**`Out 1`**) or the secondary output (**`Out 2`**), then the value it follows:

- **Min Value** fixes the output at the lowest value it can produce — for example a constant 4 mA on a 4–20 mA output.
- **Max Value** fixes the output at the highest value it can produce.
- The other entries make the output follow a reading of the controller, such as mass flow, volumetric flow, absolute pressure or flow temperature.

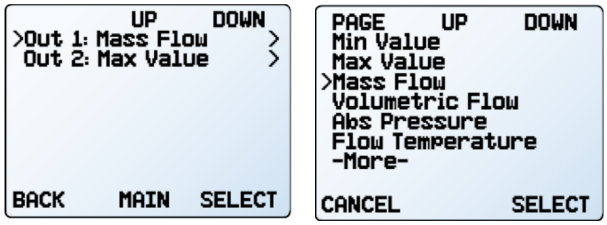


Figure 3-4. Signals menu (left) and the values an output can follow (right).

CHAPTER 4

Commissioning

First power-up

With the gas line connected and leak-tested but not yet pressurised, bring the controller into service in this order. By default the controller restores its last set point at power-up, so a controller that has been used before may open its valve as soon as it is switched on. Setting a zero set point before you pressurise the line keeps the valve closed and protects the sensors from the pressure step.

1. With the line not pressurised, switch on the power supply. The controller is ready to measure in less than a second and shows the main display (p. 11).
2. Set the set point to zero: press the set point button, then **CLEAR** and **SET**. If a computer, PLC or analogue signal supplies the set point, make sure it sends zero. A controller configured with a fixed power-up set point of zero (see Set point after power-up, p. 28) already starts closed.
3. Bring the line to its normal operating pressure with no flow through the controller.
4. Tare the flow reading (see Taring, p. 21).
5. If you need other units than those on the display, choose them (see Engineering units, p. 24).
6. Check that the gas shown on the right of the main display is your process gas; change it if necessary (see Selecting the gas, p. 22).
7. Check the set point source (see Set point source, p. 28), then give the controller its first set point.

CHAPTER 5

Operation

The front panel shows every reading of the controller at once and gives access to all of its settings through its buttons. This chapter explains how the menus are organised, the everyday tasks at the front panel, the totalisers and batch dispensing, and how to configure and optimise control; the main display and its status messages are described in Product description (p. 9).

Finding your way in the menus

Press **MENU** on the main display to open the main menu. Its entries group the settings by task; this manual names a setting by its path, for example **MENU › SETUP › Sensor › Zero Band**. On a monochrome display the selectable item is marked with >; **BACK** returns one level and **MAIN** returns to the main display.

Menu	What you find there	See
TARE FLOW / TARES	Flow tare; absolute pressure tare (barometer option)	Taring (p. 21)
CONTROL	Set point, optimising control, check control, set point set-up (source, limits, zero and power-up behaviour), set point ramp, control loop, valve drive display, batches	Giving a set point (p. 22), Configuring control (p. 27)
SETUP	Active gas and gas mixes; sensor settings (units, totalisers, STP/NTP, averaging, zero band); serial communication; analogue signals; display; advanced settings	Everyday operation (p. 21), Chapter 6 (p. 35)
ABOUT	Device information, full-scale ranges, Analyt-MTC name and contact details (web, phone, e-mail)	Device information (p. 20)

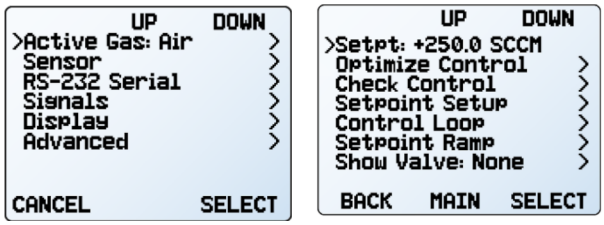


Figure 5-1. Setup menu (left) and control menu (right).

Display settings

The display settings are under **MENU › SETUP › Display**:

Setting	Effect
Data Screens › Main	The screen shown when you press **MAIN**. Only screens that are switched on can be chosen. If it is not the live screen, the live screen is reached with **NEXT**.
Data Screens › Live Screen › Any Key Press	What a reading's button does on the main display: highlight the reading (default), or *Show Actions Menu*, which offers both highlighting and a change of that reading's unit.
Data Screens › Live Screen › Show Valve Drive	Shows or hides the valve drive in percent (see Showing the valve drive, p. 25).

Setting	Effect
Data Screens › Live Screen › Top Left Key Value	Barometer option only: show barometric, gauge or absolute pressure at the top left.
Data Screens › Min/Max Screen	*Show* switches the Min/Max screen on, *Hide* switches it off.
Data Screens › Totalizer 1 Screen, Totalizer 2 Screen	The view of each totaliser screen; the same setting as under The totaliser screens (p. 26), and a change in one menu changes the other.
Display Lighting	Monochrome: **LESS CONTRAST** / **MORE CONTRAST**, and **POWER UP** Lit or Dark to set whether the backlight is on at power-up. Colour: **LESS BRIGHT** / **BRIGHTER**.
Display Rotation	Turns the screen content upside down, for controllers mounted upside down.

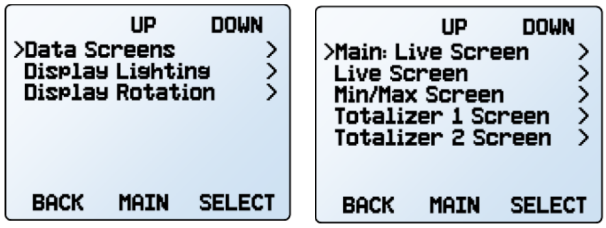


Figure 5-2. Display setup menu (left) and data screens menu (right).

Locking the front panel

The buttons can be locked from a computer so that nobody changes the controller's settings at the device; the display then shows LCK and the controller can be operated only through its connector. To unlock at the device, press and hold the four outer buttons together. From a computer, send the unlock command (see Commands most used with a controller, p. 39).

Device information

MENU › **ABOUT** holds information for set-up, configuration and troubleshooting. Have it open when you call Analyt-MTC.

Screen › field	Content
ABOUT DEVICE	
MODEL	Model of the controller (the number of characters is limited, so a long part number may be cut off)
SERIAL NO	Serial number
DATE MFG	Date of manufacture
DATE CAL	Date of the most recent calibration
CAL BY	Initials of the person who calibrated it
SW	Firmware version
FULL SCALE RANGES	
The maximum calibrated range of each reading: mass flow, volumetric flow and pressure.	
ABOUT MANUFACTURER	
Analyt-MTC name and contact details (web, phone, e-mail)	

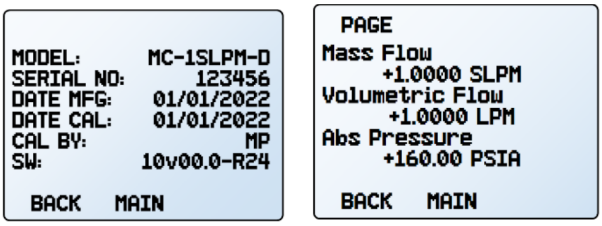


Figure 5-3. About device screen (left) and full-scale ranges screen (right).

Everyday operation

This section covers the tasks you perform at the front panel in normal use: taring, giving a set point, selecting the gas, defining a gas mix and adapting how readings are measured and shown. The same tasks can be done over the serial interface (see Chapter 6, p. 35).

Taring

A tare gives the controller its zero reference under your present conditions, so that it measures as accurately as it can. Tare the controller:

- after installation;
- when its orientation changes;
- after any significant knock or impact;
- after any significant change of temperature or pressure.

With autotare (p. 28) switched on, the controller tares its flow reading by itself after it has had a zero set point for a set time.

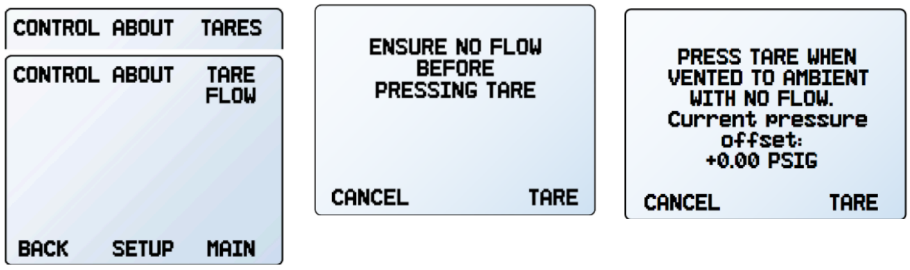


Figure 5-4. Left: the main menu with TARE FLOW, or with TARES on a controller with barometer (top). Middle: tare flow confirmation. Right: tare pressure confirmation.

Taring flow

1. Bring the line to the expected process pressure, with no gas flowing through the controller.
2. Press **MENU** › **TARE FLOW**, or **MENU** › **TARES** › **TARE FLOW** on a controller with barometer. The screen asks you to make sure there is no flow.
3. Press **TARE** to confirm.

Taring absolute pressure barometer option

On a controller with the optional barometer, the absolute pressure reading can be tared against the barometer. The tare screen shows the present pressure offset.

1. Open the controller to atmosphere, with no flow.
2. Press **MENU** › **TARES** › **TARE PRESS**. The screen asks you to tare when vented to ambient with no flow.

3. Press **TARE** to confirm.

Giving a set point

The set point is the flow (or, in pressure control, the pressure) the controller holds. Press the set point button on the main display (button 3, **SETPT**), or go to **MENU** › **CONTROL** › **Setpt**. The set point screen shows the engineering unit and the largest set point allowed, for example **SLPM: +1.000 Max**. Enter the value and press **SET**; the controller starts controlling at once. To give a zero set point, press **CLEAR**, then **SET**.

The front panel and the serial interface share one set point: the controller follows whichever command came last. An analogue set point signal takes over from both when the set point source (p. 28) is set to **Analog**.

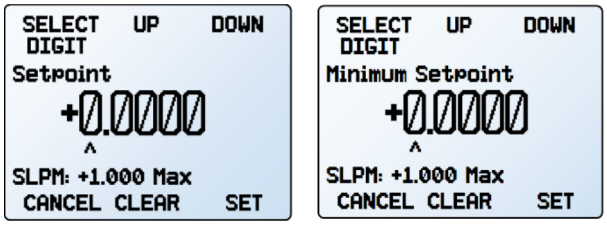


Figure 5-5. Set point screen, from the main display (left) and from the control menu (right).

Selecting the gas

The controller is calibrated with air at the factory. Because it calculates the flow from the properties of the gas, you can switch it to another gas from its built-in list without sending it back for recalibration. The change takes effect as soon as you press **SET**; no restart is needed. The gas selected appears below the engineering unit on the right of the main display.

The gas list is divided into categories — such as standard, chromatography and welding gases — together with the gases you selected recently and your own mixes. Corrosive gases and refrigerants are available only on corrosion-resistant controllers. Appendix B (p. 57) lists every gas with its number.

1. Press **MENU** › **SETUP**, point the cursor at **Active Gas** and press **SELECT**.
2. Press **PAGE** to show the next page of categories or gases, or **SELECT** to open a category.
3. Highlight your gas and press **SET**. The controller loads the gas properties and returns to the set-up menu.

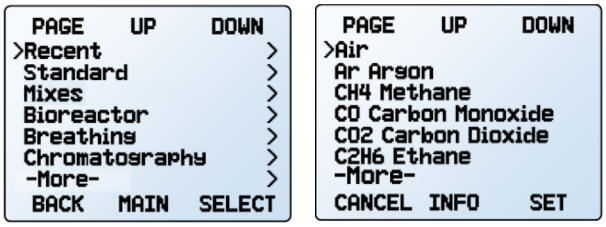


Figure 5-6. First page of the gas categories (left) and of the standard gas category (right).

Gas mixes

To stay accurate, the controller needs the viscosity of the gas that flows through it; the closer you define the actual composition, the more accurate the flow reading. You can define your own mixes: the controller calculates the mixture's properties from the molar (volume) fractions of its components using Wilke's semi-empirical method. A mix has up to five components, each specified to within 0.01 %, and the controller stores up to 20 mixes. Saved mixes appear in the user mixes category of the gas list; select one and press **SET** to use it.

Note
Defining a mix does not mix anything. It only tells the controller what gas to expect so that its flow calculation matches.

Creating a mix

1. Press **MENU** › **SETUP** › **Active Gas**, open the user mixes category and select **Create Mix**.

   Tip
   Avoid spaces in the short name. Some programs read the serial data frame incorrectly when the short name contains a space.

2. Enter a short name and a long name. **UP** and **DOWN** change the character; allowed are A–Z, 0–9, the characters . , - and space. **SET** accepts the name; **CANCEL** returns to the mix settings.
3. Select **Add Gas to Mix**, choose a component from the gas list and press **SET**; enter its percentage and press **SET**. The total so far is shown in the mix settings.
4. Repeat step 3 for each component. Once components have been added, the controller proposes the balance to 100 % for the next one, which you can adjust down.

   NOTICE
   Pressing **BACK** before **Save Mix** discards the new mix. The mix is lost permanently. Select Save Mix before you press BACK.

5. When the components total 100 %, select **Save Mix**.

PAGE turns the pages of a long gas list.

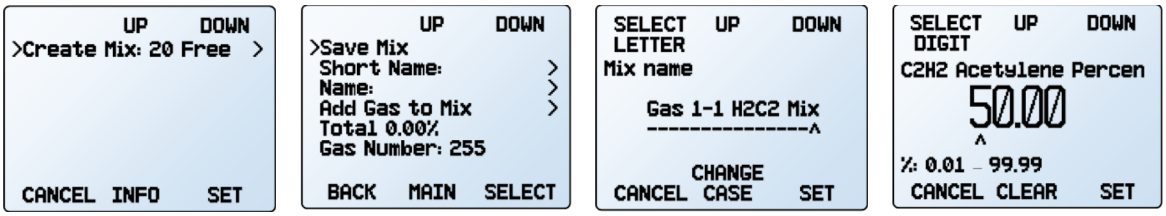


Figure 5-7. Creating a mix, from left: mix list without existing mixes; mix settings; defining the long name; setting the percentage of a component (acetylene).

