ANALYT MESSTECHNIK



OPERATING MANUAL

358 Series LC Liquid Flow Controllers

Installation, operation, control tuning and maintenance of 358 Series LC liquid flow controllers.

AMTC-MN-0003

Rev. 2 · October 2026

www.analyt-mtc.com

About this manual

This manual is for everyone who installs, operates or maintains a 358 Series LC liquid flow controller: plumbing it into the liquid line, removing trapped air, wiring it, reading the display, giving set points, tuning the control loop and keeping it in calibration.

The LC is calibrated for one liquid, typically water, and measures the volumetric flow, gauge pressure and temperature of that liquid. Read Safety (p. 7) before you connect it. Then follow Installation (p. 12) up to First power-up (p. 16). If you control the instrument from a computer or programmable logic controller (PLC), Communication (p. 32) 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); for Modbus RTU, see Modbus RTU (p. 37).

Which options your controller has — display type, totaliser, output signals, connector, seal material — 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: plain-text character code
BSPP	British Standard Pipe Parallel: parallel British pipe thread
EPDM	Ethylene propylene diene monomer rubber
FFKM	Perfluoroelastomer
FKM	Fluoroelastomer
NC	Not connected (pin assignments)
NIST	National Institute of Standards and Technology (USA)
NPT	National Pipe Thread: tapered US pipe thread
PTFE	Polytetrafluoroethylene
RTU	Remote terminal unit: Modbus transmission mode
RX	Receive: serial input
SAE	Society of Automotive Engineers (fitting standard)
TFT	Thin-film transistor (colour display)
TX	Transmit: serial output
UNC	Unified National Coarse: US coarse screw thread
UNF	Unified National Fine: US fine screw thread

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.

Document information

Title	358 Series LC Liquid Flow Controllers — Operating manual
Document number	AMTC-MN-0003
Revision	Rev. 2 — October 2026
Applies to	358 Series LC liquid flow controllers, 0.5 mL/min to 10 L/min full scale, including the LCR (large-valve) and anti-corrosive versions
Language	English
Related documents	358 Series serial interface (RS-232/RS-485) — Communication guide (AMTC-CG-0002); 358 Series Modbus RTU and Modbus TCP/IP — Communication guide (AMTC-CG-0001)

Revision history

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

Related documents: technical data sheet; calibration sheet

Information in this manual is subject to change without notice. © 2026 ANALYT-MTC Messtechnik GmbH. All rights reserved.

Contents

1 **Safety** 7
- Intended use 7
- Rules that protect people 7
- Rules that protect the instrument 7
- Settings that can cause an unwanted flow 8

2 **Product description** 9
- The controller at a glance 9
- The main display 10
- Status messages 11
- Colour display (option) 11

3 **Installation** 12
- Mounting and orientation 12
- Connecting the liquid line 12
- Pressure limits 13
- Power and signal connections 13
- Bleeding air from the controller 14

4 **Commissioning** 16
- First power-up 16
- Quick start 16

5 **Operation** 17
- Finding your way in the menus 17
- Data screens 17
- Everyday operation 18
  - The process liquid 18
  - Taring 18
  - Giving a set point 19
  - Locking the front panel 19
  - Device information 19
- Process control 20
  - Set point options 20
  - Set point ramping 22
  - Batch dispensing 23
  - Showing the valve drive 24
  - Checking control 24
  - Optimizing control (autotune) 24
  - Control loop 26
- Instrument set-up 28
  - Sensor set-up 28
  - Totaliser options 29

Analogue outputs 30
Display settings 31

6 **Communication** 32
Ways to control the controller digitally 32
Communication settings 32
Connecting to a computer 33
Collecting data 34
Sending a set point 34
Checking control over the interface 34
Optimizing control over the interface 35
Commands most used with a controller 36
Modbus RTU 37

7 **Calibration and verification** 38

8 **Maintenance** 39
Care and cleaning 39
Repair 39
Advanced settings 39

9 **Troubleshooting** 41
General use 41
Flow readings 41
Pressure readings 42
Serial communication 42

10 **Specifications** 43
Measurement and control performance 43
Flow ranges and process data 43
Operating limits and media 44
Wetted materials 44
Electrical data 44
Dimensions and weight 44

11 **Ordering information** 46
Controllers 46

12 **Service, warranty and contacts** 47
Technical support 47
Sending in a controller 47
Warranty 48
Disposal 48

A **Engineering units** 49

B **Connector pinouts** 50
6-pin locking industrial connector 50
9-pin D-sub connector 51

15-pin D-sub connector 51
8-pin M12 connector 52

CHAPTER 1

Safety

Read this chapter before you connect liquid or power. Each point returns where it applies.

Intended use

The controller measures and controls the volumetric flow — or, when configured for it, the gauge pressure — of one liquid within the limits on its calibration sheet and in Specifications (p. 43). By default it is calibrated for water: ultrapure water (UPW), highly purified water (HPW), high-purity water, reverse-osmosis (RO) water or deionised (DI) water. The ambient temperature must stay between −10 and +60 °C, and the liquid must stay liquid at all times.

NOTICE

One liquid. The controller is designed to work with only one liquid, typically water, and reads correctly only with the liquid it was calibrated for. Any other liquid gives wrong readings. Run only the calibrated liquid. A different liquid needs a new calibration, so contact Analyt-MTC first (see The process liquid (p. 18)).

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 the process medium, and any hazardous medium 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 from the system.

Rules that protect the instrument

NOTICE

Pressure. A common-mode pressure above 13.8 bar g (200 psig), or a differential pressure above 5.17 bar (75 psi), can damage the controller. Keep the line pressure at or below 6.9 bar g, the full scale of the pressure sensor (see Pressure limits, p. 13). If you suspect damage, stop using the controller and contact Analyt-MTC.

NOTICE

Bleed screws on an inverted controller. On a controller mounted upside down, liquid can leak from an open bleed screw and cause permanent damage. Do not use the bleed screws while the controller is mounted upside down.

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 only after every pin has been confirmed to be 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 and flow body. Pipe dope or liquid sealant on the process connections can reach the flow stream and damage the controller permanently. Debris inside the flow body is not something to clean out yourself. Do not use pipe dope or sealants, and do not take the flow body apart. If you suspect debris inside, contact Analyt-MTC for cleaning.

NOTICE

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

Note

Controllers with Rolamite valves must be mounted with the valve vertical. The flow body can be configured to connect in another direction.

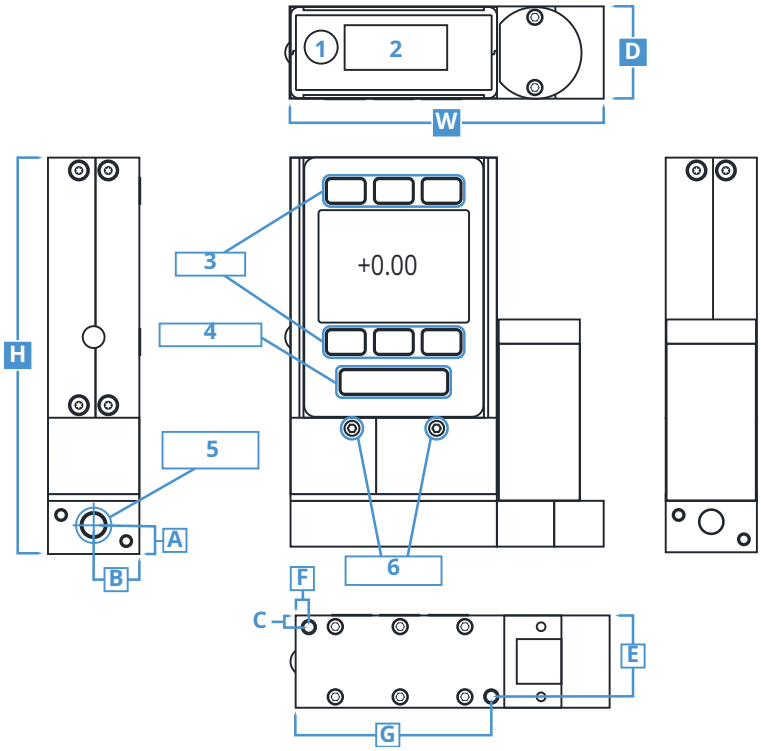
Settings that can cause an unwanted flow

Lower set point limit (p. 22) above zero	The controller cannot stop the flow until the limit is cleared.
Batch dispensing (p. 23) switched off	The flow restarts at once at the current set point.
Remembered set point at power-up (see Set point after power-up, p. 21)	A controller used before restarts at its last set point as soon as it is powered.
Valve hold active (see Commands most used with a controller, p. 36)	Set point changes have no effect until the hold is cancelled.
Batch while controlling pressure	A sudden rise of a supply pressure that was too low can push the batch past its size before the valve reacts (see Totalising while controlling pressure, p. 30).

CHAPTER 2

Product description

The controller at a glance



#	Part
1	Power jack (DC in)
2	Signal connector (I/O port; shape depends on the option)
3	Buttons
4	Backlight button
5	Process connection
6	Bleed screws, upstream and downstream

Figure 2-1. A typical controller seen from the top, the sides, the front and below. The appearance and connections of your controller may differ. The letters are the dimensions in Dimensions and weight (p. 44).

The liquid flows through the flow body in the direction of the arrow on it, usually from left to right when you face the display. The mounting holes are on the bottom of the flow body; their thread and depth are given per range in Flow ranges and process data (p. 43).

Controllers in the 0.5–1 mL/min ranges are shipped with two 316L stainless-steel M5 male O-ring face-seal fittings to 1/8" female NPT (Table 10-2, see Flow ranges and process data, p. 43).

The main display

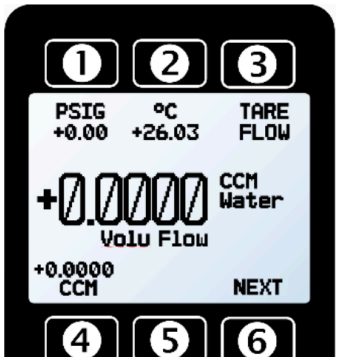


Figure 2-2. Main display of a liquid meter measuring the volumetric flow of water. On a controller, button 3 opens the set point.

The display shows every parameter the controller measures at the same time: gauge pressure, temperature, volumetric flow and set point, each in its engineering unit. Pressing a reading's button puts that reading in the centre of the display. The liquid the controller is calibrated for appears below the unit on the right.

The sensors measure 1000 times per second and the display updates 10 times per second.