Viewing, copying and deleting a mix

In the user mixes category, highlight a mix and press **INFO** instead of **SET**. The info screen shows the short and long names, the gas number and the composition (on a second page if needed, reached with **PAGE**), and offers to delete the mix or to create a similar one from it. A long mix is quicker to define over the serial interface (see Defining a mix over the serial interface, p. 38).

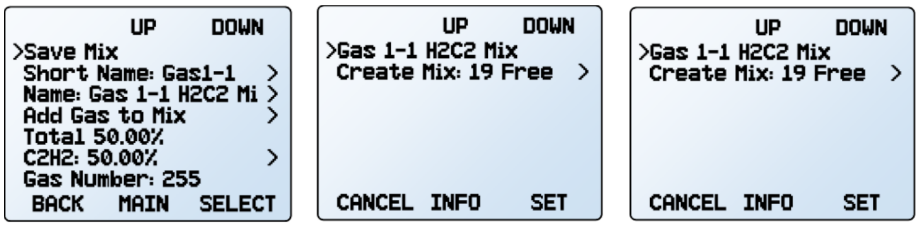


Figure 5-8. Mix settings after adding acetylene (left), and the mix list with the new mix (middle and right).

Sensor settings

MENU › **SETUP** › **Sensor** sets how the readings are calculated and reported: units, totalisers, reference conditions, averaging and zero band.

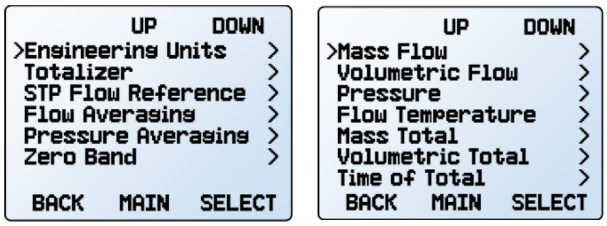


Figure 5-9. Sensor setup menu (left) and engineering units menu (right).

Engineering units

Each reading — flow, pressure, temperature, totals — can be shown in its own unit. Go to **MENU** › **SETUP** › **Sensor** › **Engineering Units**, choose the reading, then the unit, and confirm on the last screen. The change applies to the display and to the serial data frame. The available units are listed in Appendix A (p. 55).

Standard and normal reference conditions

A mass flow is calculated against a fixed reference temperature and pressure. Units beginning with **S** (**SLPM**, **SCCM**…) refer to standard conditions (STP), units beginning with **N** (**NLPM**…) to normal conditions (NTP). Unless you ordered otherwise, the controller ships with:

STP (units starting with S)	21.11 °C, 1013.25 mbar
NTP (units starting with N)	0 °C, 1013.25 mbar

> **Note**
> Changing the STP or NTP reference changes every mass flow reading. If the controller disagrees with another flow instrument in the same line, compare the reference conditions of both instruments first.

To change them, go to **MENU** › **SETUP** › **Sensor** › **STP Flow Ref** or **NTP Flow Ref**; which one is offered depends on the selected flow unit (**SLPM** makes STP editable, **NLPM** makes NTP editable). The menu sets **Stan T** and **Stan P**, or **Norm T** and **Norm P**, and the temperature and pressure units they are entered in.

Smoothing readings

A running average smooths fluctuating flow and pressure readings separately. Go to **MENU** › **SETUP** › **Sensor**, select **Flow Averaging** or **Pressure Averaging**, enter the averaging time and press **SET**. The value is the time constant of the geometric running average, in milliseconds; higher values smooth more, up to 255 ms.

Zero band

The zero band hides the small readings around zero: any flow below the threshold is displayed and reported as 0. The threshold is set in percent of full scale, up to 6.38 %, and also applies to gauge pressure on controllers with the barometer option. Example: on a 20 sL/min (21.11 °C, 1013.25 mbar) controller, a zero band of 0.25 % shows every reading below 0.05 sL/min as 0. Set it under **MENU** › **SETUP** › **Sensor** › **Zero Band** and press **SET**.

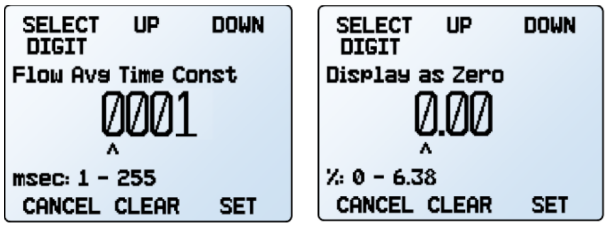


Figure 5-10. Adjusting the flow averaging time constant (left) and the zero band (right).

Showing the valve drive

The valve drive is the voltage applied to the valve, in percent of the most it can be driven. It does not equal the percentage the valve is open, but 0 % means the valve is closed, and its trend is a good diagnostic: a drive that rises over time for the same flow points to a blockage that the valve is working harder to overcome.

Under **`MENU`** › **`CONTROL`** › **`Show Valve`** or **`MENU`** › **`SETUP`** › **`Display`** › **`Data Screens`** › **`Live Screen`** › **`Show Valve Drive`**, choose where the value appears: *None*, *Main Screen*, *Digital Data* (serial data frame only) or *Screen and Digital*.

Totalisers and batch dispensing

The optional totalisers count the total amount of gas that has passed through the controller since the last reset. A controller can have two, Totaliser 1 and Totaliser 2. With a totaliser switched on, the controller can also dispense a fixed quantity and close its valve by itself.

Setting up a totaliser

The totaliser settings are under **`MENU`** › **`SETUP`** › **`Sensor`** › **`Totalizer`**, then **`Totalizer 1`** or **`Totalizer 2`**:

Setting	Effect
`Totalize`	Counts *Mass Flow* or *Volumetric Flow*; *None* switches the totaliser off.
`Batch`	The batch quantity (see Dispensing batches, p. 26). Batches need a totaliser that is switched on.
`Mode`	Which flow is counted (see below).
`Limit and Format`	Number of digits, position of the decimal point and behaviour at the maximum count (see below).
`Display`	The view of the totaliser screen (see below).
`Digital Data`	*None* leaves the total out of the serial data frame; *Volume* adds the present total to it.

`MENU` › **`SETUP`** › **`Sensor`** › **`Totalizer`** › **`Power Up Restore`** decides what happens at power-up: when it is on, the totalisers keep their values and continue counting; when it is off, they restart from 0.

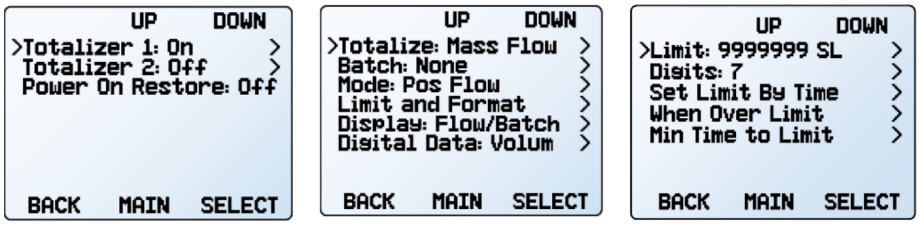


Figure 5-11. Totaliser on/off (left), totaliser settings (middle), limit and format (right).

Totaliser mode

- **Positive Flow Only** — counts only flow from left to right through the flow body; flow in the other direction is not counted.

- **Reset After No Flow** — when the flow stops completely, the total is held until flow starts again; it then restarts from zero.
- Bidirectional dual-valve controllers also offer **Negative Flow Only** (counts only flow from right to left) and **Bidirectional** (adds positive flow and subtracts negative flow).

Totaliser limit and format

The total can have up to 10 digits. Seven digits suit most systems that read the total as a floating-point number; more digits can need special handling. With fewer than 10 digits, the position of the decimal point trades resolution against capacity: more digits after the point give a finer total, but the maximum is reached sooner. Set the maximum directly (**`Limit`**) when you know the largest quantity, or by time (**`Set Limit By Time`**) when you know how long the totaliser must run; it can generally be set so that the limit is not reached for at least 10 minutes of full-scale flow, up to at least 100 years. **`Min Time to Limit`** shows how long the totaliser can run at full flow before it reaches the limit.

`When Over Limit` sets what happens at the maximum count:

`Set to Zero`	The total restarts from zero and keeps counting; no status message.
`Zero and Set OVR`	The total restarts from zero and keeps counting; `OVR` shows that the maximum was reached.
`Hold and Set OVR`	The total stops at the maximum until you reset it; `OVR` is shown.
`Hold`	The total stops at the maximum until you reset it; no status message.

The elapsed-time counter depends on the format; with many formats it does not reach its maximum for over 100 years.

The totaliser screens

Press **`NEXT`** on the main display to open the screen of Totaliser 1; **`NEXT`** again opens Totaliser 2, if it is switched on. Under **`Display`** (in the totaliser settings, or under Display settings) each screen shows one of three views: *Flow and Batch* (default: flow, set point and batch), *Detailed Flow* (flow rates, total and average flow, without batches) or *Multi-variable* (resembles the live screen). The buttons:

`M AVG` / **`V AVG`**	Average mass or volumetric flow since the last reset, updated live.
flow unit (e.g. **`SLPM`**)	The live flow.
`SETPT`	The set point; press to change or clear it.
`BATCH`	The batch quantity; `-NONE-` when batch dispensing is off.
`RESET`	Clears the total and sets the timer to zero. With a non-zero set point this starts a new batch at once.
`MENU`	Opens the main menu.

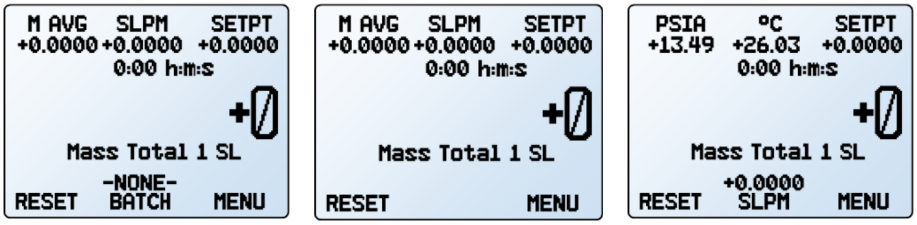


Figure 5-12. Totaliser screen views: Flow and Batch (left), Detailed Flow (middle), Multi-variable (right).

Dispensing batches

In batch mode the controller flows at its set point until the total reaches the batch quantity, then closes the valve. The next identical batch takes one button press. Batch mode needs a totaliser that is switched on, a batch quantity and a non-zero set point. Set the quantity with **`BATCH`** on the totaliser

screen, or under **MENU** › **CONTROL** › **Batch 1** (for Totaliser 1) or **Batch 2** (for Totaliser 2). Set only one batch at a time; otherwise the flow can stop too early.

While a batch runs, the quantity still to be dispensed is shown below the total. When the batch is complete, -DONE- appears above the **BATCH** button and the flow stops; the set point stays as it is.

NOTICE

When you switch batch dispensing off, the flow restarts immediately at the current set point. This gives an unwanted flow of gas if the flow must stay off. Set the set point to zero before you switch batch dispensing off.

Note
The batch quantity is kept when the controller is switched off. Clear it when you no longer need it.

Starting a batch

1. Enter the quantity to dispense in each batch and press **SET**.
2. Give the controller a set point (see Giving a set point, p. 22). The flow starts as soon as you press **SET**. If a non-zero set point was already active, the flow starts as soon as you confirm the batch quantity in step 1.

Repeating, changing, pausing and cancelling

To…	Do this
repeat the same batch	Press **RESET**. The flow starts immediately.
dispense a different quantity	Press **BATCH**, enter the new quantity and press **SET**. With a non-zero set point the flow starts on **SET**.
change the quantity of a running batch	Enter the new quantity. If it is larger than the amount already dispensed, the flow continues to the new value; if it is smaller, the flow stops at once. Press **RESET** to start the next batch.
pause a batch	Set the set point to zero: **SETPT** › **CLEAR** › **SET**. The timer keeps running while the batch is paused. Give a non-zero set point to resume.
cancel batch mode	Press **BATCH** › **CLEAR** › **SET** (or **REMAIN** › **CLEAR** › **SET** during a batch). The set point is unchanged, so the flow continues at the set point.

Totalising while controlling pressure

In pressure control, an abrupt pressure change can drive the flow above the highest measurable value, 128 % of full scale. The total then flashes and TMF appears to show that flow was missed. Reset the totaliser to clear the message. A flow limit (p. 33) inside the measurable range prevents the error, but it may keep the controller from reaching the pressure set point.

NOTICE

If the supply pressure is too low to reach the set point and then rises suddenly, the burst of gas can exceed the batch size before the valve reacts. The batch then overshoots its quantity. Keep the supply pressure high enough to reach the set point while a batch runs.

Configuring control

The controller leaves the factory set up to perform well over a range of expected conditions, so many installations never need this section. Use it when the process differs from what was ordered: a different control variable, a slower or faster response, protection against bursts, or a defined behaviour after a power cut. All settings are under **MENU** › **CONTROL**.

Set point behaviour

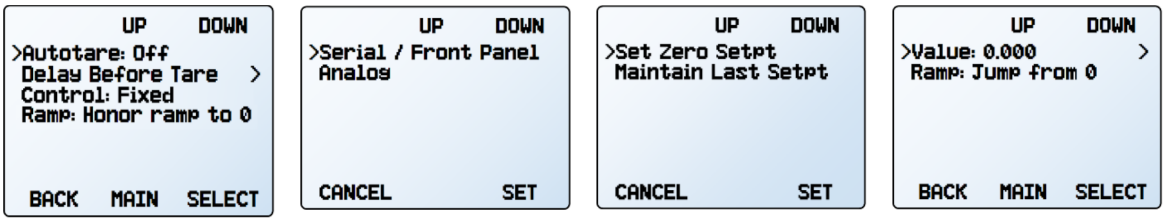


Figure 5-13. From left: zero set point (autotare) menu; set point source menu; communication timeout menu; power-up set point menu.

Set point source

`CONTROL` › **`Setpoint Setup`** › **`Setpoint Source`** decides where the controller takes its set point from:

- **`Serial/Front Panel`** — the front panel and the RS-232/RS-485 interface are equal partners: the controller follows the most recent command from either.
- **`Analog`** — the controller follows the analogue set point input, ignores serial set point commands and blocks set point entry at the front panel.

Zero set point and autotare

`CONTROL` › **`Setpoint Setup`** › **`Zero Setpoint`** sets what happens when the set point is zero:

- **Autotare** on or off. When on, the controller tares its flow reading after it has had a zero set point for the time set in **Delay Before Tare**. Make the delay long enough for the process to stop the flow and settle.
- **Ramp** — *Honor ramp to 0* takes the flow to zero at the configured ramp rate (p. 29); *Instantly to 0* goes to zero at once.

> **Tip**
> Autotare is generally not recommended when the controller controls pressure. Switch it off before you change the control variable to pressure.

Set point when the connection is idle

`CONTROL` › **`Setpoint Setup`** › **`On Comm Timeout`** decides what happens when the serial or Modbus RTU connection times out: go to a zero set point (*Set Zero Setpt*), or keep the last set point (*Maintain Last Setpt*). The timeout itself is infinite by default; set it in the serial communication menu (see Communication settings, p. 35).

Set point after power-up

By default the controller remembers its last set point through a power cut. Under **`CONTROL`** › **`Setpoint Setup`** › **`Power Up Setpoint`** › **`Value`** you can choose **`Fixed Setpoint`** instead and enter the value it should start with every time.

Use a fixed power-up set point whenever a computer or PLC sends new set points more often than every few minutes. Every remembered set point is written to non-volatile memory, and frequent writes wear that memory out.

Under **`Power Up Setpoint`** › **`Ramp`**, choose **Honor from 0** to ramp up from zero at the set rate after power-up, or **Jump from 0** to go to the set point at once. This is the same setting as Power Up in the ramp options; changing one changes the other.

Set point limits

By default the limits of the set point are the measuring range of the controller. For critical processes, **CONTROL** › **Setpoint Setup** › **Setpoint Limits** sets a tighter upper and lower limit. A serial set point outside the limits is rejected with an error. An analogue set point outside the limits is treated as the nearest limit: asking for less than the lower limit gives the lower limit.

NOTICE

With a lower set point limit above zero, the controller cannot stop the flow. The flow then continues when you need it off. Clear the lower limit before you need to shut the flow off.

Note

Limits are stored as a percentage of full scale and keep that percentage when you change the control variable. Example: a 10 sL/min (21.11 °C, 1013.25 mbar) limit on a 20 sL/min controller is 50 %; after switching to absolute pressure control on a 160 psia range it becomes 80 psia.

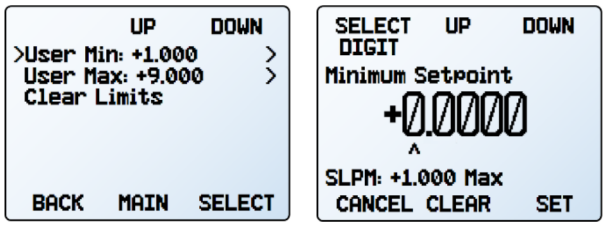


Figure 5-14. Set point limits menu (left) and setting a minimum set point (right).

Set point ramping

A ramp limits how fast the controller moves to a new set point. Use it to protect delicate equipment from a burst of pressure or flow when a process starts. Ramping applies to the variable being controlled: in pressure control it limits how fast the pressure changes. To limit the flow itself during pressure control, use the flow limiter (p. 33).

1. Press **MENU** › **CONTROL** › **Setpoint Ramp**.
2. Set the rate: **Ramp** sets the maximum rate of change, **Units** changes the time unit it is expressed in, and **Set By Delta / Time** lets you enter a change and the time period separately.
3. Choose when the ramp applies:

Ramp Up	On or off. When off, increases of the set point are not ramped.
Ramp Down	On or off. When off, decreases of the set point are not ramped.
Power Up	*Allow Ramp* ramps from a zero set point after power-up; *No Ramp* ignores the ramp directly after power-up. The same setting as **Power Up Setpoint** › **Ramp**.
0 Setpt	With *No Ramp*, a zero set point stops the flow at once; otherwise the flow ramps down at the set rate.

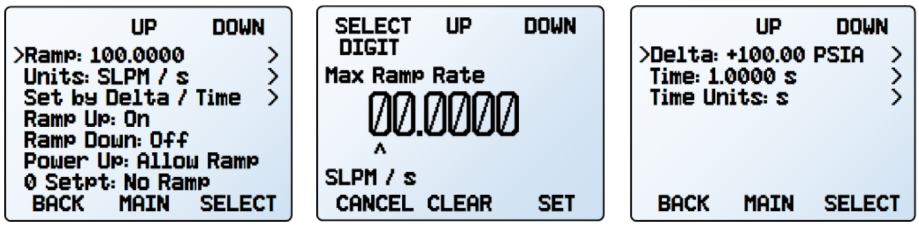


Figure 5-15. Set point ramping menu (left), maximum ramp rate (middle) and delta/time ramping (right).

Checking the control response

MENU › **CONTROL** › **Check Control** measures the main figures of the control response. Use them to characterise the controller, to adjust the system or the controller configuration, or to see whether optimising the control is worthwhile.

1. Enter a **GO TO** set point clearly different from the present set point, and a **TIME** over which to collect data.
2. Press **START**. The controller moves to the new set point and collects data for the time set.
3. Read the results. If they may not be useful, **WARN** becomes active and explains why.

Overshoot	How far the process overshot during the set point change.
Time Const	The time the process needed to cover 63.2 % of the set point change after it began to change.
Dead Time	The delay between the set point change and the moment the process began to change.
Bandwidth	The estimated frequency of the fastest sine-wave set point the controller can reasonably follow; most sinusoidal disturbances of lower frequency are rejected.

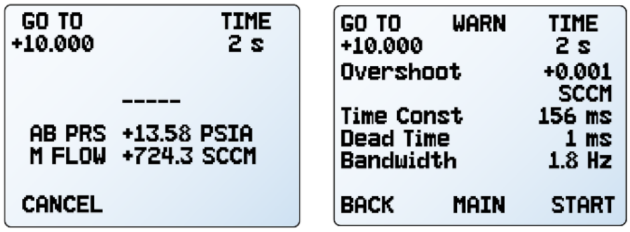


Figure 5-16. Check control in progress (left) and its results (right).

Optimising control

MENU › **CONTROL** › **Optimize Control** adjusts the control gains by itself to give the best response for the present process and conditions. It is much faster than manual tuning and needs no knowledge of control parameters. Optimise the control:

- at installation, to match the present process conditions;
- when the process changes significantly — a very different pressure, or a process gas with very different properties;
- when the physical system changes significantly, for example by a large added restriction or volume;
- when the controller goes into a different process or experiment;
- when an exact response is needed, or several controllers must respond the same way;
- when the flow control has degraded through process changes over time.

Before you start, see Getting the best result (p. 31).

NOTICE

During optimisation the controller moves to several set points, some of them above the present set point. A process that cannot take that flow can be damaged. Set Max Flow (below) to protect it.

Press **START**. The controller moves to a series of set points; for each change it determines the system properties and optimises its control parameters, reporting the absolute pressure and maximum flow as it goes. When it is done, the new settings are in effect and the controller reports overshoot, dead time, time constant and bandwidth of a typical response. Most controllers finish in 30–90 seconds; ultra-low flow ranges (roughly 50 smL/min and below, at 21.11 °C, 1013.25 mbar) take longer, and 0.5 smL/min controllers up to 15 minutes. While the optimisation runs, the display shows GTA.

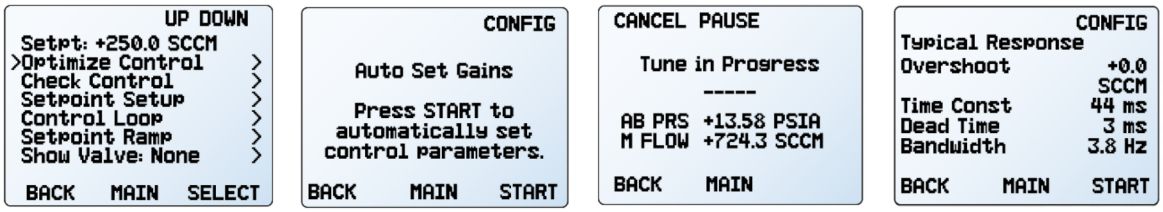


Figure 5-17. From left: Optimize Control in the control menu; the start screen; optimisation in progress; the results.

Getting the best result

- Use process conditions that give the largest pressure difference across the valve. The controller performs best at a pressure difference or common-mode pressure equal to or below the one it was optimised at.
- Keep the environment steady. Optimisation is more sensitive to fluctuations than normal control; most fluctuations give smaller gains than necessary, and large ones can prevent optimisation. Ultra-low flow and other slow controllers are more sensitive.
- Set up the fastest set point ramp you will use: ramps are mostly honoured during optimisation.
- Operate the valve before you optimise. Some valves behave quite differently when they have not been opened for some time.

Optimisation settings

For most situations the factory defaults give the best response. **`MENU`** › **`CONTROL`** › **`Optimize Control`** › **`Config`** adapts the optimisation to unusual processes or specific goals:

`Speed`	**FAST** (default) — balances speed and versatility for most situations.
	FASTEST — the shortest response time; a small overshoot is allowed.
	VERSATILE — handles a wider range of conditions with a slower response; the system may not keep up with quickly changing conditions.
	MOST VERSATILE — handles an even wider range of conditions, with a slower response.
	GOAL — aims at a response time you enter, to reach a particular response or to match several controllers. A goal that cannot be met (0, for example) gives the shortest possible time constant, as FASTEST does.
`Max Flow`	The highest flow allowed during optimisation, to protect delicate processes. In unusual cases it can still be exceeded, but the controller keeps that as short as it can.
`Loop Type`	**AUTOMATIC** (default and recommended) chooses the best control algorithm; PD²I or PD/PDF can be specified if needed.

Control variable

The control variable is the measurement the controller holds at the set point. It controls one variable at a time but keeps measuring the others. A mass flow controller can control mass flow, volumetric flow, pressure (absolute, or gauge with the barometer option) or valve drive.

In pressure control, the valve position decides which pressure is controlled. A controller with its valve upstream controls the outlet pressure. A controller with a downstream valve controls the back pressure upstream of it, but only if it has been configured for this type of control.

NOTICE

After a change of the control variable, the control settings may no longer give stable, fast control. Check the stability and speed of the control loop. Optimise or retune it if needed (see Optimising control, p. 30).

Select the control variable under **`MENU`** › **`CONTROL`** › **`Control Loop`** › **`Control`**.

Tuning the control loop by hand

A closed control loop decides how to drive the valve to reach the set point. Its gains are tuned at the factory for your operating conditions; on site, a different supply pressure, volume or gas can make the loop oscillate, overshoot or respond slowly. Optimising control is usually the first step; tune by hand when a particular response profile is needed or several controllers must respond the same way. Two algorithms are available under **`MENU`** › **`CONTROL`** › **`Control Loop`** › **`Loop Type`**:

- **PD/PDF** — the default and the right choice for most applications.
- **PD²I** — usually faster on dual-valve controllers; recommended when a dual-valve controller controls pressure.

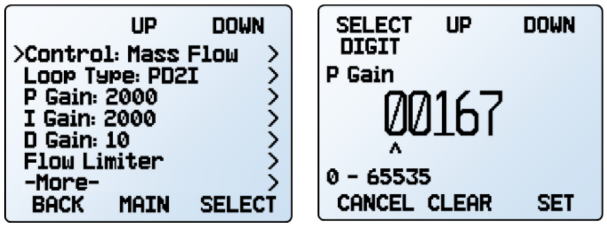


Figure 5-18. Control loop menu in PD²I mode (left) and setting the P gain (right).

What each gain does

Algorithm	Gain	Effect of a larger value
PD/PDF	**D**	Faster correction of the difference between set point and measured value. Acts like the P term of a textbook PDF controller.
	P	Faster correction of an offset, weighted by its size and by how long it has lasted. Acts like the I term of a textbook PDF controller.
PD²I	**P**	More aggressive correction of the error between set point and measured value.
	I	Faster correction of an offset, weighted by its size and duration.
	D	Squared derivative term: stronger anticipation from the present rate of change. It often slows the response a little, which reduces overshoot and oscillation.

> **Note**
> In PD/PDF the gain names are swapped compared with textbooks: **D** does the job usually called P, and **P** the job usually called I.

Correcting common control problems

Symptom	PD/PDF	PD²I
Fast oscillation around the set point	Reduce P in steps of 10 %.	Increase P in steps of 10 %, then fine-tune with I.
Overshoot of the set point	Reduce P in steps of 10 %.	Increase P in steps of 10 %.
Set point reached late or not at all	Increase P in steps of 10 %, then reduce D slightly to fine-tune.	Increase P in steps of 10 %, then increase I to fine-tune.

If the set point is not reached whatever the tuning, check the supply pressure first (see Troubleshooting, p. 44).

Gas adjust

With **`MENU`** › **`CONTROL`** › **`Control Loop`** › **`Gas Adjust`** switched on, the controller changes its control gains when the gas is changed, so that the response time stays more consistent. Choose *On*, *Off*, or *Until Set Gain*.

Pressure control options

Limiting the flow during pressure control

While it controls pressure, the controller lets as much gas through as the pressure demands. A flow limit keeps that flow within the measurable range of the controller and protects sensitive equipment further down the process.