#	Button
1	Highlights the pressure
2	Highlights the temperature
3	Opens the set point screen
4	Highlights the volumetric flow
6	Opens the menu or moves to the next screen
7	Switches the backlight on and off (the button below the display)

Button 5 highlights the mass flow on mass flow instruments and has no function on a liquid controller; nothing happens when an unused button is pressed. A liquid controller has no tare button on the main display: tare it from the menu (see Taring, p. 18). The button functions can be changed (see Display settings, p. 31).

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
EXH	Exhaust mode active (controllers only)
GTA	Control optimization in progress (controllers only)
HLD	Valve hold active (controllers only; see Commands most used with a controller, p. 36)
LCK	Front display locked (see Locking the front panel, p. 19)
MOV	Mass flow above the range of a mass flow instrument
OVR	Totaliser rolled over to zero
POV	Pressure above the range of the instrument
TMF	Totaliser missed flow that was out of range
TOV	Temperature above the range of the instrument
VOV	Volumetric flow above the range of the instrument

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

Press the backlight button to switch the colour display 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 2-3. Colour display (shown on a mass flow controller).



Figure 2-4. Colour display, the item ready to select in yellow (shown on a mass flow instrument).

CHAPTER 3

Installation

Install the controller in four steps: plumb it into the liquid line, check that your pressures stay within its limits, wire power and signals, then fill it and bleed the air out. 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. Tare it again each time you change its orientation (see Taring, p. 18). Size and position of the mounting holes on the bottom of the flow body follow from the dimensions of your range (see Dimensions and weight, p. 44).

Note

Controllers with Rolamite valves are the only exception: mount them with the valve vertical. The flow body can be configured so that it connects in another direction.

Connecting the liquid line

1. Mount the controller so that the liquid flows through the flow body in the direction of the arrow, or from left to right if there is no arrow.
2. Remove the plastic plugs from the inlet and outlet ports.

   NOTICE

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

   NOTICE

   Thread tape on the first two threads can get into the flow stream, where it clogs or damages the controller. A partly blocked controller cannot reach its set point (see Troubleshooting, p. 41). Do not wrap the first two threads that enter the controller.
3. Plumb the liquid lines to the inlet and outlet. 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 cables to the power and signal connectors (see Power and signal connections, p. 13).

NOTICE

Power on a wrong pin damages the controller permanently. Do not switch on the power until every pin has been confirmed to be connected correctly.

5. Switch on the power supply. The controller turns on as soon as it is powered; bring it into service as described in First power-up (p. 16).

If you take the controller out of the line for more than a short time, drain all liquid from it (see Care and cleaning, p. 39). Before you send it in, also close the process ports with their plugs or caps (see Sending in a controller, p. 47).

Filters

Where the extra pressure drop is acceptable, use an in-line sintered filter upstream of the controller to keep large particles out of the flow body. The suggested largest particle size depends on the full-scale range:

Full-scale range	Largest particle size
up to 100 mL/min	20 µm
above 100 mL/min	40 µm

Pressure limits

The gauge pressure sensor has a full scale of 6.9 bar g (100 psig). Damage is possible above 13.8 bar g (200 psig) common-mode pressure, and above 5.17 bar (75 psi) differential pressure.

At the other end, the pressure difference between inlet and outlet must exceed the pressure drop of your range at full scale, otherwise the controller cannot reach its full flow (see Table 10-2, p. 43).

NOTICE

A common-mode pressure above 13.8 bar g (200 psig) or a differential pressure above 5.17 bar (75 psi) can damage the controller. Keep the line pressure within the range of the pressure sensor. If you suspect damage, stop using the controller and contact Analyt-MTC.

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 valve and the analogue output options — see Electrical data (p. 44). An output of 4–20 mA needs a supply of at least 12 V DC.

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 B (p. 50). Which output signals your controller has depends on the options ordered and is noted on its calibration sheet.

8-pin Mini-DIN connector

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 normally carries a constant 5.12 V DC. Connect power only to pin 7.

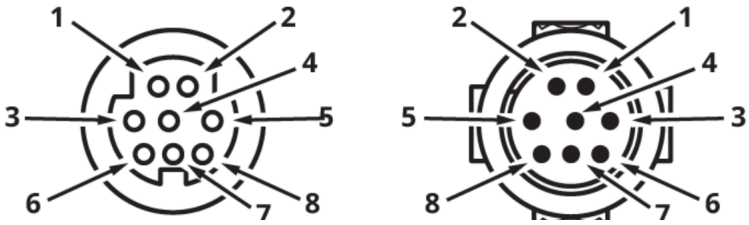


Figure 3-1. 8-pin Mini-DIN pin numbering. Left: female connector. Right: male connector.

Table 3-1 8-pin Mini-DIN pinout

Pin	Standard	Option
1	Not connected	4–20 mA primary output
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 basic alarm
3	Serial input (receive): RS-232 RX / RS-485 B(+)	
4	Analogue set point input (controllers); remote tare, ground to tare (meters and gauges)	
5	Serial output (send): RS-232 TX / RS-485 A(−)	
6	0–5 V DC analogue output	1–5 V DC or 0–10 V DC output
7	Power in	
8	Ground, common to power, digital communication, analogue signals and alarms	

Analogue signals

The **primary analogue output** is linear over its whole range. On ranges that start at 0 V DC, zero flow or zero pressure reads about 0.010 V DC. 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, and so on.

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. Which reading each output tracks is set in the controller (see Analogue outputs, p. 30).

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.

Bleeding air from the controller

Air bubbles trapped in the flow body falsify the readings. Two bleed screws on the front of the flow body (part 6 in Figure 2-1) let the air out. They are 8-32 screws with a nylon tip and a 5/64-inch hex socket. Bleed both screws after filling the controller for the first time, and whenever you suspect air.

NOTICE

A small amount of liquid leaks from the controller while you bleed it, and it can damage anything nearby. Take precautions to protect anything nearby. Do not use the bleed screws on a controller mounted upside down.

1. With the controller installed, start a flow above 50 % of full scale.
2. Gently loosen the upstream bleed screw by one to two turns, or until liquid begins to leak from the thread. Do not remove the screw: it has pressure behind it, is very small, easy to lose and delicate to re-thread.
3. Tap the flow body gently to shake the air bubbles loose; a screwdriver handle works well. You may neither see nor hear them leave.
4. Tighten the screw gently until the leak stops. Do not crush its nylon tip.
5. Repeat steps 2 to 4 with the downstream bleed screw.

CHAPTER 4

Commissioning

First power-up

With the liquid 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.

1. With the line not pressurised, switch on the power supply. The controller is ready in less than a second and shows the main display (p. 10).
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.
3. Bring the liquid supply to its normal operating pressure, within the range of the pressure sensor (see Pressure limits, p. 13).
4. Fill the controller and bleed the air out of it (see Bleeding air from the controller, p. 14).
5. Set the set point to zero again and, with the line at operating pressure and no flow, tare the flow reading (see Taring, p. 18).
6. Choose the engineering units under **MENU** › **SETUP** › **Sensor** › **Engineering Units** (see Engineering units, p. 28).
7. Check the set point source (see Set point source, p. 21), then give the controller its first set point.

Quick start

Task	How
Connect the controller	The liquid flows through the controller in the direction of the arrow on the flow body, usually from left to right (see Connecting the liquid line, p. 12).
Choose the engineering units	**MENU** › **SETUP** › **Sensor** › **Engineering Units**.
Monitor flow, temperature and pressure	The readings update live on the main display (see The main display, p. 10).
Read totals (option)	The totaliser shows the total flow since its last reset. Enable it under **MENU** › **SETUP** › **Sensor** › **Totalizer**, **Totalizer 1** or **Totalizer 2** (see Totaliser options, p. 29).
Switch the backlight	Press the backlight button below the display. On a colour display the same button switches the display off to save power.
Keep it accurate	A liquid controller needs minimal cleaning with a clean liquid (see Care and cleaning, p. 39). Have it calibrated once a year (see Calibration and verification, p. 38).

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 and how to operate the controller: everyday tasks, process control, the set-up of the sensor, the totaliser and the display. 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 or **TARES**	Flow tare; on a controller with a barometer, the tares of each reading	Taring (p. 18)
CONTROL	Set point, optimization, check control, set point set-up, control loop, set point ramp, valve drive display, batches	Process control (p. 20)
SETUP	Sensor (units, totalisers, averaging, zero band); serial communication; analogue outputs; display; advanced settings	Instrument set-up (p. 28), Chapter 6 (p. 32)
ABOUT	Device information, full-scale ranges, Analyt-MTC name and contact details	Device information (p. 19)

Data screens

Depending on its configuration, the controller has up to four data screens: the live screen, the min/max screen and one screen per totaliser. **NEXT** moves from one to the next. Which screens are shown is set under **MENU** › **SETUP** › **Display** › **Data Screens** (see Display settings, p. 31).

The **live screen** is the default data screen: the main display with every reading (see The main display, p. 10).

The **min/max screen** shows the selected reading together with its minimum and maximum since the last reset. Enable it under **MENU** › **SETUP** › **Display** › **Data Screens** › **Min/Max Screen** by changing **Hide** to **Show**. Its buttons:

- **RESET** sets the minimum and maximum to the present value.
- **SHOW VALUE** chooses the reading to show, with its minimum and maximum.
- **SETPT** shows the set point; press it to set or clear the set point.
- **NEXT** moves to the totaliser screen, if enabled; **MENU** opens the menu.

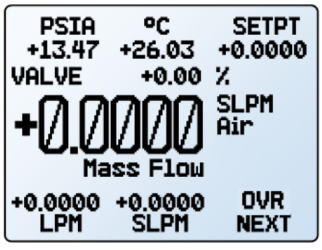


Figure 5-1. Live screen (shown on a mass flow controller).

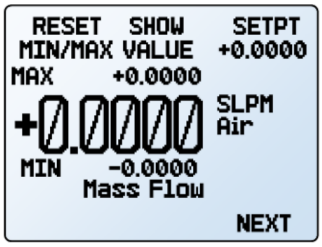


Figure 5-2. Min/max screen (shown on a mass flow controller).

Totaliser screens (option)

The optional totalisers count the total volume that has passed through the controller since their last reset. A controller has up to two, each with its own screen. Enable and configure them as described in Totaliser options (p. 29). With a totaliser enabled, the controller can also dispense batches (see Batch dispensing, p. 23). The buttons of a totaliser screen:

V AVG	Average flow since the last reset, updated live.
flow unit (e.g. **CCM**)	The live flow.
SETPT	Shows the set point; press it to set or clear the set point.
V PEAK	The peak flow since the last reset (on meters).
BATCH	The quantity to dispense per batch; -NONE- when batch dispensing is off (controllers only).
RESET	Clears all totalized data and sets the timer to zero. With a non-zero set point, a new batch starts at once.
MENU	Opens the main menu.
NEXT	Moves to the second totaliser, if enabled.