1. Press **MENU** › **CONTROL** › **Control Loop** › **Flow Limiter**.
2. Select **TYPE** to choose whether the limit applies to mass flow or to volumetric flow.
3. Select **MAX FLOW** and enter the highest flow allowed, in the engineering units displayed.
4. Set the **Limiter Gain** to 500 and adjust it as needed. It sets how hard the controller corrects a flow above the limit: a higher value corrects more aggressively, but is more likely to oscillate near the limit.

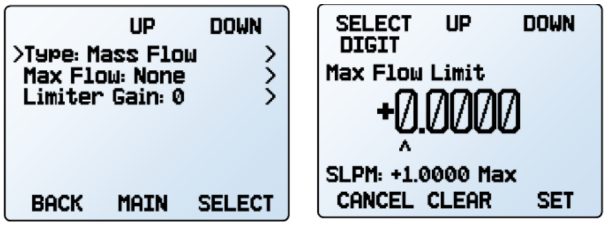


Figure 5-19. Flow limiter menu (left) and setting a maximum flow limit (right).

> **Note**
> If a flow limit and a pressure set point ramp are both active, whichever is more restrictive governs how the controller approaches the set point.

> **Note**
> On a bidirectional controller the flow limit is symmetric. A 20 sL/min (21.11 °C, 1013.25 mbar) bidirectional controller with a limit of 10 sL/min is limited to −10 to +10 sL/min.

Control deadband

A deadband is a pressure window around the set point inside which the controller does not control. It saves gas and makes the pressure more stable. The deadband becomes active once the controller has reached the set point; if the pressure drifts out of the band, control resumes until the set point is reached again.

Example: with a set point of 30 psia, a deadband of ±0.25 psia lets the absolute pressure vary between 29.75 and 30.25 psia.

> **Note**
> A deadband cannot be set while the controller controls flow. The menu then shows the message *Only active when controlling pressure*.

> **Note**
> A mass flow controller has no exhaust valve. If the pressure rises above the deadband, the controller cannot bring it down.

1. Press **MENU** › **CONTROL** › **Control Loop** › **Control Deadband** and enter a non-zero value under **Deadband**.

2. Under **When in Band**, choose whether the valve holds its position or closes inside the band. Hold the position on single-valve controllers; close the valves on dual-valve controllers.

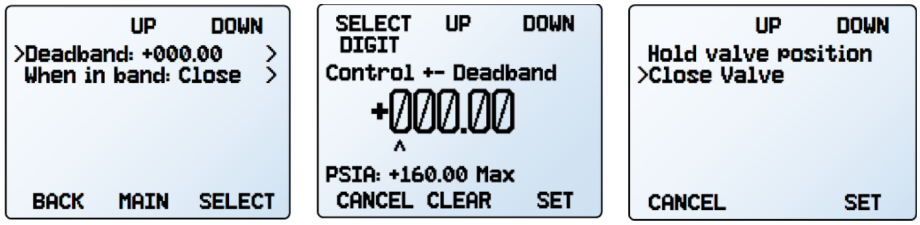


Figure 5-20. Deadband menu (left), deadband size (middle) and behaviour inside the band (right).

CHAPTER 6

Communication

Over its RS-232 or RS-485 interface the controller can be read, configured and given set points by a computer or PLC, with ASCII serial commands or with the Modbus RTU protocol. This chapter covers the settings at the device and the commands that matter most for a controller. The full command reference, with parameters and responses, is the *358 Series serial interface (RS-232/RS-485) — Communication guide* (AMTC-CG-0002); the Modbus registers are in the *358 Series Modbus RTU and Modbus TCP/IP — Communication guide* (AMTC-CG-0001).

Communication settings

The interface settings are under **MENU** › **SETUP**, in a menu called **RS-232 Serial** or **RS-485 Serial** depending on the interface of your controller. Check them before you connect the controller to a computer.

Setting	Purpose
Unit ID	A letter from A to Z that addresses the controller; up to 26 devices can share one COM port, each with its own letter (polling mode). Choosing @ puts the controller into streaming mode. The change takes effect when you select **SET**. Default: A.
Stream	The interval between the start of two data frames in streaming mode, 0–999 999 999 ms. If the interval is shorter than one frame takes to send, the next frame starts as soon as the previous one is complete.
Modbus Address	The address of the controller on a Modbus RTU network, 1–247.
Baud Rate	Must match the computer or PLC. Default: 19 200 baud. The new rate applies as soon as you press **SET**; your software may need a restart to pick it up.
Idle	How long a serial or Modbus RTU connection may stay without a valid request before the controller applies its idle behaviour (p. 28). Infinite by default (*Always Wait*); adjustable up to 99 999.9 s (1 day, 3 hours, 46 minutes, 39.9 seconds).

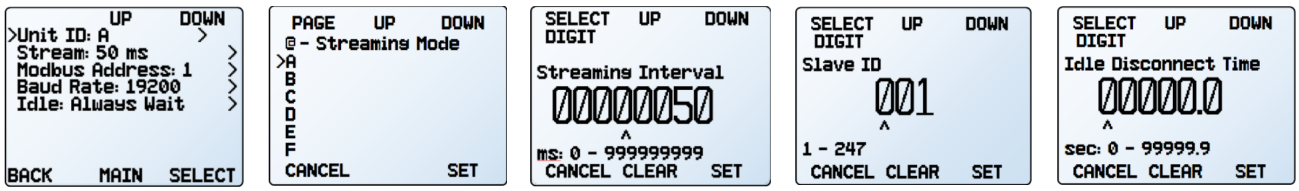


Figure 6-1. From left: serial communication menu; unit ID or streaming; streaming interval; Modbus address; idle time.

Connecting to a computer

The controller can be read and set from a computer over its serial interface, as described in the *358 Series serial interface (RS-232/RS-485) — Communication guide* (AMTC-CG-0002), or over Modbus, as described in the *358 Series Modbus RTU and Modbus TCP/IP — Communication guide* (AMTC-CG-0001). Controllers with the Bluetooth option carry -BT in their part number.

Any serial terminal program can send commands. Connect the controller to a serial (COM) port, or through a USB cable that the computer recognises as a virtual COM port; if it does not, install the USB driver. The port number is shown in the Windows Device Manager. Open the port with these settings:

Baud rate	19 200 (default; any rate works if the controller, the software and the computer use the same one)
Data bits	8

Parity	None
Stop bits	1
Flow control (handshaking)	None
Command terminator	Carriage return (**<CR>**, ASCII 13, hexadecimal D — the Enter key in a terminal)

Commands are not case-sensitive and begin with the unit ID. If two devices on one COM port have the same unit ID, data and commands are corrupted. When you connect several devices to one port, connect them one at a time and give each its unit ID before you connect the next.

Taring over the serial interface

Tare in the same situations as at the front panel (see Taring, p. 21), and before you collect data. With autotare (p. 28) on, a zero set point is enough: for most ranges the tare runs within 2 s of the zero set point. Otherwise tare by command:

Tare flow	**AV**	No flow through the controller.
Tare absolute pressure	**APC**	Barometer option: aligns the absolute pressure sensor with the barometer. Controller open to atmosphere.

Polling and streaming

In **polling mode** (unit ID A–Z; A as shipped unless you ordered otherwise) the controller answers only when asked: sending its unit ID alone, `A`, returns one line of live data. In **streaming mode** (unit ID `@`) it sends a line of data at regular intervals, by default every 50 ms; `ANCS 500` sets 500 ms. Only one device per COM port may stream. Start streaming with `A@ @` and stop it with `@@ A`, which also assigns unit ID A.

A streaming controller still accepts commands, but the data stream does not stop while you type and can hide what you enter. An invalid command is ignored: if in doubt, press **Backspace** a few times, then **Enter**, and type the command again.

The data frame

Each line of live data lists the readings in a fixed order, separated by single spaces, in the units currently selected (see Engineering units, p. 24). A frame from a controller polled as unit A looks like this:

A	+15.542	+24.57	+16.667	+15.444	+15.444	22741.4	N2
unit ID	absolute pressure	temperature	volumetric flow	mass flow	set point	totaliser	gas

The unit ID appears only in polling mode. Further columns, such as the valve drive if you chose to show it (see Showing the valve drive, p. 25) and status codes (see Status messages, p. 12), can follow as the rightmost columns. The exact layout and units of your controller are returned by `A??D*`.

Giving a set point

The controller accepts serial set points only when its set point source (p. 28) is **Serial/Front Panel**. It reads the set point in the current engineering units: `AS 15.44` gives a set point of +15.44 sL/min (21.11 °C, 1013.25 mbar). A bidirectional controller takes a negative set point with a hyphen as minus sign: `AS -15.44`. When the set point is accepted, the next data frame shows it; a set point outside the

set point limits (p. 29) is rejected. If your software writes set points more often than every few minutes, set a fixed power-up set point (p. 28) to spare the controller's memory.

Checking the control response

The controller moves from its present set point to the one you give and collects process data for the time you set, then returns the control statistics (see Checking the control response, p. 30):

```
A LCRC goto_setpoint collection_time
```

Example: `A LCRC 10.00 2` moves to 10 sL/min (21.11 °C, 1013.25 mbar) and records for 2 s.

- `goto_setpoint` must differ from the present set point. With an analogue set point source, it overrides the analogue set point during data collection only.
- `collection_time` is 2 s by default. Controllers with a small full-scale range may need 10 or 20 s. In pressure control, allow about three times the expected fill or bleed time; a `goto_setpoint` closer to the normal set point shortens it.

The controller returns
`A termination notes overshoot delaymsec timeconstantmsec risetimemsec bandwidthhz`:

`termination`	0 normal; 1 aborted manually; 2 aborted because of oscillation.
`notes`	The sum of the values in Table 6-1.
`overshoot`	The largest overshoot during the trial, in the units of the set point.
`delaymsec`	The system delay (dead time) during the trial, in ms; usable in a first-order-plus-dead-time (FOPDT) model.
`timeconstantmsec`	The closed-loop time constant (T63), in ms; usable in an FOPDT model.
`risetimemsec`	The time the closed-loop response needs to go from 10 % to 90 % of the step, in ms.
`bandwidthhz`	The estimated frequency, in Hz, of the fastest sine-wave set point the controller can reasonably follow; most sinusoidal disturbances of lower frequency are rejected.

Table 6-1 Notes returned by the control check

Value	Meaning
0	The process data showed typical patterns.
+1	The collection time was too short to give reliable results.
+2	The process variable oscillated significantly. Control was not stable and the results are not reliable.
+4	The process variable moved little compared with the noise in the system, so the results may not be reliable. Usually the set point change was too small, or the process oscillated in a way the oscillation detection did not catch.
+8	A closed valve was opened during data collection. The results are correct, but performance differs significantly from that with the valve already open.
+16	The valve opened fully during data collection. The results are correct, but performance is probably limited by the valve size rather than the control loop configuration.

Optimising control

The optimisation (see Optimising control, p. 30) can also be started by command. It opens the valve to varying degrees to estimate the system behaviour and sets the control gains to match, typically in 10–90 s; some controllers, such as 0.5 smL/min (21.11 °C, 1013.25 mbar) ranges, need up to 15 minutes.

NOTICE

During optimisation the controller moves to several set points, some of them above the present set point. A process that cannot take that flow can be damaged. Set the maximum flow with `A LCTCF` before you start the optimisation.

To protect delicate processes from the set points used during optimisation, set the highest flow allowed in the units of the present set point; 0 allows the full-scale range. The value must be at least 20 % of full scale. It may be exceeded briefly; the controller keeps that as short as it can.

```
A LCTCF max_flow
```

Example: `A LCTCF 0` optimises with the full-scale range as maximum flow.

Then start the optimisation:

```
A LCTCS speed_mode goal_time algorithm
```

Example: `A LCTCS 3` optimises with the FAST speed mode.

Table 6-2 Speed modes

Value	Mode	Effect
0	Goal	Aims at the time constant given in `goal_time`, to reach a particular response or to match several controllers.
1	Most versatile	The widest range of conditions, with the slowest response; the system may not keep up with quickly changing conditions.
2	Versatile	A range of conditions, with a slower response.
3	Fast	The default: balances speed and versatility for most situations.
4	Fastest	The shortest control response time; a small overshoot is allowed.

- `goal_time` is the desired time constant in Goal mode, a non-negative integer in ms. A goal shorter than the system can reach gives the shortest possible time constant, so 0 acts like speed mode 4.
- `algorithm` is normally 0, which lets the optimisation choose. Give 1 for the PDF algorithm or 2 for PD²I.

Selecting the gas and defining a mix

Look up the gas number in Appendix B (p. 57) and send `AG gas_number`: `AG 8` selects nitrogen, `AG 206` P-10. User mixes carry numbers 236 to 255 and are selected the same way: `AG 255`.

Defining a mix over the serial interface

A mix is faster to define by command than at the front panel (see Gas mixes, p. 22):

```
AGM mix_name mix_number gas1_% gas1_number gas2_% gas2_number …
```

- `mix_name`: up to 6 characters — letters, digits, period or hyphen. It is the short name of the mix.
- `mix_number`: 236 to 255. A mix already stored under that number is overwritten; 0 takes the next free number, counted down from 255.
- For each component, its percentage (up to two decimals), then its gas number. A mix has two to five components, and the percentages must add up to 100.00 %.

Example 1 stores 71.35 % helium (gas 7), 19.25 % nitrogen (gas 8) and 9.4 % carbon dioxide (gas 4) as gas 252, named MyGas1:

```
AGM MyGas1 252 71.35 7 19.25 8 9.4 4
```

The controller confirms the new gas: `A 252 71.35% He 19.25% N2 9.40% CO2`.

Example 2 stores 93 % methane (gas 2), 3 % ethane (gas 5), 1 % propane (gas 12), 2 % nitrogen (gas 8) and 1 % carbon dioxide (gas 4) under the next free number, named MyGas2:

```
AGM MyGas2 0 93 2 3 5 1 12 2 8 1 4
```

The controller confirms with the number it assigned:
`A 253 93.00% CH4 3.00% C2H6 1.00% C3H8 2.00% N2 1.00% CO2`.

Commands most used with a controller

The examples address unit A and end with **Enter** (**<CR>**). The commands are shown in capitals only to set them apart from the variables. Many more commands are described in the *358 Series serial interface (RS-232/RS-485) — Communication guide* (AMTC-CG-0002).

Task	Command	Remarks
GENERAL		
Change the unit ID	**A@** `B`	From A to B.
Tare flow	**AV**	No flow through the controller.
Tare absolute pressure	**APC**	Barometer option; vented to atmosphere.
Poll live data	**A**	Returns one data frame.
Start / stop streaming	**A@ @** / **@@ A**	Stopping assigns unit ID A.
Streaming interval	**ANCS** `ms`	Default 50 ms.
Describe the data frame	**A??D***	
Device information	**A??M***	
Firmware version	**AVE**	
Lock / unlock front panel	**AL** / **AU**	Display shows `LCK` while locked.
CONTROLLER		
New set point	**AS** `value`	In the current unit. Bidirectional controllers accept a minus sign.
Hold valve at present position	**AHP**	Display shows `HLD` (see Holding the valve, p. 40).
Hold valve closed	**AHC**	
Cancel valve hold	**AC**	Control resumes.
Check the control response	**A LCRC** `goto_setpoint collection_time`	See p. 37.
Optimise control	**A LCTCS** `speed_mode goal_time algorithm`	See p. 37.
GAS		
List installed gases	**A??G***	
Select a gas	**AG** `gas_number`	`AG 8` nitrogen.
Define a mix	**AGM** `name n % gas % gas …`	See p. 38.
Delete a mix	**AGD** `n`	`n` = 236–255.

Holding the valve

A valve hold freezes the valve — at its present position, or closed — and suspends closed-loop control until you cancel the hold. While a hold is active, the display shows `HLD` and set point changes have no effect on the valve.

Modbus RTU

Modbus is an application-layer messaging protocol that formats data for communication over serial RS-232 or RS-485. The controller supports Modbus RTU; set its address under Communication settings (p. 35). Over Modbus RTU you can control:

- taring;
- data collection;
- the set point;
- the totaliser and batch dispensing;
- the gas;
- the optimising control;
- the control loop settings.

The registers and functions are described in the *358 Series Modbus RTU and Modbus TCP/IP — Communication guide* (AMTC-CG-0001).

CHAPTER 7

Calibration and verification

Analyt-MTC recommends recalibrating the controller once a year. The date of the last calibration is on the label on the back of the controller and on the About Device (p. 20) screen (**MENU** › **ABOUT** › **About Device**, DATE CAL). When the calibration is due, contact Analyt-MTC with the serial number of the controller; see Service, warranty and contacts (p. 53) for the procedure.

Between calibrations you can check the zero of the controller by taring it (see Taring (p. 21)) and its control by running **Check Control** (see Checking the control response (p. 30)).

CHAPTER 8

Maintenance

A controller that flows clean, dry gas needs no routine maintenance apart from its yearly calibration. This chapter explains what you may do yourself and which settings to leave to the Analyt-MTC engineers; how to trace the most common problems is described in Troubleshooting (p. 44).

⚠ WARNING

A controller disconnected from a system that is still under pressure releases gas, and any hazardous gas left in the system escapes. Before you disconnect the controller, confirm independently that all pressure has been safely released and that hazardous gases have been purged.

Cleaning

The inside of the controller needs no cleaning as long as it flows clean, dry gas. If necessary, wipe the outside with a soft, dry cloth.

NOTICE

Opening the flow body to clean it damages the controller and voids its calibration. If you suspect that debris or other foreign material has entered the controller, do not take the flow body apart. Contact Analyt-MTC for cleaning (see Service, p. 53).

Repair

If the controller has malfunctioned or no longer works as intended, contact Analyt-MTC. The controller may only be serviced by certified personnel. Dismantling and repairing it yourself may void the warranty and can cause further failure.

Advanced settings

MENU › **SETUP** › **Advanced** holds settings and diagnostic values meant for working with the Analyt-MTC application engineers:

Factory Restore	Returns all settings and registers to their defaults, after a confirmation screen. If the controller does not behave as expected, contact an application engineer first to confirm that a restore is needed.
Register Status	Live values of the internal registers. Read them out to the Analyt-MTC engineer on the phone: some values tell a hardware fault from an operating problem at once.
Edit Register, Device Properties	Low-level configuration, used by technical support to fine-tune the controller's functions.

NOTICE

A factory restore resets all settings and registers. Every calibration made by a third party is removed. Contact Analyt-MTC before you restore the factory settings.

NOTICE

Wrong values under Edit Register or Device Properties can make the controller inoperable. Change these values only together with an Analyt-MTC application engineer.

CHAPTER 9

Troubleshooting

Work through the table for your symptom. If the problem remains, contact Analyt-MTC with the information listed under Before you call (p. 53).

General use

Symptom	What to do
The buttons do not respond and the display shows LCK	The front panel was locked from a computer. Press and hold the four outer buttons to unlock, or send the unlock command (see Locking the front panel, p. 20).
A three-letter message appears next to the reading	Look up the message in the table of status messages (see Status messages, p. 12).
The display is hard to read	Increase the contrast or brightness (see Display settings, p. 19). In low light, press the button below the display (the logo) to switch on the backlight of a monochrome display.
The analogue output reads lower than the display	The voltage drops along the cable. Use a heavier wire gauge, especially for the ground conductor.
How often must the controller be calibrated?	Once a year. The date of the last calibration is under **MENU** › **ABOUT** › **About Device**. When it is due, contact Analyt-MTC (see Calibration and verification (p. 41)).
The controller was dropped	If it switches on and responds normally, it is probably fine; it may or may not need a recalibration. Tare it (see Taring, p. 21) and compare it with a flow standard you trust. If it agrees, keep using it, and tell Analyt-MTC about the drop at the next calibration so that it can be checked.
Readings are needed in other units	Change them under **MENU** › **SETUP** › **Sensor** › **Engineering Units** (see Engineering units, p. 24).
The controller does not reach its set point	The supply pressure is usually too low: raise the inlet pressure. If that does not help, look for a blockage — loose PTFE tape in the flow channel is a common one; remove it and keep the first two threads of each fitting free of tape. A valve drive (p. 25) that has risen over time also points to a blockage.

Flow readings

Symptom	What to do
The live readings do not settle	The controller is very fast and shows variations that slower instruments miss; this can point to a problem with a pump or another device in the line. Optimise the control (see Optimising control, p. 30), and check the response with a control check (see Checking the control response, p. 30).
The flow reading is negative at zero flow	The tare is poor. Make sure autotare is on and give a zero set point for at least 2 s; the reading should return to zero. Otherwise tare by hand (see Taring, p. 21).
The controller disagrees with another flow instrument in the line	Check that both use the same STP or NTP reference conditions (**MENU** › **SETUP** › **Sensor** › **STP / NTP Flow Ref**, see p. 24) and that the controller is set to the right gas or mix.
The reading does not change when the flow changes	The flow sensor may be damaged. Contact Analyt-MTC.
Can the controller be used with other gases?	Yes. Its built-in list holds up to 130 preloaded gases and gas mixes (see Appendix B (p. 57)), and you can define your own mixes (see Gas mixes, p. 22).

Pressure readings

Symptom	What to do
The pressure reading is negative	If a negative reading is not expected, the pressure may need a tare. On a controller with the barometer option, open it to ambient atmosphere first (see Taring absolute pressure, p. 21).
Low readings jump to zero	The zero band, preset at the factory, shows small readings as zero. Reduce it under **MENU › SETUP › Sensor › Zero Band** (see Zero band, p. 24).
The pressure reading disagrees with another instrument in the line	Two pressure readings can normally be compared if there is no leak between the two instruments. Otherwise the tare may be poor (see Taring, p. 21).

Serial communication

Symptom	What to do
The computer gets no answer from the controller	• Check that the software, the COM port and the controller use the same baud rate (**MENU › SETUP › RS-232 Serial** or **RS-485 Serial › Baud Rate**). • Check the unit ID: every command must start with the controller's letter. • Check that the software uses the right COM port number. • Set flow control (handshaking) on the computer or PLC as in Connecting to a computer (p. 35). • Check the wiring against the pinout of your connector (see Mini-DIN, p. 16; Appendix C, p. 60).

CHAPTER 10

Specifications

The data below apply to standard 358 Series MC controllers. Options and special versions can differ. Pressure drop, process connections, dimensions and wetted materials depend on the flow range; they are given by range at the end of this chapter.

Measurement and control performance

Table 10-1 Performance by full-scale range (sL/min and smL/min at 21.11 °C, 1013.25 mbar)

	0.5–5 smL/min	10 smL/min – 20 sL/min	50–5000 sL/min
Mass flow accuracy[1]	±0.8 % of reading + 0.2 % of full scale	±0.6 % of reading or ±0.1 % of full scale, whichever is greater	±0.8 % of reading + 0.2 % of full scale
High-accuracy option[1]	±0.4 % of reading + 0.2 % of full scale (5 smL/min)	±0.5 % of reading or ±0.1 % of full scale, whichever is greater	±0.4 % of reading + 0.2 % of full scale (up to 500 sL/min)
Repeatability (2σ)	±0.2 % of reading + 0.02 % of full scale	±0.1 % of reading + 0.02 % of full scale	±0.2 % of reading + 0.02 % of full scale
Control response (T63), adjustable[2]	as fast as 100 ms	as fast as 30 ms	as fast as 30 ms (50–100 sL/min); as fast as 100 ms (250–5000 sL/min)
Pressure sensitivity	Mass flow zero and span shift: ±(0.08 % of reading + 0.02 % of full scale) per atm from calibration conditions (0.5–5 smL/min and 50 sL/min and above); 10 smL/min – 20 sL/min: zero shift ±0.01 % of full scale per atm from tare pressure, span shift ±0.1 % of reading per atm from calibration conditions		
Temperature sensitivity	Mass flow zero and span shift: ±0.02 % of full scale per °C from 25 °C (0.5–5 smL/min and 50 sL/min and above); 10 smL/min – 20 sL/min: zero shift ±0.01 % of full scale per °C from tare temperature, span shift ±0.01 % of reading per °C from 25 °C		
Indication response	< 10 ms, depending on the flow rate		

[1] At calibration conditions, after a tare under equilibrium conditions. [2] Time to 63.2 % of a set point step; depends on the flow rate and is adjustable through the control loop tuning.

Table 10-2 Common data (sL/min at 21.11 °C, 1013.25 mbar)

Steady-state control range	0.01–100 % of full scale up to 100 sL/min; 0.2–100 % of full scale for 250–5000 sL/min
Valve	Normally closed
Operating pressure range	11.5–160 psia (about 0.8–11 bar a)
Pressure accuracy	±0.5 % of reading above 1 atm; ±0.07 psia (about ±4.8 mbar) below 1 atm
Temperature accuracy	±0.75 °C
Totaliser	±0.1 % of reading additional uncertainty
Sensor response time	< 1 ms
Warm-up time	< 1 s
Measurement rate / display update	1000 per second / 10 Hz
Display	Monochrome LCD or colour TFT display with integrated buttons; shows mass flow, volumetric flow, temperature, set point and pressure at the same time
Flow and pressure averaging	Adjustable up to 255 ms
Gas mixes	Up to 20 user mixes of up to 5 components, 0.01 % resolution

Operating limits and mechanical data

LIMITS AND MOUNTING (SL/MIN AND SML/MIN AT 21.11 °C, 1013.25 MBAR)	
Operating temperature	−10 to +60 °C, ambient and gas
Humidity	0–95 %, non-condensing
Ingress protection	IP40
Mounting orientation	No sensitivity up to 100 sL/min; large-valve controllers (250–5000 sL/min) must be mounted with the valve upright
Mounting holes	2× 8-32 UNC, thread depth 0.175" [4.45 mm] (0.5–50 smL/min) or 0.350" [8.89 mm] (100 smL/min – 20 sL/min); 50 sL/min and above: 4–8× 8-32 UNC, thread depth 0.330" [8.38 mm]
Wetted materials	Up to 100 sL/min: 302, 303, 304, 316L and 430FR stainless steel; FKM, alumina ceramic, brass, glass, gold, heat-cured epoxy, heat-cured silicone rubber, polyamide, silicon. 250 sL/min and above: 302, 303, 304, 316L and 410 stainless steel; FKM, alumina ceramic, Delrin®, glass, gold, heat-cured epoxy, heat-cured silicone rubber, nylon, polyamide, silicon
Damage limits (standard version)	Above 13.8 bar a (200 psia) common mode; rapid pressure change above 5.17 bar (75 psid) differential. See Pressure limits (p. 15).

Electrical data

POWER SUPPLY (SL/MIN AT 21.11 °C, 1013.25 MBAR)	
Small-valve controllers (up to 100 sL/min)	12–24 V DC, 250 mA
Large-valve controllers below 2000 sL/min	24 V DC, 0.5 A
Large-valve controllers, 2000–3000 sL/min	24 V DC, 1 A
Dual large-valve controllers (5000 sL/min)	24 V DC, 2 A
With 4–20 mA output	add 40 mA; supply 12–24 V DC
With colour display	add 40 mA at 12 V DC
SIGNALS	
Analogue outputs	0–5 V DC (standard); 1–5 V DC, 0–10 V DC or 4–20 mA as options; optional secondary output
Analogue signal accuracy	±0.1 % of full scale additional uncertainty
Analogue set point input	Mini-DIN pin 4
Digital interface	RS-232 and Modbus RTU (standard); RS-485, Modbus TCP/IP, DeviceNet, EtherCAT, EtherNet/IP, Profibus, PROFINET and IO-Link as options
Data update rate	Digital 40 Hz at 19 200 baud; analogue 1 kHz
Connectors	8-pin Mini-DIN (standard); 6-pin locking industrial, 8-pin M12, 9-pin D-sub, 15-pin D-sub as options (see Appendix C, p. 60)

Controllers with a fieldbus interface have their own power and data rate requirements; they are given in the documentation of the interface.