Everyday operation

This section covers the tasks you perform at the front panel in normal use: keeping the liquid right, taring, giving a set point and reading the device information. The same tasks can be done over the serial interface (see Chapter 6, p. 32).

The process liquid

The controller is designed to work with only one liquid, typically water, and reads correctly only with that liquid. The name of the liquid is shown on the right of the main display.

- By default the controller measures ultrapure water (UPW), highly purified water (HPW), high-purity water, reverse-osmosis (RO) water or deionised (DI) water.
- Other liquids compatible with the wetted materials, with a dynamic viscosity between about 0.1 and 3.0 cP — ethanol, methanol or acetone, for example — need a custom calibration for that liquid. Contact Analyt-MTC before you change the liquid.
- Filter out particles and biological material that could grow inside the controller (see Filters, p. 13).

Taring

A tare gives the controller its zero reference; it makes the readings as accurate as they can be. Tare the controller:

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

A liquid controller has no tare button on the main display: press **MENU**, then **TARE FLOW**. On a controller with a barometer the main menu shows **TARES** instead, with one tare per reading. With autotare switched on, the controller also tares itself when its set point has been

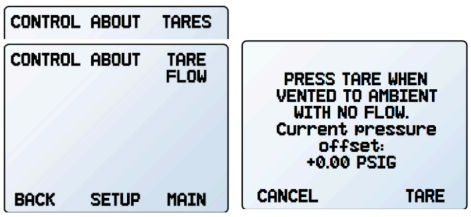


Figure 5-3. Tare from the main menu: **TARES** with a barometer (top), **TARE FLOW** without; right, the pressure tare confirmation screen.

zero for a set time (see Zero set point and autotare, p. 21).



Figure 5-4. Flow tare confirmation screen.

Tare	Path	Condition
Flow	**MENU** › **TARE FLOW** or **MENU** › **TARES** › **TARE FLOW**	At the expected process pressure, with no flow. If the screen asks you to ensure no flow, press **TARE** to confirm.
Pressure	**MENU** › **TARES** › **TARE PRESS**	The controller open to the atmosphere, with no flow. The screen shows the present pressure offset; press **TARE** to confirm. An absolute pressure tare also needs the optional barometer.

Giving a set point

The set point is the flow (or, in pressure control, the pressure) the controller holds. From the main display, press the set point button (button 3), or go to **MENU** › **CONTROL** › **Setpt**. The set point screen shows the engineering unit and the largest set point allowed. Enter the value and press **SET**: the controller starts to control 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. 21) is set to Analogue.

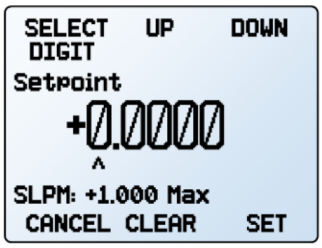


Figure 5-5. Set point selection screen (shown on a mass flow controller).

Locking the front panel

The buttons can be locked by a serial command so that nobody changes the controller's settings at the device; the display then shows LCK. 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. 36).

Device information

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

Screen › field	Content
ABOUT DEVICE	
MODEL	Model of the instrument (limited in length: the part number may be cut off)
SERIAL NO	Serial number
DATE MFG	Date of manufacture
DATE CAL	Date of the most recent calibration

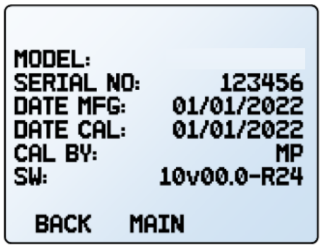


Figure 5-6. About Device screen.

Screen › field	Content
CAL BY	Initials of the person who calibrated it
SW	Firmware version
FULL SCALE RANGES	
The maximum calibrated range of each reading; on a liquid controller, volumetric flow and pressure.	
ABOUT MANUFACTURER	
Analyt-MTC's contact details: name, web address, phone number and e-mail address.	

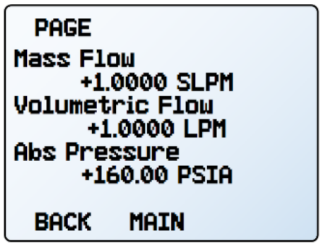


Figure 5-7. Full Scale Ranges screen (shown on a mass flow instrument, which also lists mass flow).

Process control

To regulate the flow or pressure, the controller needs a set point: the flow or pressure it tries to reach in the process. The controller leaves the factory tuned for the conditions you specified; the settings below adapt it to a different process. They are under **MENU** › **CONTROL**.

Item	Purpose
Setpt	The present set point (see Giving a set point (p. 19))
Optimize Control	Automatic tuning (see Optimizing control (autotune) (p. 24))
Check Control	Measures the control response (see Checking control (p. 24))
Setpoint Setup	Zero set point, source, timeout, power-up and limits (see Set point options (p. 20))
Control Loop	Controlled variable, algorithm, gains, flow limiter, deadband (see Control loop (p. 26))
Setpoint Ramp	Rate of change of the set point (see Set point ramping (p. 22))
Show Valve	Valve drive display (see Showing the valve drive (p. 24))
Batch 1, **Batch 2**	Batch size per totaliser (see Batch dispensing (p. 23))

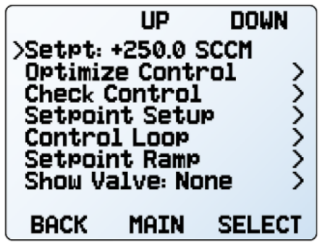


Figure 5-8. Control menu (shown on a mass flow controller).

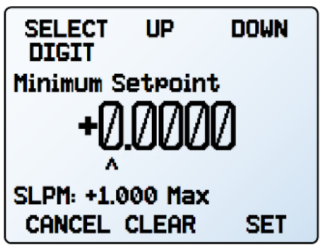


Figure 5-9. Set point screen (shown on a mass flow controller).

Set point options

The options under **MENU** › **CONTROL** › **Setpoint Setup** adapt the set point to your process.

Item	What it sets	See
Zero Setpoint	Autotare at a zero set point, and whether the flow ramps to zero	Zero set point and autotare (p. 21)
Setpoint Source	Front panel and serial, or analogue	Set point source (p. 21)
On Comm Timeout	Set point when the connection is idle	Set point when the connection is idle (p. 21)
Power Up Setpoint	Set point and ramp at power-up	Set point after power-up (p. 21)

Item	What it sets	See
`Setpoint Limits`	Upper and lower limits of the set point	Set point limits (p. 22)

Zero set point and autotare

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

- **Autotare** — when on, the controller tares itself once it has had a zero set point for the time set in **Delay Before Tare**. Make the delay long enough for the flow to stop and the process to settle.
- **Ramp** — *Honor ramp to 0* moves to zero at the set ramp rate (see Set point ramping, p. 22); *Instantly to 0* moves to zero at once.

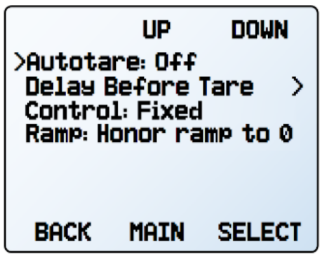


Figure 5-10. Zero set point (autotare) menu.

Set point source

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

- **Serial/Front Panel** — the controller accepts set points from the front panel and from the RS-232/RS-485 interface. Neither source is subordinate to the other: the most recent command from either applies.
- **`Analog`** — the controller follows the analogue set point input, ignores serial set point commands and blocks set point entry at the front panel.

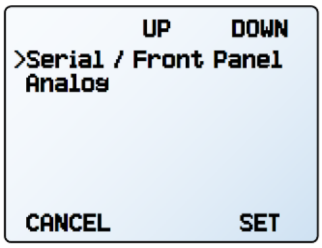


Figure 5-11. Set point source menu.

Set point when the connection is idle

When the serial or Modbus RTU connection times out, the controller can either go to a zero set point or keep the last set point. Choose under **`MENU`** › **`CONTROL`** › **`Setpoint Setup`** › **`On Comm Timeout`**. The timeout is infinite by default; set it in the serial communication menu (see Communication settings, p. 32).

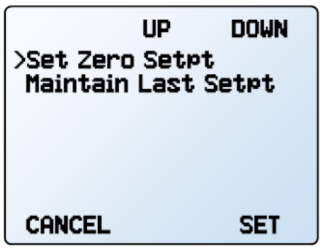


Figure 5-12. Communication timeout menu.

Set point after power-up

By default the controller remembers its last set point through a power cycle. Under **`MENU`** › **`CONTROL`** › **`Setpoint Setup`** › **`Power Up Setpoint`** › **`Value`** you can choose **`Fixed Setpoint`** instead and enter the value: the controller then goes to that set point at every power-up, whatever it was before.

Use a fixed power-up set point whenever a computer or PLC sends new set points more often than every few minutes: it avoids wearing out the non-volatile memory of the controller.

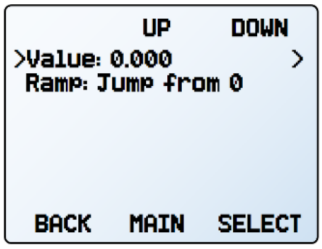


Figure 5-13. Power-up set point menu.

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 power-up set point at once. This is the same setting as **Power Up** in Set point ramping (p. 22): changing one changes the other.

Set point limits

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.

By default the limits of the set point are the measuring range of the controller. For critical processes, **MENU › CONTROL › Setpoint Setup › Setpoint Limits** sets a stricter 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.

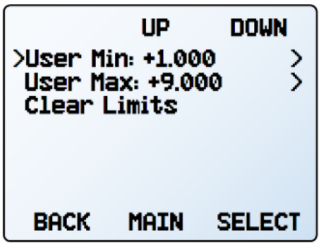


Figure 5-14. Set point limits menu.

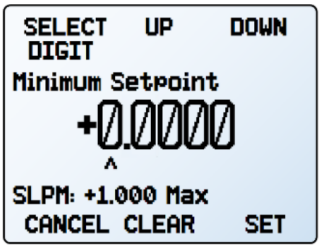


Figure 5-15. Setting a minimum set point (shown on a mass flow controller).