Pressure drop and process connections

Table 10-3 Data by full-scale range (sL/min and smL/min at 21.11 °C, 1013.25 mbar)

Full scale	Pressure drop at full scale, air vented to atmosphere[1]	Default process connections[2]
0.5 smL/min	1.0 psid	M5 female (10-32 compatible)[3]
1–5 smL/min	2.0 psid	M5 female (10-32 compatible)[3]
10 smL/min	2.8 psid	M5 female (10-32 compatible)[3]
20–50 smL/min	1.0 psid	M5 female (10-32 compatible)[3]
100–500 smL/min	1.0 psid	1/8" NPT female
1 sL/min	1.5 psid	1/8" NPT female
2 sL/min	3.0 psid	1/8" NPT female
5 sL/min	2.0 psid	1/8" NPT female
10 sL/min	5.5 psid	1/8" NPT female
20 sL/min	12.0 psid	1/8" NPT female
50 sL/min	5.0 psid	1/4" NPT female
100 sL/min	15.5 psid	1/4" NPT female
250 sL/min	2.4 psid	1/2" NPT female
500 sL/min	6.5 psid	3/4" NPT female
1000 sL/min	14.0 psid	3/4" NPT female
2000 sL/min	28.6 psid	3/4" NPT female (1 1/4" NPT connection: ask Analyt-MTC)
3000 sL/min	16.8 psid	1 1/4" NPT female
5000 sL/min	14.1 psid	1 1/2" NPT female

[1] For lower pressure drops and other valves, ask Analyt-MTC. [2] For other process connections, such as compression, face seal, push-to-connect, BSPP, SAE, or Swagelok® (including tube, VCO® and VCR®), ask Analyt-MTC. [3] Shipped with a Buna-N O-ring face seal to 1/8" female NPT fittings.

For full-scale ranges above 5000 sL/min, ask Analyt-MTC.

Dimensions

The letters in the drawings refer to the columns of Table 10-4 (Figures 10-1 and 10-2) and Table 10-5 (Figure 10-3). The drawings show the power jack (DC in) and the multi-pin connector (input and output ports) on top, the display with its buttons and backlight button at the front, and the process connections on the sides. The numbered call-outs are the same on every drawing: 1 DC power input, 2 Input and output port, 3 Controls, 4 Backlight switch, 5 Process connection. On the drawing of Figure 10-3, 6 marks the flow direction with the valve downstream.

Table 10-4 Dimensions in mm and weight in kg, 0.5 smL/min to 20 sL/min (21.11 °C, 1013.25 mbar)

Full scale	Width	Depth	Height	A	B	C	E	F	G	Weight
0.5–5 smL/min	84.8	26.7	99.0	8.5	13.3	3.2	23.5	3.8	56.5	≈ 0.5
10–50 smL/min	84.8	26.7	99.0	8.5	13.3	3.2	23.5	3.8	56.5	≈ 0.5
100 smL/min – 20 sL/min	91.1	26.7	103.3	8.9	13.3	3.2	23.5	3.8	56.5	≈ 0.5

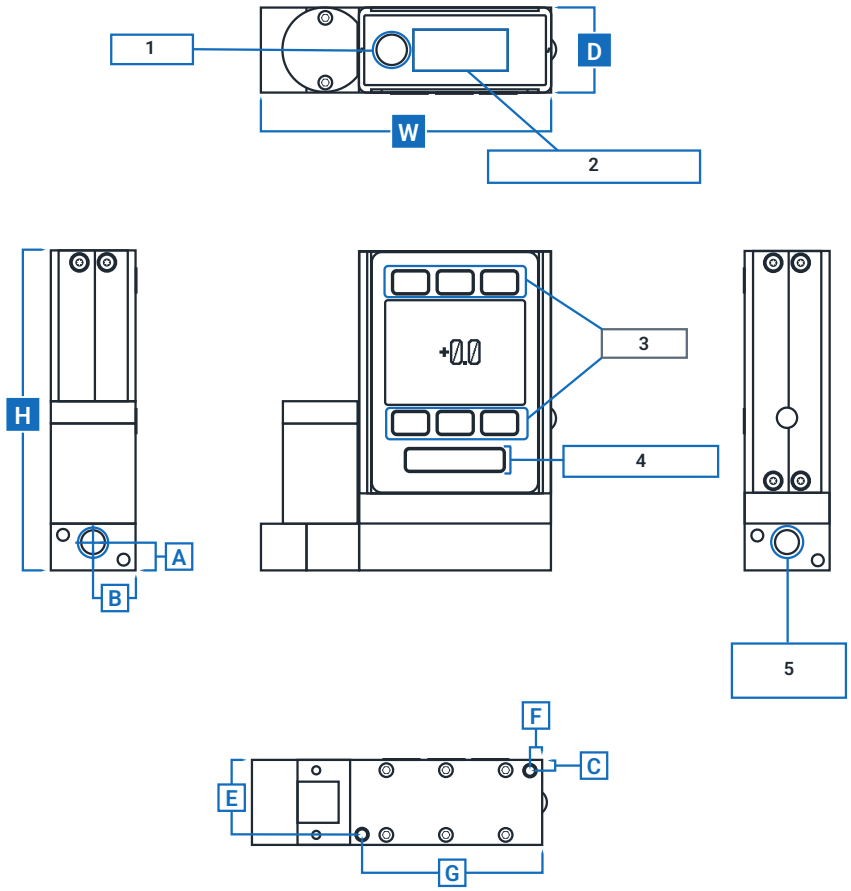


Figure 10-1. Controllers from 0.5 to 5 smL/min.

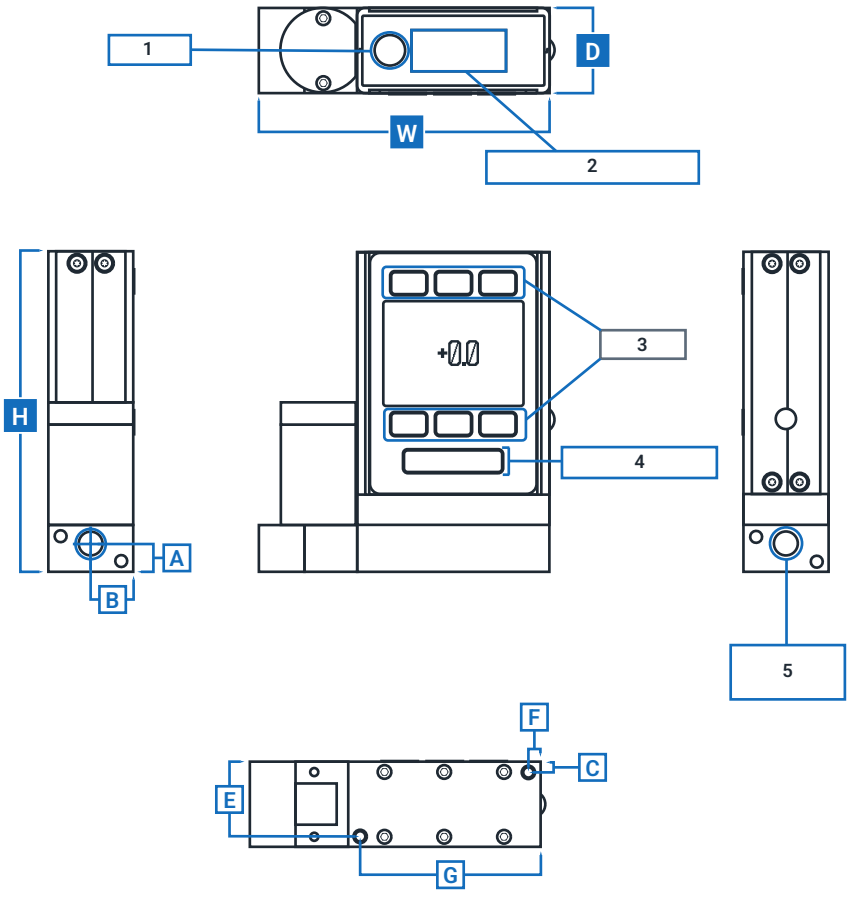


Figure 10-2. Controllers from 10 smL/min to 20 sL/min.

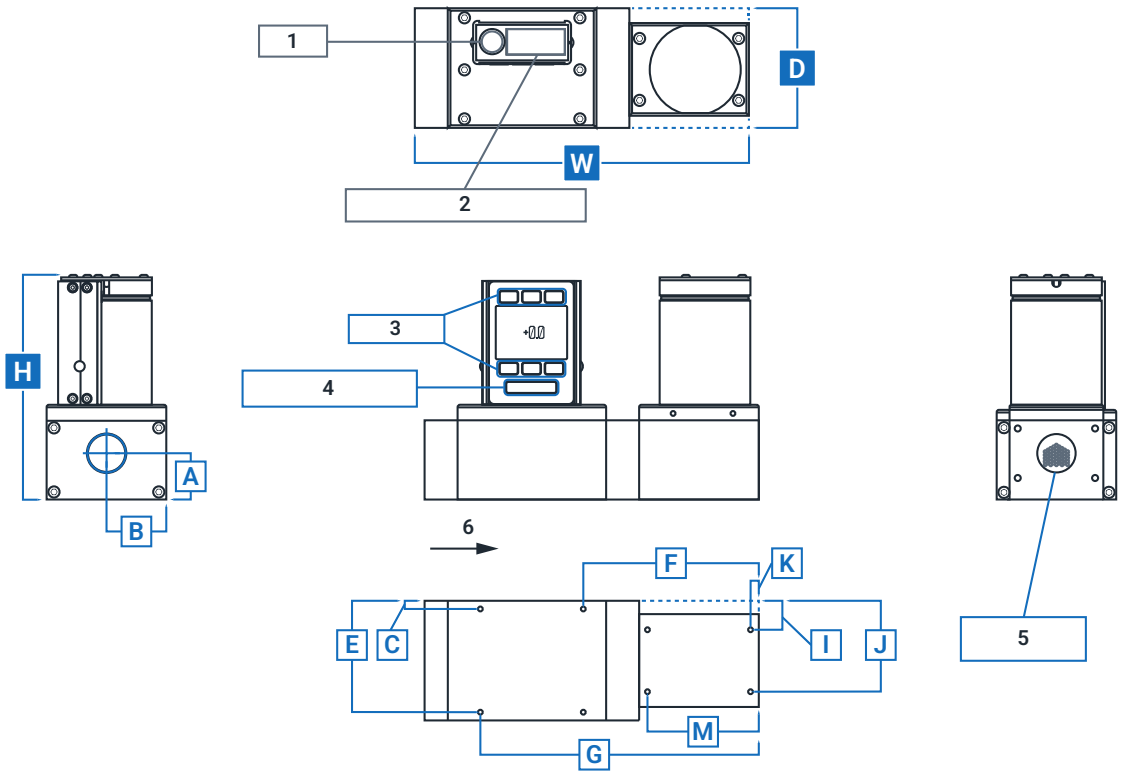


Figure 10-3. Controllers of 50 sL/min and above; the bottom view shows the downstream valve, with the flow from left to right.

Table 10-5 Dimensions in mm and weight in kg, 50 sL/min and above (21.11 °C, 1013.25 mbar)

Full scale	Width	Depth	Height	A	B	C	E	F	G	I	J	K	M	Weight
50–100 sL/min	137.4	40.6	110.9	12.7	20.3	4.4	36.2	19.1	82.6	–	–	–	–	≈ 1.4
250 sL/min	194.3	57.2	139.6	28.4	28.6	4.4	36.2	111.8	175.3	9.5	47.6	14.6	78.1	≈ 4.1
500–1000 sL/min	184.9	57.2	139.6	28.4	28.6	4.4	36.2	102.2	165.7	9.5	47.6	5.1	68.6	≈ 4.1
2000 sL/min	205.7	73.7	139.6	28.4	36.8	5.1	68.6	108.0	171.5	17.8	55.9	5.1	68.6	≈ 5.4
3000 sL/min	226.1	73.7	139.6	24.4	36.8	5.1	68.6	128.3	191.8	17.8	55.9	25.4	88.9	≈ 5.4
5000 sL/min	248.9	97.5	159.2	36.8	48.8	7.5	90.0	151.3	214.8	–	–	–	–	≈ 12.7

CHAPTER 11

Ordering information

Order controllers and accessories from Analyt-MTC, quoting the order code. The controllers below are the standard versions; for any other version, contact Analyt-MTC.

Controllers

The standard versions are calibrated for air at standard conditions (21.11 °C, 1013.25 mbar); you select another gas or a gas mix on the controller itself, as described in Selecting the gas (p. 22) and Gas mixes (p. 22). For the versions with positive shut-off valve, bidirectional, low-pressure-drop or corrosion-resistant versions, or for options such as the totaliser, the barometer, the colour display, the high-accuracy option, other connectors or other output signals, give Analyt-MTC your gas, flow range, inlet and outlet pressures, and the options you need.