Note

Limits are stored as a percentage of full scale and keep that percentage when you change the controlled variable: a limit at 50 % of the flow full scale becomes a limit at 50 % of the pressure full scale.

Set point ramping

A ramp limits how fast the controller moves to a new set point. Use it to keep bursts of pressure or flow from damaging delicate equipment 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 (see Limiting the flow during pressure control, p. 27).

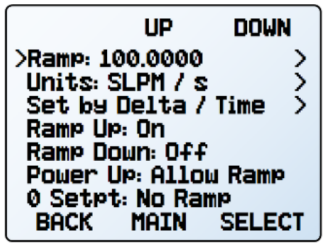


Figure 5-16. Set point ramping menu (shown on a mass flow controller).

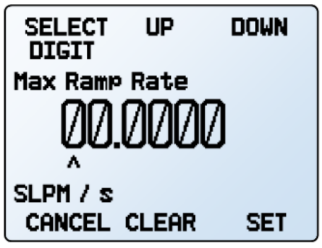


Figure 5-17. Setting a maximum ramp rate (shown on a mass flow controller).

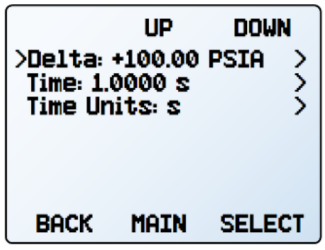


Figure 5-18. Configuring delta/time ramping (shown on a pressure controller).

1. Press **MENU** › **CONTROL** › **Setpoint Ramp**.
2. Set the rate: **Ramp** changes the maximum rate of change, **Units** shows the engineering units (the time unit can be changed), and **Set By Delta / Time** lets you enter a change and its time period separately.
3. Choose when the ramp applies:

Ramp Up	On or off. When off, the ramp rate is not used when the flow or pressure rises to a new set point.
Ramp Down	On or off. When off, the ramp rate is not used when the flow or pressure falls to a new set point.
Power Up	*No Ramp* ignores the ramp rate just after power-up; *Allow Ramp* ramps up from a zero set point. Same setting as the power-up ramp (see Set point after power-up, p. 21).
0 Setpt	With *No Ramp*, a zero set point is reached at once; otherwise the controller ramps down at the set rate.

Batch dispensing

Batch dispensing flows a set volume. Once that volume has passed through the controller, the valve closes and the flow stops; the next identical batch takes one button press. Batching needs at least one enabled totaliser (see Totaliser options, p. 29). Press **BATCH** on the totaliser screen, or go to **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 early.

While a batch runs, the quantity still to dispense is shown below the total. When the batch is complete, -DONE- appears just above the **BATCH** button and the flow stops. The set point is not cleared.

NOTICE

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

Note

The batch size is kept through a power cycle. Clear it when you no longer need it.

Starting a batch

1. Choose the quantity to dispense per batch and press **SET**.
2. Give the controller a non-zero set point (see Giving a set point, p. 19). The flow starts when you press **SET**. If a non-zero set point was already active, the flow starts as soon as you confirm the batch size in step 1.

Repeating, changing, pausing and cancelling

To…	Do this
repeat the same batch	Press **RESET**. The flow starts immediately.

To…	Do this
dispense a different volume	Press **BATCH**, enter the new size and press **SET**. With a non-zero set point the flow starts on **SET**.
change the size of a running batch	Enter the new size. If it is larger than the volume already totalized, the flow continues to the new value; if it is smaller, the flow stops at once. Press **RESET** to start the new batch.
pause a batch	Set the set point to zero: **SETPT** › **CLEAR** › **SET**. The timer keeps running. Give a non-zero set point again to resume.
remove the batch setting	Press **BATCH** › **CLEAR** › **SET** (or **REMAIN** › **CLEAR** › **SET** during a batch). The set point is unchanged, so the flow continues at the set point.

Showing the valve drive

The valve drive is the percentage of the largest possible voltage driven to the valve. It does not equal the percentage the valve is open, but a drive of 0 % means the valve is not open. Its trend helps troubleshooting: a drive that rises over time for the same flow points to a blockage that needs more voltage to overcome.

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

Checking control

MENU › **CONTROL** › **Check Control** measures the common variables of the control response. Use the results to characterise the controller, to adjust the system or the controller configuration, or to decide whether an optimization is worth running.

Enter a **GO TO** set point clearly different from the present one, and a **TIME** over which to collect data, then press **START**. The controller moves to the new set point and reports:

- **Overshoot** — how far the process overshot during the change;
- **Time constant** — the time the process takes to cover 63.2 % of the set point change once it starts to change;
- **Dead time** — the delay between the set point change and the start of the process change;
- **Bandwidth** — the estimated frequency of the fastest sine-wave set point the controller can reasonably follow; it rejects most slower sinusoidal disturbances.

The **WARN** button becomes active to explain when the results may not be useful.

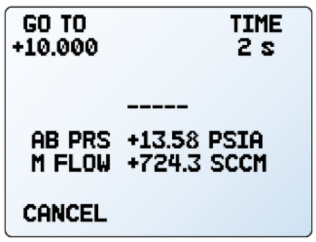


Figure 5-19. Check control in progress (shown on a mass flow controller).

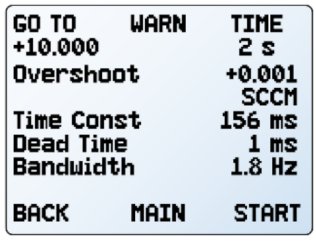


Figure 5-20. Check control results (shown on a mass flow controller).

Optimizing control (autotune)

The controller is set up at the factory to perform well over a range of expected conditions. **MENU** › **CONTROL** › **Optimize Control** adjusts the control gains automatically to the present process and conditions; it is much faster than tuning by hand and needs no detailed knowledge of control. Optimize:

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

NOTICE

During optimization 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`** (see below) to protect it.

Press **START**. The controller moves to a series of set points, determines the system properties at each change and optimizes its control parameters, reporting the pressure and the flow as it goes. When it is done, the response is set to the optimal settings and the controller reports the overshoot, dead time, time constant and bandwidth of a typical response. For most instruments this takes 30 to 90 seconds; ultra-low-flow instruments can take longer.

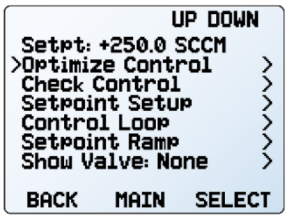


Figure 5-21. Optimize Control (shown on a mass flow controller).



Figure 5-22. Press **START** to optimize control.

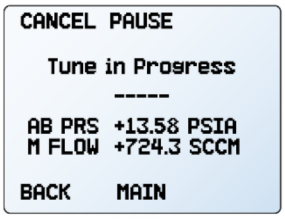


Figure 5-23. Optimization in progress (shown on a mass flow controller).

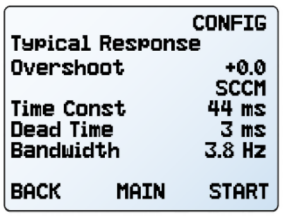


Figure 5-24. Optimization results (shown on a mass flow controller).

Optimization recommendations

- Use process conditions that give the largest pressure difference across the valve. The controller performs best when operated at a pressure difference or common-mode pressure equal to or lower than the one used for the optimization.
- Optimization is more sensitive to fluctuations in the environment than normal control. Most fluctuations make the gains smaller than they could be; large ones can prevent the optimization. Ultra-low-flow and other slowly responding instruments are the most sensitive.
- Set point ramps are mostly honoured during optimization: configure the fastest ramp you will use.
- A valve that has not been opened for some time can act differently. Operate the valve before you optimize.

Advanced configuration

For most situations the factory defaults give the best result. **`MENU`** › **`CONTROL`** › **`Optimize Control`** › **`Config`** adapts the function to unusual process requirements or specific control goals:

Speed	**FAST** — the default; balances speed and versatility for most situations.
	FASTEST — the shortest control response time; a small overshoot is allowed.
	VERSATILE — a wider range of conditions, with a slower response; the system may not follow quickly changing conditions.
	MOST VERSATILE — an even wider range of conditions, with a slower response.
	GOAL — aims at a given response time, to reach a particular response or tune several controllers alike. An impossible goal (for example 0) gives the nearest possible time constant, as FASTEST.

Max Flow	Limits the flow during optimization to protect delicate processes. In unusual circumstances the limit can still be exceeded; the controller keeps that time as short as it can.
Loop Type	**AUTOMATIC** (default and recommended) uses the best control loop for the process; PD²I or PDF can be specified instead (see Control loop, p. 26).

Control loop

The control loop decides which variable is controlled and how the controller reacts to changes in the system. The Optimize Control function tunes it (see Optimizing control (autotune), p. 24) automatically for the present conditions; tune it by hand when a particular response profile is needed or several controllers must respond the same way.

Controlled variable

NOTICE

After a change of the controlled variable, the gains of the control loop may no longer give stable, fast control. Check the stability and speed of the control loop. Retune it if needed (see Tuning the control loop, p. 26).

The controller regulates one variable at a time to the set point, and keeps measuring the others. A liquid controller can control the volumetric flow, the gauge pressure or the valve drive. Select it under **`MENU`** › **`CONTROL`** › **`Control Loop`** › **`Control`**.

In pressure control, 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.

Tuning the control loop

The controller drives its valve through a closed control loop. Its gains are tuned at the factory for your operating conditions; on site they sometimes need adjusting to correct the stability, an oscillation or the speed of response. Two algorithms are available under **`MENU`** › **`CONTROL`** › **`Control Loop`** › **`Loop Type`**:

- **PD/PDF** — the default, recommended for most applications.
- **PD²I** — usually a faster response in dual-valve controllers; recommended when a dual-valve controller controls pressure.

Optimize the control first (see Optimizing control (autotune), p. 24), then tune by hand if needed.

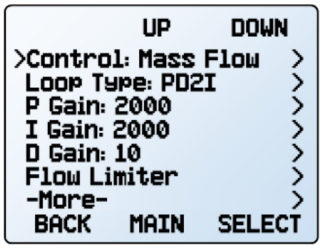


Figure 5-25. Control loop menu in PD²I mode (shown on a mass flow controller).

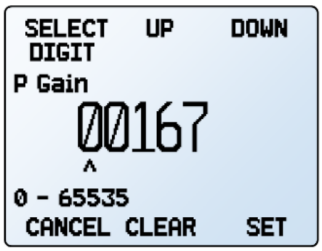


Figure 5-26. Setting the P gain.

What each gain does

Algorithm	Gain	Effect of a larger value
PD/PDF	**D**	Faster correction of the error between set point and measured value. Acts like the P term of a common 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 common PDF controller.

Algorithm	Gain	Effect of a larger value
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 prediction of the corrections needed from the present rate of change. It often slows the system down, which reduces overshoot and oscillation.

Note
In PD/PDF the gain names differ from common PDF controllers: **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 pressure difference across the controller first (see Troubleshooting, p. 41).

Limiting the flow during pressure control

A flow limit during pressure control keeps the flow within the measurable range of the controller and protects sensitive equipment further down the process. The settings are under **`MENU`** › **`CONTROL`** › **`Control Loop`** › **`Flow Limiter`**.

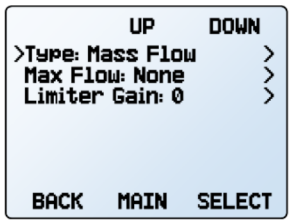


Figure 5-27. Flow limiter menu (shown on a mass flow controller).

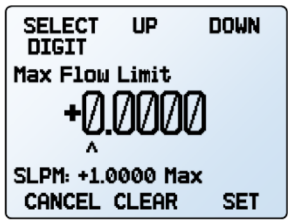


Figure 5-28. Setting a maximum flow limit (shown on a mass flow controller).

Item	Setting
`Type`	The flow to limit; on a liquid controller, the volumetric flow.
`Max Flow`	The highest flow allowed, in the displayed engineering units.
`Limiter Gain`	How aggressively the controller corrects a flow above the limit. Start with 500 and adjust: a higher value corrects more aggressively but is more likely to oscillate near the limit.

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.

Control deadband

A deadband is a window around the set point inside which the controller does not control. It improves the stability of pressure control. A deadband cannot be set while the controller controls flow; the menu then shows the error **`Only active when controlling pressure`**. The controller must first reach the set point for the deadband to engage; 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.

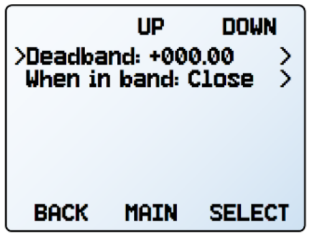


Figure 5-29. Deadband menu.

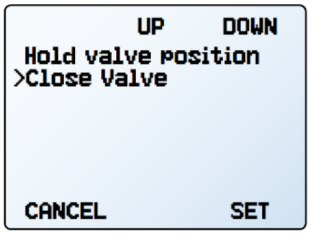


Figure 5-30. Choosing the deadband options.

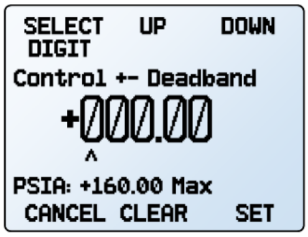


Figure 5-31. Choosing the deadband size (shown on a pressure controller).

1. Press **MENU** › **CONTROL** › **Control Loop** › **Control Deadband** › **Deadband** and enter a non-zero value.
2. Under **When in Band**, choose whether the valve holds its present position or closes inside the band. Hold the position on a single-valve controller such as the LC; closing is for dual-valve controllers.

Instrument set-up

The set-up menus decide how the controller calculates and reports its readings, what its analogue outputs track and how its display behaves. They are under **MENU** › **SETUP**; the serial communication settings are in Communication settings (p. 32), the advanced settings in Advanced settings (p. 39).

Sensor set-up

Item of **MENU** › **SETUP** › **Sensor**	See
Engineering Units	Engineering units (p. 28)
Totalizer	Totaliser options (p. 29)
Flow Averaging, **Pressure Averaging**	Smoothing readings (p. 28)
Zero Band	Zero band (p. 29)

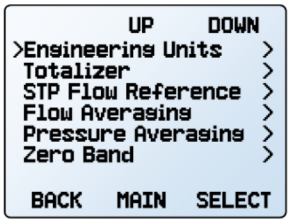


Figure 5-32. Sensor set-up menu (shown on a mass flow controller; **STP Flow Reference** applies to mass flow instruments only).

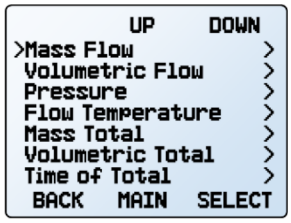


Figure 5-33. Engineering units menu (shown on a mass flow controller).

Engineering units

Go to **MENU** › **SETUP** › **Sensor** › **Engineering Units**, choose the reading whose unit you want to change, 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. 49).

Smoothing readings

The controller is fast enough to show variations that slower instruments miss. A running average over a longer time smooths fluctuating readings, separately for flow and pressure. Go to **MENU** › **SETUP** › **Sensor**, select **Flow Averaging** or **Pressure Averaging**, enter the time constant of the average in milliseconds and press **SET**. Higher values smooth more, up to 255 ms.

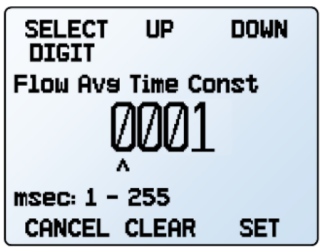


Figure 5-34. Adjusting the flow averaging time constant.

Zero band

The zero band is the threshold of flow or pressure below which readings are displayed and reported as 0. It is set in percent of full scale, up to 6.38 %, under **MENU** › **SETUP** › **Sensor** › **Zero Band**. On a controller with the optional barometer it also applies to the gauge pressure reading.

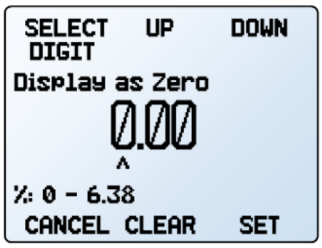


Figure 5-35. Configuring the zero band.

Totaliser options

The totalisers count the total flow over time; their values are shown on the totaliser screens (see Totaliser screens (option), p. 18). Each totaliser is set up under **MENU** › **SETUP** › **Sensor** › **Totalizer** › **Totalizer 1** or **Totalizer 2**.

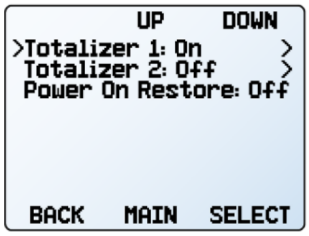


Figure 5-36. Totaliser on/off screen.

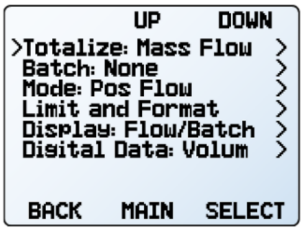


Figure 5-37. Totalize type options (shown on a mass flow controller).

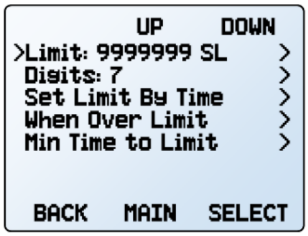


Figure 5-38. Totaliser limit and format screen (shown on a mass flow controller).

Item	Setting
Totalize	What the totaliser counts: *Volumetric Flow* on a liquid controller (*Mass Flow* on mass flow instruments). *None* switches the totaliser off.
Power Up Restore	On: the totals are kept through a power cycle and the count continues when power returns. Off: the totals reset to 0 when the controller is switched off.
Batch	The batch size; batching works only with an enabled totaliser and together with the set point (see Batch dispensing, p. 23).
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* holds the total while the flow is stopped and resets it to zero when the flow starts again. Bidirectional dual-valve controllers also offer *Negative Flow Only* and *Bidirectional*.
Limit and Format	The number of digits, the position of the decimal point and the behaviour at the limit (see below).
Display	The layout of the totaliser screen: *Flow and Batch* (default: flow, set point and batch), *Detailed Flow* (flow rates, total and average flow, no batch) or *Multi-variable* (like the main display).
Digital Data	*None* leaves the total out of the serial data frame; *Volume* includes the present total.

Totaliser limit and format

The totaliser reports up to 10 digits. Seven digits are often used in systems that store numbers as 32-bit floating-point values; more digits need 64-bit values or special handling. With fewer than 10 digits, resolution trades against capacity: more digits after the decimal point give a finer total but a lower maximum, which is reached sooner.

The maximum can be set directly, when you know a volume the total will never exceed, or from a time interval, so that the total is tracked without reaching the limit. In general the totaliser can be set so that the limit is not reached for anything from at least 10 minutes of full-scale flow (finest resolution) to at least 100 years; unusual combinations of total unit and flow range can narrow that range. **Min**

Time to Limit shows how long the totaliser can run at full flow before it reaches the limit; more digits and a decimal point further right lengthen that time. The elapsed-time counter depends on the format; many formats will not reach its maximum for over 100 years.

When Over Limit	What the totaliser does at its maximum
Set to Zero	Resets to zero and continues counting. No status message.
Zero and Set OVR	Resets to zero and continues; the status message OVR shows that the maximum was reached.
Hold and Set OVR	Stops counting until it is reset; shows OVR.
Hold	Stops counting until it is reset. No status message.

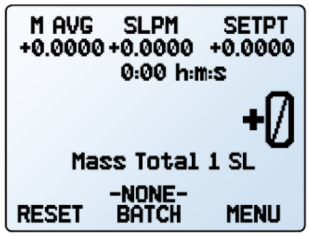


Figure 5-39. Totaliser Flow and Batch view (shown on a mass flow controller).

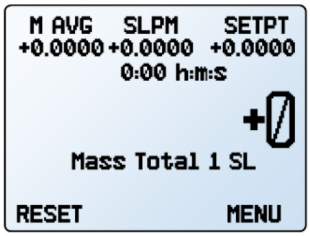


Figure 5-40. Totaliser Detailed Flow view (shown on a mass flow controller).

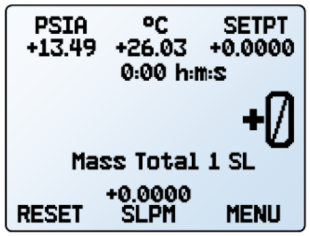


Figure 5-41. Totaliser Multi-variable view (shown on a mass flow controller).

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 the totaliser missed flow data. Reset the totaliser to clear the message. An upper flow limit inside the measurable range prevents the error (see Limiting the flow during pressure control, p. 27), 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 batch can exceed its size before the valve reacts. The batch then overshoots its volume. Keep the supply pressure high enough to reach the set point while a batch runs.