Table 11-1 Controllers, standard versions (full scale at 21.11 °C, 1013.25 mbar)

Full scale	Order code
0.5 smL/min	35820
1 smL/min	35821
2 smL/min	35822
5 smL/min	35823
10 smL/min	35824
20 smL/min	35825
50 smL/min	35826
100 smL/min	35827
200 smL/min	35828
500 smL/min	35829
1 sL/min	35830
2 sL/min	35831
5 sL/min	35832
10 sL/min	35833
20 sL/min	35834
50 sL/min	35835
100 sL/min	35836
250 sL/min	35837
500 sL/min	35838
1000 sL/min	35839
2000 sL/min	35912
3000 sL/min	35913
5000 sL/min	35966

Accessories

Table 11-2 Accessories

Description	Order code
Universal baseplate: bench-top stand for the controller	35780
RS-232 communication cable, 8-pin Mini-DIN to 9-pin D-sub, 1.8 m	35754
USB to RS-232 adapter, USB 2.0 type A to one 9-pin D-sub serial port	35782
USB to RS-232 converter with eight serial ports	USB-RS232
Hard transport case with foam insert	1200-000-110E

CHAPTER 12

Service, warranty and contacts

Calibration, repair, cleaning and technical support for your controller are provided by Analyt-MTC. Get in touch before you send anything: many problems turn out to be settings that can be corrected with you on the phone, and the controller never has to leave your bench.

Contact and support

ANALYT-MTC Messtechnik GmbH

German Headquarters

Klosterrunsstraße 18, 79379 Müllheim
Germany

+49 7631 5545

info@analyt-mtc.de

French Subsidiary

175 Avenue d'Alsace, 68000 Colmar
France

+33 3 89 41 47 78

info@analyt-mtc.fr

www.analyt-mtc.com

Before you call

Have the following at hand so that Analyt-MTC can help you quickly:

- the model and serial number (About Device screen, p. 20, or the label on the device);
- the firmware version (SW line on the same screen);
- your gas, set point and inlet and outlet pressures, or the serial command and response.

Technical support

The Analyt-MTC application engineers help with installation, configuration, control tuning and serial communication. Have the model, serial number and firmware version at hand (About Device screen, p. 20), together with a description of your process: gas, set point, and inlet and outlet pressures.

The contact details of Analyt-MTC are given above and on the back cover.

Open and follow every service request in the Analyt-MTC customer portal at portal.analyt-mtc.com: where your controller is in the process, and, once the work is done, its certificates, digitally signed.

Sending in a controller

1. **Open a service request.** Open it online in the Analyt-MTC customer portal, portal.analyt-mtc.com, with the model, the serial number and the reason for service: calibration, repair or cleaning. Do not put paper forms in the box: the service request carries everything Analyt-MTC needs.
2. **Confirm the safety declaration.** Residues of hazardous media can injure the people who unpack and service the device. Clean the controller and remove all residues before you send it. In the service request, state the substances the controller has been in contact with and their hazards, and confirm the safety declaration online. If you are not sure, do not send it.

3. **Pack the controller alone.** Send the controller without power supply, cables, fittings or case unless they are part of the problem; Analyt-MTC is not responsible for accessories sent. Close the process ports with their plugs or caps so that nothing enters the flow path, protect the connectors against electrostatic discharge, and pack each controller individually for transport.
4. **Ship it to Müllheim.** Send the parcel to the Analyt-MTC service centre in Müllheim, Germany, never to the Colmar address.

When the controller arrives, it is registered and assessed, and you receive a quote before any work begins: no work is done without your agreement. If you decline the quote, a bench fee and return transport are charged. Every instrument passes a final check before it is returned with its documentation. A standard service typically takes one to two weeks from arrival to dispatch; this lead time is indicative. Express service can be requested in the service request.

Warranty

The warranty terms for your controller are those agreed in your order confirmation. To make a warranty claim, contact Analyt-MTC with the serial number and a description of the fault before returning the controller.

Connecting a 4–20 mA output to a loop-powered system damages the controller beyond repair and voids the warranty (see Analogue signals, p. 17).

Disposal

Do not dispose of the controller with household waste. Dispose of it as electrical and electronic equipment under local regulations (WEEE). Remove batteries first where fitted and dispose of them separately.

APPENDIX A

Engineering units

These are the units you can select under Engineering units (p. 24). Absolute and barometric pressure units end in A, gauge units in G; gauge units need the barometer option. Standard flow units begin with S and refer to the STP reference, normal flow units begin with N and refer to the NTP reference (see Standard and normal reference conditions, p. 24). Water-column units exist twice with the same label; the menu lists both. The serial unit numbers are listed in the *358 Series serial interface (RS-232/RS-485) — Communication guide* (AMTC-CG-0002).

A-1 Pressure units

Absolute or barometric	Gauge	Unit
PaA	PaG	Pascal
hPaA	hPaG	Hectopascal
kPaA	kPaG	Kilopascal
MPaA	MPaG	Megapascal
mbarA	mbarG	Millibar
barA	barG	Bar
g/cm²A	g/cm²G	Gram-force per square centimetre†
kg/cm²A	kg/cm²G	Kilogram-force per square centimetre*
PSIA	PSIG	Pound-force per square inch
PSFA	PSFG	Pound-force per square foot
mTorrA	mTorrG	Millitorr
torrA	torrG	Torr
mmHgA	mmHgG	Millimetre of mercury at 0 °C
inHgA	inHgG	Inch of mercury at 0 °C
mmH_2OA	mmH_2OG	Millimetre of water at 4 °C (NIST conventional)†
mmH_2OA	mmH_2OG	Millimetre of water at 60 °F†
cmH_2OA	cmH_2OG	Centimetre of water at 4 °C (NIST conventional)†
cmH_2OA	cmH_2OG	Centimetre of water at 60 °F†
inH_2OA	inH_2OG	Inch of water at 4 °C (NIST conventional)†
inH_2OA	inH_2OG	Inch of water at 60 °F†
atm		Atmosphere
m asl		Metre above sea level
ft asl		Foot above sea level
V		Volt
count	count	Set point count, 0–64000
%	%	Percent of full scale

A-2 Flow units

Volumetric	Standard	Normal	Unit
µL/m	SµL/m	NµL/m	Microlitre per minute‡
mL/s	SmL/s	NmL/s	Millilitre per second
mL/m	SmL/m	NmL/m	Millilitre per minute
mL/h	SmL/h	NmL/h	Millilitre per hour
L/s	SL/s	NL/s	Litre per second
LPM	**SLPM**	**NLPM**	Litre per minute
L/h	SL/h	NL/h	Litre per hour
US GPM			US gallon per minute
US GPH			US gallon per hour
CCS	SCCS	NCCS	Cubic centimetre per second
CCM	**SCCM**	**NCCM**	Cubic centimetre per minute
cm³/h	Scm³/h	Ncm³/h	Cubic centimetre per hour†
m³/m	Sm³/m	Nm³/m	Cubic metre per minute†
m³/h	Sm³/h	Nm³/h	Cubic metre per hour†
m³/d	Sm³/d	Nm³/d	Cubic metre per day†
in³/m	Sin³/m		Cubic inch per minute†
CFM	**SCFM**		Cubic foot per minute
CFH	SCFH		Cubic foot per hour
CFD	SCFD		Cubic foot per day
	kSCFM		1000 cubic feet per minute
count	count	count	Set point count, 0–64000
%	%	%	Percent of full scale

A-3 Temperature units

Label	Unit
°C	Degree Celsius
°F	Degree Fahrenheit
K	Kelvin
°R	Degree Rankine

A-4 Time units

Label	Unit
ms	Millisecond
s	Second
m	Minute
hour	Hour
day	Day

* Shown on the display as kg/cmA and kg/cmG. † Superscript and subscript numerals are shown as normal numerals. ‡ μ is shown as a lower-case u.

APPENDIX B

Gas list

The gases below can be selected under Selecting the gas (p. 22) or with the select-gas command (see Commands most used with a controller, p. 39). They are listed by gas number, the number used over the serial interface; on the display the same gases are grouped by category (see Gases by category, p. 58). The short name is the one shown on the display and in the data frame. Numbers 236 to 255 are reserved for your own gas mixes (p. 22). The gases installed on your controller are listed on its display; if your gas is not listed, ask Analyt-MTC whether the controller is suitable.

#	Short name	Long name
0	Air	Air (Clean Dry)
1	Ar	Argon
2	CH_4	Methane
3	CO	Carbon Monoxide
4	CO2	Carbon Dioxide
5	C_2H_6	Ethane
6	H_2	Hydrogen
7	He	Helium
8	N_2	Nitrogen
9	N_2O	Nitrous Oxide
10	Ne	Neon
11	O_2	Oxygen
12	C_3H_8	Propane
13	nC_4H_{10}	Normal Butane
14	C_2H_2	Acetylene
15	C_2H_4	Ethylene (Ethene)
16	iC_4H_{10}	Isobutane
17	Kr	Krypton
18	Xe	Xenon
19	SF_6	Sulfur Hexafluoride[1]
20	C-25	25 % CO_2, 75 % Ar
21	C-10	10 % CO_2, 90 % Ar
22	C-8	8 % CO_2, 92 % Ar
23	C-2	2 % CO_2, 98 % Ar
24	C-75	75 % CO_2, 25 % Ar
25	He-25	25 % He, 75 % Ar
26	He-75	75 % He, 25 % Ar
27	A1025	90 % He, 7.5 % Ar, 2.5 % CO_2
28	Star29	Stargon CS (90 % Ar, 8 % CO_2, 2 % O_2)
29	P-5	5 % CH_4, 95 % Ar
30	NO	Nitric Oxide[2]
31	NF_3	Nitrogen Trifluoride[2]
32	NH_3	Ammonia[2]
33	Cl_2	Chlorine[2]
34	H_2S	Hydrogen Sulfide[2]
35	SO_2	Sulfur Dioxide[2]
36	C_3H_6	Propylene[2]
80	1Buten	1-Butylene[2]
81	cButen	Cis-Butene (cis-2-Butene)[2]
82	iButen	Isobutene[2]
83	tButen	Trans-2-Butene[2]
84	COS	Carbonyl Sulfide[2]
85	DME	Dimethylether (C_2H_6O)[2]
86	SiH_4	Silane[2]
100	R-11	Trichlorofluoro-methane (CCl_3F)[2,3]
101	R-115	Chloropentafluoro-ethane (C_2ClF_5)[2,3]
102	R-116	Hexafluoroethane (C_2F_6)[2]
103	R-124	Chlorotetrafluoro-ethane (C_2HClF_4)[2,3]
104	R-125	Pentafluoroethane (CF_3CHF_2)[2,3]
105	R-134A	Tetrafluoroethane (CH_2FCF_3)[2,3]
106	R-14	Tetrafluoromethane (CF_4)[2]
107	R-142b	Chlorodifluoroethane (CH_3CClF_2)[2,3]
108	R-143a	Trifluoroethane ($C_2H_3F_3$)[2,3]
109	R-152a	Difluoroethane ($C_2H_4F_2$)[2]
110	R-22	Difluoromonochloro-methane ($CHClF_2$)[2,3]
111	R-23	Trifluoromethane (CHF_3)[2,3]
112	R-32	Difluoromethane (CH_2F_2)[2,3]
113	R-318	Octafluorocyclobutane (C_4F_8)[2]
114	R-404A	44 % R-125, 4 % R-134A, 52 % R-143A[2,3]
115	R-407C	23 % R-32, 25 % R-125, 52 % R-134A[2,3]
116	R-410A	50 % R-32, 50 % R-125[2,3]
117	R-507A	50 % R-125, 50 % R-143A[2,3]
140	C-15	15 % CO_2, 85 % Ar
141	C-20	20 % CO_2, 80 % Ar
142	C-50	50 % CO_2, 50 % Ar
143	He-50	50 % He, 50 % Ar
144	He-90	90 % He, 10 % Ar
145	Bio5M	5 % CH_4, 95 % CO_2
146	Bio10M	10 % CH_4, 90 % CO_2
147	Bio15M	15 % CH_4, 85 % CO_2
148	Bio20M	20 % CH_4, 80 % CO_2
149	Bio25M	25 % CH_4, 75 % CO_2
150	Bio30M	30 % CH_4, 70 % CO_2
151	Bio35M	35 % CH_4, 65 % CO_2
152	Bio40M	40 % CH_4, 60 % CO_2
153	Bio45M	45 % CH_4, 55 % CO_2
154	Bio50M	50 % CH_4, 50 % CO_2
155	Bio55M	55 % CH_4, 45 % CO_2
156	Bio60M	60 % CH_4, 40 % CO_2
157	Bio65M	65 % CH_4, 35 % CO_2
158	Bio70M	70 % CH_4, 30 % CO_2
159	Bio75M	75 % CH_4, 25 % CO_2
160	Bio80M	80 % CH_4, 20 % CO_2
161	Bio85M	85 % CH_4, 15 % CO_2
162	Bio90M	90 % CH_4, 10 % CO_2
163	Bio95M	95 % CH_4, 5 % CO_2
164	EAN-32	32 % O_2, 68 % N_2

#	Short name	Long name
165	EAN-36	36 % O_2, 64 % N_2
166	EAN-40	40 % O_2, 60 % N_2
167	HeOx20	20 % O_2, 80 % He
168	HeOx21	21 % O_2, 79 % He
169	HeOx30	30 % O_2, 70 % He
170	HeOx40	40 % O_2, 60 % He
171	HeOx50	50 % O_2, 50 % He
172	HeOx60	60 % O_2, 40 % He
173	HeOx80	80 % O_2, 20 % He
174	HeOx99	99 % O_2, 1 % He
175	EA-40	Enriched air, 40 % O_2
176	EA-60	Enriched air, 60 % O_2
177	EA-80	Enriched air, 80 % O_2
178	Metab	Metabolic Exhalant (16 % O_2, 78.04 % N_2, 5 % CO_2, 0.96 % Ar)
179	LG-4.5	4.5 % CO_2, 13.5 % N_2, 82 % He
180	LG-6	6 % CO_2, 14 % N_2, 80 % He
181	LG-7	7 % CO_2, 14 % N_2, 79 % He