Analogue outputs

MENU › **SETUP** › **Signals** sets the value each analogue output tracks. Select the primary output (**Out 1**) or the secondary output (**Out 2**), then the value:

Min Value	Holds the output at its lowest value, for example a constant 4 mA on a 4–20 mA output.
Max Value	Holds the output at its highest value.
a reading	The output tracks that reading; the choice depends on the instrument.

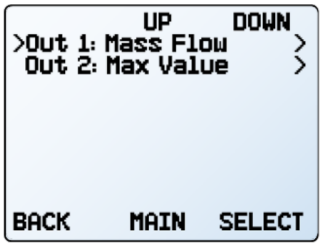


Figure 5-42. Signals set-up menu (shown on a mass flow controller).

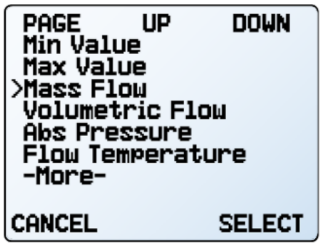


Figure 5-43. Signals parameter values (shown on a mass flow controller).

Display settings

The display settings adjust the contrast or brightness, the data screens and the screen rotation. They are under **MENU** › **SETUP** › **Display**:

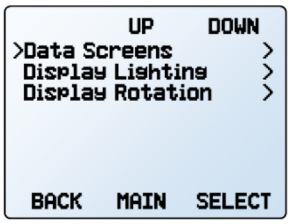


Figure 5-44. Display set-up menu.

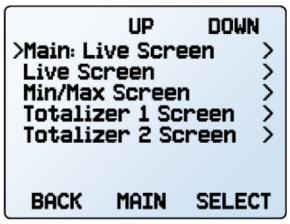


Figure 5-45. Data screens menu.

Setting	Effect
Data Screens › **Main**	The screen shown when **MAIN** is pressed; only enabled screens 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 a change of that reading's unit as well as highlighting.
Data Screens › **Live Screen** › **Show Valve Drive**	Shows or hides the valve drive in percent (see Showing the valve drive, p. 24).
Data Screens › **Live Screen** › **Top Left Key Value**	Which pressure (barometric, gauge or absolute) the top left reading shows, on a controller with the optional barometer.
Data Screens › **Min/Max Screen**	*Show* or *Hide* the min/max screen.
Data Screens › **Totalizer 1 Screen**, **Totalizer 2 Screen**	The layout of the totaliser screen, as under **Display** in the totaliser options; 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 installed upside down.

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 liquid controller. The full command reference, with parameters and responses, is the *358 Series serial interface (RS-232/RS-485) — Communication guide* (AMTC-CG-0002).

Ways to control the controller digitally

The controller can be read, configured and given set points from a computer or PLC over its serial interface, with ASCII serial commands (see Connecting to a computer (p. 33) and the *358 Series serial interface (RS-232/RS-485) — Communication guide*, AMTC-CG-0002), or with the Modbus RTU protocol (see Modbus RTU (p. 37)). The controller can also have a Bluetooth option (ask Analyt-MTC); its part number then carries `-BT`.

Communication settings

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

Setting	Purpose
`Unit ID`	A letter from A to Z that distinguishes the controller from similar instruments; up to 26 devices can share one COM port, each with its own letter (polling mode). The change applies when you press **`SET`**. Choosing `@` puts the controller into streaming mode. Default: A.
`Stream`	The interval between the start of two data frames in streaming mode, in milliseconds: from 0 up to 999 999 999. If the interval is shorter than the time needed to send a frame, 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 to 247.
`Baud Rate`	Must match the computer or PLC. Default: 19 200 baud (bits per second). The new rate applies as soon as you press **`SET`**; your software may need a restart to pick it up.
`Idle`	How long the serial or Modbus RTU connection may stay silent before the controller applies its timeout behaviour (see Set point when the connection is idle, p. 21) and shows `COM`. Infinite by default; adjustable up to 99 999.9 s (1 d 3 h 46 min 39.9 s).

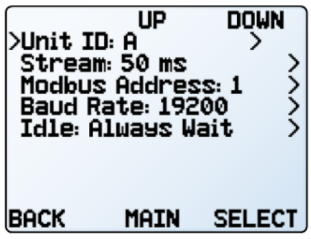


Figure 6-1. Serial communication menu.

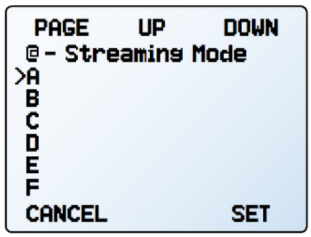


Figure 6-2. Choosing a unit ID, or streaming.

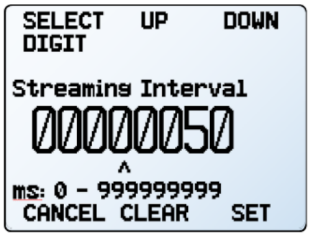


Figure 6-3. Streaming interval.

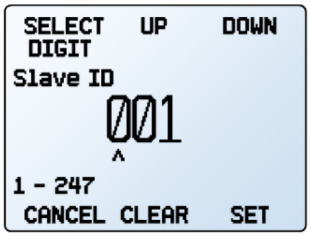


Figure 6-4. Modbus address menu.

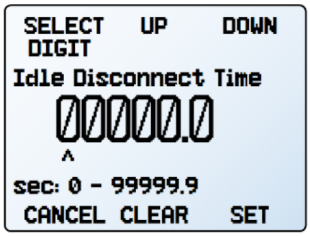


Figure 6-5. Communication idle time.

Connecting to a computer

Connect the controller with a communication cable to a serial (COM) port, or through a USB cable that the computer recognises as a virtual COM port. The port number is shown in the Windows Device Manager; if the computer does not recognise the USB cable as a COM port, contact Analyt-MTC for the driver. Any serial terminal program that sends plain text in a command line can send commands; open the port with these settings:

Baud rate	19 200 (default; any rate works if the controller, the computer and the software 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.

Unit ID

Each instrument on a COM port needs its own single-letter ID, A to Z; the default is A. If two instruments on one port share an ID, their data and commands are corrupted and do not report or execute properly. When you connect several instruments to the same port, connect them one at a time and give each its unit ID before you connect the next. To change the ID, send `unit_id@ desired_id`, for example `A@ B`; the same setting is in the communication menu (see Communication settings, p. 32).

Taring over the interface

Tare the controller in the situations listed in Taring (p. 18). With autotare enabled, a zero set point does it: the controller tares itself after a short delay that depends on the flow range, for most ranges 2 s or less. The sensor zero can shift with temperature and pressure, which usually shows as a reading other than zero at a zero set point. Manual tares:

Tare	Command	Condition
Flow	**AV**	No flow through the controller. Sets the flow reading to zero.
Gauge pressure	**AP**	Controller open to the atmosphere.
Absolute pressure (barometer option)	**APC**	Controller open to the atmosphere. Aligns the internal absolute pressure sensor with the barometer reading.

Collecting data

Tare the controller before you collect data. Live data come in one of two modes:

- **Polling mode** — the default, with unit ID A unless ordered otherwise. The controller answers only when asked: send its unit ID alone, for example `A`, to get one line of live data.
- **Streaming mode** — the controller sends a line of live data at regular intervals. Start it with `A@ @`, which is the same as changing the unit ID to `@`; stop it with `@@ A`, which also assigns unit ID A. Only one instrument per COM port may stream. The default interval is 50 ms; change it with `unit_id`**`NCS`** `number_of_ms`, for example `ANCS 500` for a new line every 500 ms.

A streaming controller still accepts commands, but the data keep flowing while you type and can make your command unreadable. An invalid command is ignored. If in doubt, press **Backspace** a few times, then **Enter**, and start again.

The data frame

Each line of live data lists the readings in a fixed order, separated by single spaces, in the engineering units currently selected (see Engineering units, p. 28). A frame from a liquid controller polled as unit A looks like this:

A	14.70	+24.57	+02.004	+02.004
unit ID	gauge pressure	temperature	volumetric flow	set point

The unit ID appears only in polling mode. Further columns, such as the total if you chose to include it (see Totaliser options, p. 29), the valve drive (see Showing the valve drive, p. 24) and status codes (see Status messages, p. 11), can follow on the right. The command `A??D*` returns the description of the data frame with its engineering units.

Sending a set point

Before you send set points over the interface, check that the set point source (p. 21) is **Serial/Front Panel**. Send `unit_id`**`S`**`set_point`; the controller reads the value in its current engineering units. `AS 15.44` sets a set point of 15.44 in the current engineering unit. When the set point is accepted, the data frame returns it; a set point outside the set point limits (p. 22) is rejected. If your software writes set points more often than every few minutes, set a fixed power-up set point (see Set point after power-up, p. 21) to spare the controller's memory.

Checking control over the interface

The controller moves from its present set point to the one given, collects process data for the given time, then calculates and returns statistics of the control response (see Checking control, p. 24).

Send `unit_id` **`LCRC`** `goto_set_point collection_time`, for example `A LCRC 10.00 2` to move to a set point of 10 and record for 2 s.

- `goto_set_point` is the set point to move to; it must differ from the present one. With an analogue set point source, it overrides the analogue set point for the duration of the data collection; the normal set point returns as soon as the collection is complete.
- `collection_time` is how long to collect data after the set point change, 2 s by default. Controllers with a small full scale may need 10 to 20 s. In pressure control the time depends on how long the system takes to fill or bleed for the change: allow about three times that time. A `goto_set_point` closer to the normal set point shortens it.

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

`termination`	0 for normal operation; 1 if the operation was aborted manually; 2 if it was aborted because of oscillation.
`notes`	Observations on the reliability of the results, as the sum of the values in the table below.
`overshoot`	The largest overshoot during the trial, a floating-point number in the units of the set point.
`delaymsec`	The system delay during the trial, in milliseconds; suitable for a first-order-plus-dead-time (FOPDT) model of the controller.
`timeconstantmsec`	The closed-loop time constant (T63) during the trial, in milliseconds; suitable for an FOPDT model.
`risetimemsec`	The time the closed-loop response took to go from 10 % to 90 % of the step, in milliseconds.
`bandwidthhz`	The estimated frequency, in hertz, of the fastest sine-wave set point the controller can reasonably follow. It can be expected to reject most sinusoidal disturbances of lower frequency.

Table 6-1 Notes returned by check control

Value	Note
0	The process data showed typical patterns.
+1	The data collection time was too short to ensure reliable results.
+2	The process variable oscillated significantly. Control was not stable, and the calculated results are not reliable.
+4	The process variable moved little compared with the noise in the system, so the results may not be reliable. This happens most often when the set point change is too small, or when the process variable oscillated in a way the oscillation detection did not catch.
+8	A closed valve was opened during the data collection. The results are correct, but the performance differs significantly from that of a valve already open at the start.
+16	The valve was opened as far as it could go during the data collection. The results are correct, but the performance is probably limited by the size of the valve, not by the configuration of the control loop.

Optimizing control over the interface

The optimization adjusts the control gains to the present process and conditions; when to use it is described in Optimizing control (autotune) (p. 24). The controller opens its valve to varying degrees to estimate the behaviour of the system and determine matching gains. This typically takes 10 to 90 s; some ultra-low-flow instruments take up to 15 minutes. When it is complete, the controller uses the optimal settings and reports various process parameters.

NOTICE

During optimization 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 a maximum flow first with `unit_id` **LCTCF** `max_flow` (see below) to protect it.

Send `unit_id` **LCTCS** `speed_mode goal_time algorithm`, for example `A LCTCS 3` to optimize with the FAST speed mode.

Table 6-2 Speed modes of the optimization

Value	Mode	Effect
0	Goal	Uses `goal_time` as the target speed, to aim at a particular response time or to match the response of several instruments.
1	Most versatile	The widest range of conditions, with the slowest response; the system may not follow 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 response time of the control loop; a small overshoot is allowed.

`goal_time`	The time constant wanted in Goal mode, a non-negative integer in milliseconds. A time shorter than the system can reach gives the gains with the shortest time constant, so 0 gives the fastest possible response, as speed mode 4.
`algorithm`	The control algorithm to apply. Usually 0, which lets the optimization choose the most suitable one; 1 for PDF, 2 for PD²I.

Set the maximum flow with `unit_id` **`LCTCF`** `max_flow`, a floating-point number in the units of the present set point. It must be at least 20 % of the full-scale flow; `A LCTCF 0` allows the full range. The limit can still be exceeded during the optimization, but the controller keeps that time as short as it can. Follow the recommendations in Optimization recommendations (p. 25).

Commands most used with a controller

The examples address unit A and end with **`Enter`** (**`<CR>`**). Replace `value` with your own values. They are a small selection of the many commands available; the full list is in the communication guide AMTC-CG-0002.

Task	Command	Remarks
ALL INSTRUMENTS		
Change unit ID	**`A@`** `B`	From A to B.
Tare flow	**`AV`**	No flow through the controller.
Tare gauge pressure	**`AP`**	Open to the atmosphere.
Tare absolute pressure	**`APC`**	Barometer option; open to the atmosphere.
Poll live data	**`A`**	Returns one data frame.
Start / stop streaming	**`A@@`** / **`@@`**`A`	Stopping assigns the unit ID given.
Streaming interval	**`ANCS`** `ms`	Default 50 ms.
Describe the data frame	**`A??D*`**	
Device information	**`A??M*`**	Model, serial number, dates, firmware.
Firmware version	**`AVE`**	
Lock / unlock front panel	**`AL`** / **`AU`**	Display shows `LCK` while locked.
CONTROLLERS		
New set point	**`AS`** `value`	In the current engineering units.
Hold valve at present position	**`AHP`**	Display shows `HLD`; set points have no effect until the hold is cancelled.
Hold valve closed	**`AHC`**	As above, with the valve closed.
Cancel valve hold	**`AC`**	Closed-loop control resumes.
Run check control	**`A LCRC`** `goto_set_point collection_time`	See Checking control over the interface (p. 34).

Task	Command	Remarks
Optimize control	**A LCTCS** `speed_mode goal_time algorithm`	See Optimizing control over the interface (p. 35).

Modbus RTU

Modbus is an application-layer messaging protocol that formats data for communication over RS-232 or RS-485. The controller supports Modbus RTU, with the data carried on pin 3 of the DB9 connector. Over Modbus RTU you can control the tare, data collection, set point, totaliser, batch dispensing, optimization (autotune) and the adjustment of the control loop. Set the Modbus address in the communication menu (see Communication settings, p. 32).

Note
The *358 Series Modbus RTU and Modbus TCP/IP — Communication guide* (AMTC-CG-0001) covers mass flow and pressure devices, not liquid flow controllers. If you want to run the controller over Modbus RTU, ask Analyt-MTC for the register information.

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 screen, line DATE CAL (see Device information, p. 19). When the calibration is due, contact Analyt-MTC with the serial number of the controller; see Service, warranty and contacts (p. 47) for the procedure.

Between calibrations you can check the zero of the controller by taring it (see Taring, p. 18) and, after a drop, compare it with a flow reference you trust (see Troubleshooting, p. 41).

CHAPTER 8

Maintenance

A controller that sees only clean liquid needs no routine maintenance apart from its yearly calibration. What shortens its life is contamination and deposits. This chapter explains how to prevent both and which settings to leave to the Analyt-MTC engineers; how to trace the most common problems is described in Troubleshooting (p. 41).

⚠ WARNING

A controller disconnected from a system that is still under pressure releases the process medium, and any hazardous medium 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 from the system.

Care and cleaning

To keep the controller accurate:

- Run only the liquid it is calibrated for (see The process liquid, p. 18).
- Keep filters in place to remove particles and biological material that could grow inside the controller.
- Before taking the controller out of the line for a longer period, drain all the liquid from it, so that no deposits of calcium or other dissolved minerals can affect it.
- If necessary, clean the outside with a soft, dry cloth.

NOTICE

Taking the flow body apart to clean it can damage the controller. 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. 47).

Repair

If the controller has malfunctioned or no longer works as intended, contact Analyt-MTC (see Service, p. 47). The controller may only be serviced by certified personnel.

NOTICE

Taking the controller apart can cause further failure and may void the warranty. Do not dismantle or repair the controller yourself. Contact Analyt-MTC for any repair.

Advanced settings

MENU › **SETUP** › **Advanced** holds settings and information for troubleshooting together with the Analyt-MTC application engineers:

NOTICE

A factory restore removes any third-party calibration. The controller then reads with its factory calibration only. Restore the factory settings only after talking to an application engineer.

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.

`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 necessary.
`Register Status`	Live values of the internal registers. Many of them help an application engineer diagnose operating problems; some tell a hardware fault from an operating problem at once, which speeds up troubleshooting.
`Edit Register`, **`Device Properties`**	Let technical support fine-tune the functions of the controller. Leave them alone unless you are working with Analyt-MTC to diagnose or correct a problem.

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 in Service, warranty and contacts (p. 47).

General use

Symptom	What to do
The buttons do not respond and the display shows LCK	The front panel was locked by a serial command. Press and hold the four outer buttons to unlock it (see Locking the front panel, p. 19).
A three-letter message appears next to the reading	Look up the message in the table of status messages (see Status messages, p. 11).
The display is hard to read	During the day, increase the contrast or brightness (see Display settings, p. 31). On a monochrome display in low light, press the button below the display to switch on the backlight.
The analogue output reads lower than the display	The voltage of an analogue signal drops over long distances. Use wires of a heavier gauge, especially for the ground wire.
How often does the controller need calibrating?	Once a year. The last calibration date is under **MENU** › **ABOUT** › **About Device**. When the calibration is due, contact Analyt-MTC (see Calibration and verification, p. 38).
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. 18) and compare it with a flow reference you trust. If it checks out, keep using it, and mention the fall at its next yearly 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. 28).
The controller does not reach its set point	The supply pressure is often too low: raising the inlet pressure usually fixes it, within the pressure limits (p. 13). If that does not help, look for a blockage. Loose PTFE tape often gets stuck in the flow channel; remove it, and never tape the first two threads that enter the controller.

Flow readings

Symptom	What to do
The live readings do not settle	The controller is very fast and detects subtle variations of flow that slower instruments miss; this can help find problems with pumps or other flow controllers. Use the optimization to improve the performance (see Optimizing control (autotune), p. 24), and check the control response (see Checking control, p. 24).
The flow reading is negative at zero flow	The tare is poor. Make sure autotare is on and give the controller a zero set point for at least 2 s (see Zero set point and autotare, p. 21).
The reading does not change when the flow changes	The flow sensor may be damaged. Contact Analyt-MTC to troubleshoot.
You want to use a different liquid	The controller is designed to work with only one liquid, typically water. Another liquid needs a recalibration: contact Analyt-MTC (see The process liquid, p. 18).

Pressure readings

Symptom	What to do
The pressure reading is negative	If a negative reading is not expected, tare the pressure with the controller open to the ambient atmosphere (see Taring, p. 18).
The pressure reading jumps to zero at low pressure	The programmable zero band, preset at the factory, sets low readings to zero. Reduce it under **`MENU`** › **`SETUP`** › **`Sensor`** › **`Zero Band`** (see Zero band, p. 29).

Serial communication

Symptom	What to do
The computer gets no answer from the controller	1. 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`**). 2. Check the unit ID under the same menu, to be sure your commands address the controller. 3. Check that the COM port number matches the one your software uses. 4. On the computer or PLC, set flow control (handshaking) as described in Connecting to a computer (p. 33). 5. Check the pinout of your connector to confirm the connection is on the right pin (see 8-pin Mini-DIN connector, p. 13; Appendix B, p. 50).

CHAPTER 10

Specifications

The data below apply to standard 358 Series LC controllers with water. Options and special versions can differ; the calibration sheet of your controller gives its own values.

Measurement and control performance

Table 10-1 Performance

Volumetric flow accuracy[1]	±2.0 % of full scale
Repeatability	±0.2 % of full scale
Steady-state control range[2]	0.01–100 % of full scale
Valve	Normally closed
Temperature sensitivity	Zero shift 0.02 % of full scale per °C from the tare temperature; span shift 0.02 % of full scale per °C from the calibration temperature
Pressure measurement	Gauge pressure, full scale 6.9 bar g (100 psig), for other sensor ranges, ask Analyt-MTC; accuracy ±0.5 % of full scale
Temperature accuracy	±0.75 °C
Totaliser	±0.5 % of reading additional uncertainty
Sensor response time	< 1 ms
Indication response[3]	< 10 ms, depending on the flow rate
Control response (T63)	As fast as 30 ms, depending on the flow rate; user adjustable
Warm-up time	< 1 s
Measurement rate / display update	1000 per second / 10 per second

[1] At calibration conditions, with water. [2] The control actually achieved also depends on the control loop tuning and the process conditions; the dynamic performance is also limited by the control response time, which can vary with the flow rate. [3] Includes the adjustable averaging of 1–255 ms.

Flow ranges and process data

To reach full-scale flow, the pressure difference across the controller must be larger than its pressure drop at full scale.