#	Short name	Long name
182	LG-9	9 % CO_2, 15 % N_2, 76 % He
183	HeNe-9	9 % Ne, 91 % He
184	LG-9.4	9.4 % CO_2, 19.25 % N_2, 71.35 % He
185	SynG-1	40 % H_2, 29 % CO, 20 % CO_2, 11 % CH_4
186	SynG-2	64 % H_2, 28 % CO, 1 % CO_2, 7 % CH_4
187	SynG-3	70 % H_2, 4 % CO, 25 % CO_2, 1 % CH_4
188	SynG-4	83 % H_2, 14 % CO, 3 % CH_4
189	NatG-1	93 % CH_4, 3 % C_2H_6, 1 % C_3H_8, 2 % N_2, 1 % CO_2
190	NatG-2	95 % CH_4, 3 % C_2H_6, 1 % N_2, 1 % CO_2
191	NatG-3	95.2 % CH_4, 2.5 % C_2H_6, 0.2 % C_3H_8, 0.1 % C_4H_{10}, 1.3 % N_2, 0.7 % CO_2
192	CoalG	50 % H_2, 35 % CH_4, 10 % CO, 5 % C_2H_4
193	Endo	75 % H_2, 25 % N_2

#	Short name	Long name
194	HHO	66.67 % H_2, 33.33 % O_2
195	HD-5	LPG: 96.1 % C_3H_8, 1.5 % C_2H_6, 0.4 % C_3H_6, 1.9 % n-C_4H_{10}
196	HD-10	LPG: 85 % C_3H_8, 10 % C_3H_6, 5 % n-C_4H_{10}
197	OCG-89	89 % O_2, 7 % N_2, 4 % Ar
198	OCG-93	93 % O_2, 3 % N_2, 4 % Ar
199	OCG-95	95 % O_2, 1 % N_2, 4 % Ar
200	FG-1	2.5 % O_2, 10.8 % CO_2, 85.7 % N_2, 1 % Ar
201	FG-2	2.9 % O_2, 14 % CO_2, 82.1 % N_2, 1 % Ar
202	FG-3	3.7 % O_2, 15 % CO_2, 80.3 % N_2, 1 % Ar
203	FG-4	7 % O_2, 12 % CO_2, 80 % N_2, 1 % Ar
204	FG-5	10 % O_2, 9.5 % CO_2, 79.5 % N_2, 1 % Ar
205	FG-6	13 % O_2, 7 % CO_2, 79 % N_2, 1 % Ar
206	P-10	10 % CH_4, 90 % Ar
210	D-2	Deuterium

Gases by category

On the display the gases are grouped in these categories. The gas numbers are in the list above.

Category	Gases
Pure non-corrosive gases	Acetylene (C_2H_2), air (clean, dry), argon (Ar), isobutane (i-C_4H_{10}), normal butane (n-C_4H_{10}), carbon dioxide (CO_2), carbon monoxide (CO), deuterium (D_2), ethane (C_2H_6), ethylene (ethene) (C_2H_4), helium (He), hydrogen (H_2), krypton (Kr), methane (CH_4), neon (Ne), nitrogen (N_2), nitrous oxide (N_2O), oxygen (O_2), propane (C_3H_8), sulfur hexafluoride (SF_6)[1], xenon (Xe)
Breathing gases	Metabolic exhalant, EAN-32, EAN-36, EAN-40, EA-40, EA-60, EA-80, Heliox-20, Heliox-21, Heliox-30, Heliox-40, Heliox-50, Heliox-60, Heliox-80, Heliox-99
Welding gases	C-2, C-8, C-10, C-15, C-20, C-25, C-50, C-75, He-25, He-50, He-75, He-90, A 1025, Stargon CS
Refrigerants[2]	R-11[3], R-14, R-22[3], R-23[3], R-32[3], R-115[3], R-116, R-124[3], R-125[3], R-134a[3], R-142b[3], R-143a[3], R-152a, R-318, R-404A[3], R-407C[3], R-410A[3], R-507A[3]
Chromatography gas mixes	P-5, P-10
Oxygen concentrator gas mixes	89 % O_2, 7.0 % N_2, 4.0 % Ar; 93 % O_2, 3.0 % N_2, 4.0 % Ar; 95 % O_2, 1.0 % N_2, 4.0 % Ar
Stack and flue gas mixes	2.5 % O_2, 10.8 % CO_2, 85.7 % N_2, 1.0 % Ar; 2.9 % O_2, 14 % CO_2, 82.1 % N_2, 1.0 % Ar; 3.7 % O_2, 15 % CO_2, 80.3 % N_2, 1.0 % Ar; 7.0 % O_2, 12 % CO_2, 80 % N_2, 1.0 % Ar; 10 % O_2, 9.5 % CO_2, 79.5 % N_2, 1.0 % Ar; 13 % O_2, 7.0 % CO_2, 79 % N_2, 1.0 % Ar
Laser gas mixes	4.5 % CO_2, 13.5 % N_2, 82 % He; 6.0 % CO_2, 14 % N_2, 80 % He; 7.0 % CO_2, 14 % N_2, 79 % He; 9.0 % CO_2, 15 % N_2, 76 % He; 9.4 % CO_2, 19.25 % N_2, 71.35 % He; 9.0 % Ne, 91 % He
Fuel gas mixes	Coal gas (50 % H_2, 35 % CH_4, 10 % CO, 5 % C_2H_4); endothermic gas (75 % H_2, 25 % N_2); HHO (66.67 % H_2, 33.33 % O_2); LPG HD-5 (96.1 % C_3H_8, 1.5 % C_2H_6, 0.4 % C_3H_6, 1.9 % n-C_4H_{10}); LPG HD-10 (85 % C_3H_8, 10 % C_3H_6, 5 % n-C_4H_{10})

Category	Gases
Natural gases	93.0 % CH_4, 3.0 % C_2H_6, 1.0 % C_3H_8, 2.0 % N_2, 1.0 % CO_2; 95.0 % CH_4, 3.0 % C_2H_6, 1.0 % N_2, 1.0 % CO_2; 95.2 % CH_4, 2.5 % C_2H_6, 0.2 % C_3H_8, 0.1 % C_4H_{10}, 1.3 % N_2, 0.7 % CO_2
Bioreactor gas mixes	5–95 % CH_4/CO_2 in 5 % steps
Synthesis gases	40 % H_2, 29 % CO, 20 % CO_2, 11 % CH_4; 64 % H_2, 28 % CO, 1.0 % CO_2, 7.0 % CH_4; 70 % H_2, 4.0 % CO, 25 % CO_2, 1.0 % CH_4; 83 % H_2, 14 % CO, 3.0 % CH_4
Pure corrosive gases[2]	Ammonia (NH_3), butylene (1-Buten), cis-butene (c-Buten), isobutene (i-Buten), trans-butene (t-Buten), carbonyl sulfide (COS), chlorine (Cl_2), dimethylether (DME), hydrogen sulfide (H_2S), nitrogen trifluoride (NF_3), nitric oxide (NO), propylene (C_3H_6), silane (SiH_4), sulfur dioxide (SO_2)

[1] Sulfur hexafluoride is a highly potent greenhouse gas monitored under the Kyoto Protocol.

[2] Corrosion-resistant devices only.

[3] Under the Montreal Protocol and its Kigali Amendment, the production and consumption of these ozone-depleting substances is being, or has been, phased out. Make sure you comply with these regulations before using these gases; the same applies to R-113, R-123 and R-141b.

APPENDIX C

Connector pinouts

The standard 8-pin Mini-DIN connector is described in 8-pin Mini-DIN connector (p. 16). The pinouts below are the common assignments of the optional connectors. Which signals are actually present depends on the options ordered: always check the calibration sheet and the pinout of your controller before wiring it. Before you connect a computer, read Connecting to a computer (p. 35).

6-pin locking industrial connector

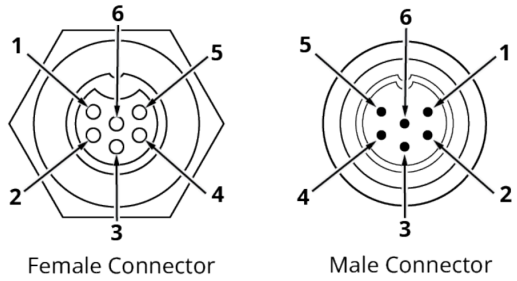


Figure C-1. Pin numbering of the locking industrial connector.

Pin	Function
1	Power in
2	Serial output (send): RS-232 TX / RS-485 A(−)
3	Serial input (receive): RS-232 RX / RS-485 B(+)
4	Analogue set point input
5	Remote tare (meters only)
6	Ground, common to power, digital communication, analogue signals and alarms

9-pin D-sub connector



Figure C-2. 9-pin D-sub. Left: female connector. Right: male connector.

Table C-1 9-pin D-sub, common pinouts

Pin	DB9 (F), DB9M (M)	DB9A, DB9K	DB9R	DB9T	DB9U	DB9B	DB9G	DB9H	DB9I	DB9N
1	Current out	NC	TX or A	TX or A	RX or B	Analogue out 2	RX or B	TX or A	NC	Power in
2	Analogue out 2	Analogue out	Analogue out	Analogue out	Analogue out	Analogue out	Analogue out	Analogue out	Analogue out	Analogue in
3	RX or B	Power in	Analogue in	Power in	Power in	Power in	Ground	Analogue in	Power in	Analogue out
4	Analogue in	Ground	Ground	Ground	Ground	Ground	Power in	RX or B	Ground	NC
5	TX or A	TX or A	NC	NC	NC	Ground	Ground	Analogue out 2	NC	Ground
6	Analogue out	Analogue in	RX or B	Analogue in	Analogue in	Analogue in	TX or A	NC	Analogue in	Ground
7	Power in	Ground	Power in	Ground	Ground	Ground	Analogue in	Power in	Ground	RX or B
8	Ground	Ground	Ground	Ground	Ground	TX or A	Current out	Ground	RX or B	TX or A
9	Ground	RX or B	Ground	RX or B	TX or A	RX or B	Ground	Ground	TX or A	NC

15-pin D-sub connector

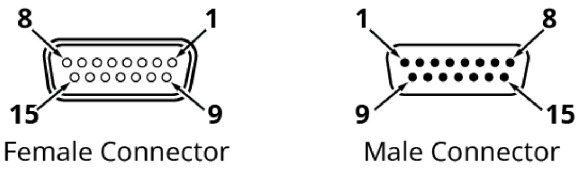


Figure C-3. 15-pin D-sub. Left: female connector. Right: male connector.

Table C-2 15-pin D-sub, common pinouts

Pin	DB15	DB15A	DB15B	DB15H	DB15K	DB15O	DB15S
1	Ground	Ground	Ground	NC	NC	Ground	Ground
2	Analogue out	Analogue out	Analogue out	RX or B	Analogue out	NC	Analogue out
3	Ground	Analogue in	Ground	NC	NC	Ground	NC
4	NC	Ground	NC	NC	NC	Analogue out	NC
5	Power in	Ground	Power in	Ground	Ground	Power in	Ground
6	NC	Ground	NC	Analogue out	NC	NC	NC
7	NC	Power in	NC	Ground	Power in	Analogue in	NC
8	Analogue in	TX or A	Analogue in	NC	Analogue in	NC	Analogue in
9	Ground	Ground	Ground	NC	Analogue out 2	Ground	Ground
10	Ground	NC	Ground	Analogue out 2	NC	Ground	Ground
11	Analogue out 2	NC	Analogue out 2	Power in	Ground	Analogue out 2	Analogue out 2
12	NC	Analogue out 2	NC	Ground	Ground	NC	RX or B
13	RX or B	NC	NC	NC	RX or B	NC	Power in
14	Ground	NC	RX or B	Analogue in	TX or A	RX or B	TX or A
15	TX or A	RX or B	TX or A	TX or A	Ground	TX or A	Ground

Table C-3 Key of terms for Tables C-1 and C-2

Analogue in	Analogue set point input
Analogue out	0–5 V DC output signal (1–5 or 0–10 V DC optional)
Analogue out 2	5.12 V DC, or optional secondary analogue output
Current out	Not connected by default; optional 4–20 mA analogue output. If this pin is not present, Analogue out includes the current output.
NC	Not connected
Power in	Supply (+V DC)
RX or B	Serial RS-232 RX or RS-485 (+)
TX or A	Serial RS-232 TX or RS-485 (–)
Ground	Common to power, digital communication, analogue signals and alarms

8-pin M12 connector

Two assignments exist: the standard M12, and the M12MD, which largely follows the 8-pin Mini-DIN. The secondary analogue output can be 4–20 mA, 0–5, 1–5 or 0–10 V DC.

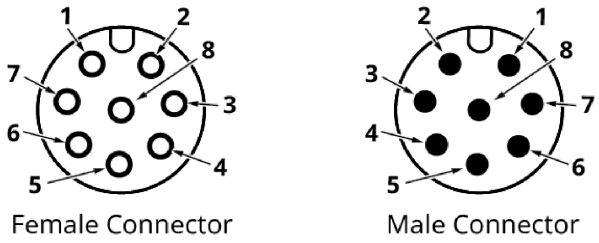


Figure C-4. 8-pin M12. Left: female connector. Right: male connector.

Table C-4 8-pin M12, common pinouts

Pin	M12	M12MD
1	0–5 V DC output; option: 1–5 or 0–10 V DC	Not connected; option: 4–20 mA primary output
2	Power in	Constant 5.12 V DC; option: secondary analogue output (4–20 mA, 0–5, 1–5 or 0–10 V DC) or basic alarm
3	Serial input (receive): RS-232 RX / RS-485 (+)	Serial input (receive): RS-232 RX / RS-485 (+)
4	Analogue set point input	Analogue set point input
5	Serial output (send): RS-232 TX / RS-485 (−)	Serial output (send): RS-232 TX / RS-485 (−)
6	Constant 5.12 V DC; option: secondary analogue output (4–20 mA, 0–5, 1–5 or 0–10 V DC) or basic alarm	0–5 V DC output; option: 1–5 or 0–10 V DC
7	Ground, common to power, digital communication, analogue signals and alarms	Power in
8	Inactive; option: 4–20 mA primary output	Ground, common to power, digital communication, analogue signals and alarms

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