Table 10-2 Ranges, pressure drop, process connections and mounting taps

Full-scale flow	Model	Pressure drop at full scale[4]	Process connection[5]	Mounting taps, depth
0.5–1 mL/min	LC, LCS	0.34 bar (5.0 psid)	M5×0.8 mm female[6]	2× 8-32 UNC, 4.45 mm
2 mL/min	LC, LCS	0.17 bar (2.5 psid)	1/8" NPT female	2× 8-32 UNC, 6.35 mm
5–100 mL/min	LC, LCS	0.34 bar (5.0 psid)	1/8" NPT female	2× 8-32 UNC, 6.35 mm
200–500 mL/min	LC, LCS	0.52 bar (7.5 psid)	1/8" NPT female	2× 8-32 UNC, 6.35 mm
1–2 L/min	LCR, LCRS	0.28 bar (4.0 psid)	1/4" NPT female	4× 8-32 UNC, 8.33 mm
5 L/min	LCR, LCRS	0.69 bar (10.0 psid)	1/4" NPT female	4× 8-32 UNC, 8.33 mm
10 L/min	LCR, LCRS	1.72 bar (25.0 psid)	1/4" NPT female	4× 8-32 UNC, 8.33 mm

[4] Standard valve, water at 25 °C, outlet venting to atmosphere. [5] For other process connections, such as compression, face seal, push-to-connect, BSPP or SAE fittings, ask Analyt-MTC. [6] 10-32 UNF compatible; shipped with two 316L stainless-steel M5 male O-ring face-seal

fittings to 1/8" female NPT.

Operating limits and media

Operating temperature	−10 to +60 °C ambient; the medium must remain liquid at all times
Pressure sensor full scale	6.9 bar g (100 psig)
Damage limits	Above 13.8 bar g (200 psig) common mode; above 5.17 bar (75 psi) differential
Minimum pressure difference	Greater than the pressure drop of the range (Table 10-2)
Ingress protection	IP40
Mounting orientation	Any; tare after a change. Controllers with Rolamite valves with the valve vertical
Standard media	Ultrapure (UPW), highly purified (HPW), high-purity, reverse-osmosis (RO) and deionised (DI) water
Other media	Liquids compatible with the wetted materials, dynamic viscosity about 0.1–3.0 cP (for example ethanol, methanol, acetone), with a custom calibration

Wetted materials

Model	Materials
LC	Stainless steel 316L, 303 and 430FR; FKM seals (EPDM or FFKM as options)
LCS	Stainless steel 316L, 303 and 430FR; FFKM seals (EPDM as option)
LCR	Stainless steel 316L, 303, 410 and 430FR; FKM seals (EPDM or FFKM as options)
LCRS	Stainless steel 316L, 303, 410 and 430FR; FFKM seals (EPDM as option)

Electrical data

POWER SUPPLY	
LC, LCS	12–30 V DC, 250 mA
LCR, LCRS	24 V DC, 600 mA
With 4–20 mA output	add 40 mA; supply at least 12 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 with Modbus RTU, Modbus TCP/IP, DeviceNet, EtherCAT, EtherNet/IP and Profibus as options
Data update rate	Digital 40 Hz at 19 200 baud; analogue 1 kHz; display 10 Hz
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 B, p. 50)

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

Dimensions and weight

The letters refer to Figure 2-1 (see The controller at a glance, p. 9). LCR controllers use the same letters. All mounting threads are 8-32 UNC; their depth is in Table 10-2.

Table 10-3 Dimensions in mm and weight

Full-scale flow	Model	H	W	D	A	B	C	E	F	G	Weight
0.5–1 mL/min	LC, LCS	114.00	84.79	26.67	8.53	13.34	3.18	23.50	28.27	80.98	≈ 0.5 kg
2–500 mL/min	LC, LCS	118.31	91.14	26.67	8.89	13.34	3.18	23.50	34.62	87.33	≈ 0.5 kg
1–10 L/min	LCR, LCRS	149.30	194.31	57.15	28.45	28.58	9.53	47.63	14.61	78.11	≈ 4.1 kg

CHAPTER 11

Ordering information

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

Controllers

The LC is the standard controller and the LCS its anti-corrosive version; both have the small valve. The LCR versions, 1 to 10 L/min, have the large valve. For another liquid, an anti-corrosive large-valve controller or other options such as the display type, totaliser, output signals, connector or seal material, give Analyt-MTC your liquid, flow range and line pressures, and the options you need.

Table 11-1 Small-valve controllers, standard versions for water

Full scale	LC, order code	LCS, order code
0.5 mL/min	—	35908
1 mL/min	—	35909
2 mL/min	—	35907
10 mL/min	35918	35918S
20 mL/min	35919	35919S
100 mL/min	35875	35875S
200 mL/min	35876	35876S
500 mL/min	35877	35877S

Table 11-2 Large-valve controllers, standard versions for water

Full scale	LCR, order code
1 L/min	35920
2 L/min	35921
5 L/min	35960
10 L/min	35879

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. 19, or the label on the device);
- the firmware version (SW line on the same screen);
- your liquid, set point and inlet and outlet pressures, or the serial command and response.

Technical support

The Analyt-MTC application engineers help with installation, bleeding, configuration, control tuning and serial communication. Have the model, serial number and firmware version at hand (About Device screen, p. 19), together with a description of your process: liquid, 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, cleaning or calibration for another liquid. 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. **Drain and 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. Drain all liquid from the controller. 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.

The warranty does not cover damage from connecting a 4–20 mA output to a loop-powered system (see Analogue signals, p. 14).

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

Units you can select under Engineering units (p. 28); their serial numbers are in the communication guide AMTC-CG-0002. A liquid controller measures gauge pressure (labels ending in G) and volumetric flow. Flow and pressure can also be shown as a set point count (0–64000) or in percent of full scale. The display shows µ as a lower-case u and superscript and subscript numerals as normal digits; kg/cm² appears as kg/cmG.

A-1 Flow units

Label	Unit
µL/m	Microlitre per minute
mL/s	Millilitre per second
mL/m	Millilitre per minute
mL/h	Millilitre per hour
L/s	Litre per second
LPM	Litre per minute
L/h	Litre per hour
US GPM	US gallon per minute
US GPH	US gallon per hour
CCS	Cubic centimetre per second
CCM	Cubic centimetre per minute
cm³/h	Cubic centimetre per hour
m³/m	Cubic metre per minute
m³/h	Cubic metre per hour
m³/d	Cubic metre per day
in³/m	Cubic inch per minute
CFM	Cubic foot per minute
CFH	Cubic foot per hour
CFD	Cubic foot per day
count	Set point count, 0–64000
%	Percent of full scale

A-2 Pressure units

Label	Unit
PaG	Pascal
hPaG	Hectopascal
kPaG	Kilopascal
MPaG	Megapascal
mbarG	Millibar
barG	Bar
g/cm²G	Gram-force per square centimetre
kg/cm²G	Kilogram-force per square centimetre
PSIG	Pound-force per square inch
PSFG	Pound-force per square foot
mTorrG	Millitorr
torrG	Torr
mmHgG	Millimetre of mercury at 0 °C
inHgG	Inch of mercury at 0 °C
mmH_2OG	Millimetre of water at 4 °C (NIST conventional)
mmH_2OG	Millimetre of water at 60 °F
cmH_2OG	Centimetre of water at 4 °C (NIST conventional)
cmH_2OG	Centimetre of water at 60 °F
inH_2OG	Inch of water at 4 °C (NIST conventional)
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	Set point count, 0–64000
%	Percent of full scale

A-3 Temperature and time units

Label	Temperature	Label	Time
°C	Degree Celsius	ms	Millisecond
°F	Degree Fahrenheit	s	Second
K	Kelvin	m	Minute
°R	Degree Rankine	hour	Hour
		day	Day

APPENDIX B

Connector pinouts

The standard 8-pin Mini-DIN connector is described in 8-pin Mini-DIN connector (p. 13). The pinouts below are the common assignments of the optional connectors. Which output signals are present depends on the options ordered: always check the calibration sheet and the pinout of your controller before wiring it. For connecting the controller to a computer, see Connecting to a computer (p. 33). For multi-strand cables, identify the wiring by a continuity check and by wire colour. To verify RS-485 functionality, check the part number or contact Analyt-MTC.

NOTICE

Connecting RS-485 to RS-232 units or cables damages the equipment. Do not connect RS-485 to RS-232 units or cables.

6-pin locking industrial connector

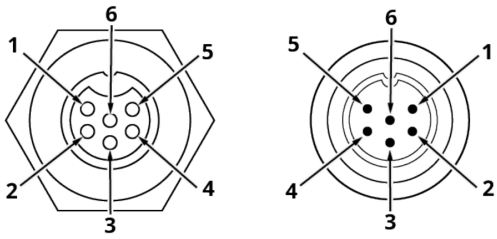


Figure B-1. 6-pin locking industrial connector. Left: female connector. Right: male connector.

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 (controllers)
5	Remote tare (meters and gauges)
6	Ground, common to power, digital communication, analogue signals and alarms

9-pin D-sub connector



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

Table B-1 Common pinouts of the 9-pin D-sub connector

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

Table B-2 Common pinouts of the 15-pin D-sub connector

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

Key of terms

Analogue in	Analogue set point input on controllers; ground to tare on meters and gauges
Analogue out	0–5 V DC output signal (1–5 or 0–10 V DC as options)
Analogue out 2	Constant 5.12 V DC, or the optional secondary analogue output
Current out	Not connected by default; optional 4–20 mA analogue output signal. Where this pin is absent, the analogue output carries the current signal.
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

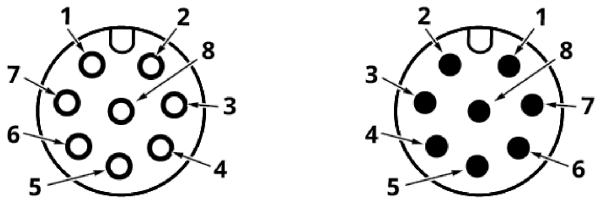


Figure B-4. 8-pin M12. Left: female connector. Right: male connector.

Table B-3 Common pinouts of the 8-pin M12 connector

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 (controllers); ground to tare (meters and gauges)	Analogue set point input (controllers); ground to tare (meters and gauges)
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

ANALYT-MTC Messtechnik GmbH

Sales, service and calibration

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

AMTC-MN-0003 · Rev. 2 · 2026-10

© 2026 ANALYT-MTC Messtechnik GmbH. All rights reserved. Subject to technical changes without notice.