ANALYT MESSTECHNIK



OPERATING MANUAL

SMVI Intelligent Control Valve

Installation, wiring, control modes, RS-485 commands and troubleshooting of SMVI20, SMVI30 and SMVI40 intelligent control valves in aluminium and stainless steel.

AMTC-MN-0049

Rev. 1 · October 2026

About this manual

This manual explains how to install, wire, operate and troubleshoot SMVI intelligent control valves. It covers the three sizes, SMVI20, SMVI30 and SMVI40, each in an aluminium version and in a 316 stainless steel version with PTFE-lined housing. The SMVI40C is the SMVI40 with compression fittings.

Read Safety (p. 6) before you install the valve. If you are setting up a new valve, follow the chapters in order: Installation (p. 9) with the electrical connections (p. 10), then Operation (p. 14). Product description (p. 7) explains the four control modes and is worth reading before you design the control circuit. The RS-485 commands are in Communication (p. 16).

For service, repairs and technical questions, contact Analyt-MTC. The contact details are in Service, warranty and contacts (p. 27) and on the back cover.

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

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.

Conventions

- Pin numbers, such as “pin 8”, refer to the 9-pin D connector on the side of the valve; see Pin assignment (p. 11). The RS-485 connector is a separate 3-pin audio jack.
- “GND” means pin 1 or pin 6 of the 9-pin D connector, the minus of the power supply; pin 6 is the same as pin 1.
- Air flows are standard flows in sL/min (21.11 °C, 1013.25 mbar); water flows are in L/min.
- Commands, replies and register names are printed as the valve sends and receives them, for example `!12`, `CM<CR>`. `<CR>` stands for the carriage return character.

Abbreviations

Abbreviation	Meaning
ADC	Analogue-to-digital converter
ASCII	American Standard Code for Information Interchange (character set)
AWG	American Wire Gauge

Abbreviation	Meaning
CR	Carriage return
Cv	Flow coefficient
EEPROM	Electrically erasable programmable read-only memory
EMC	Electromagnetic compatibility
EPR	Ethylene propylene rubber
FFKM	Perfluoroelastomer
FKM	Fluoroelastomer
FNPT	Female National Pipe Taper (US tapered pipe thread)
FS	Full scale
GND	Ground
NPN	Negative-positive-negative (transistor type)
PCB	Printed circuit board
PFA	Perfluoroalkoxy alkane
PLC	Programmable logic controller
PTFE	Polytetrafluoroethylene
RTS	Request to send (serial interface signal)
TD	Transmit data (serial interface signal)
TTL	Transistor-transistor logic
UART	Universal asynchronous receiver-transmitter (serial interface)
UPB	User push-button, the multi-function push-button

Document information

Title	SMVI Intelligent Control Valve — Operating manual
Document number	AMTC-MN-0049
Revision	Rev. 1 — October 2026
Applies to	SMVI20, SMVI30 and SMVI40 (SMVI40C with compression fittings) in aluminium (A) and stainless steel (S) versions
Language	English

Revision history

Rev.	Date	Change
1	October 2026	First issue.

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CHAPTER 1

Safety

Read this chapter before you install, wire or operate the valve. Each point is repeated, with its context, in the section where it applies.

Intended use

The SMVI is an electrically driven two-way metering needle valve. It regulates the flow of gases or liquids that are compatible with its wetted materials, within the pressure, temperature and electrical limits in Specifications (p. 20). It is a final control element: it sets an opening or moves its needle as its control signals tell it, and it has no flow measurement of its own.

The protection built into the valve works only when it is installed and operated the way this manual describes. If your application calls for anything else, agree it in writing with Analyt-MTC first.

Gases under pressure are a hazard to people and equipment. Only operators who know the valve and its limits may control and operate it.

⚠ WARNING

The SMVI is not intended for life-support applications. A failure or a wrong flow in such an application could endanger a person's life or health. Do not use the SMVI where a failure or a wrong flow could endanger a person.

Before you start

Media compatibility. You choose the model and its seal material for your gas or liquid. Check that the wetted materials are compatible before you start; they are listed in Materials and connections (p. 23).

Electrical limits. The power supply and every control input have a maximum voltage. The limits are in Pin assignment (p. 11) and Electrical (p. 22); the notices on wiring are in Electrical connections (p. 10).

Valve without power. The valve keeps its last position when the power goes off; see Power-up and power loss (p. 15).

Returning a valve. A valve that has carried hazardous media must be decontaminated before it is shipped; see Sending in a valve (p. 27).

CHAPTER 2

Product description

A high-precision linear stepping motor drives the valve spindle with its needle tip. Electronics in the valve housing turn one of four kinds of control signal into needle movement: an analogue opening set point, a digital opening set point over RS-485, direction and speed signals, or step clock and direction signals.

Needle, steps and travel

Full step	0.000125 in
Microstep (factory default, 1/16 microstepping)	0.0000078125 in
Travel, fully closed to fully open	About 0.2 in, about 25 500 microsteps
Maximum needle speed (100 %)	991.8 full steps per second

Note
The flow through the valve is not proportional to the opening. At a given opening it depends on the pressure difference across the valve (Flow and opening (p. 20)).

Control modes

The valve works in one control mode at a time. You select it with the multi-function push-button (Multi-function push-button (p. 14)) or over RS-485 (command `CM`, Communication (p. 16)). Operation in each mode is described in Operation (p. 14).

Table 2-1 Control modes

Control mode	Control signals	What the valve does
Analogue (opening position)	Analogue input, pin 4	Sets an opening proportional to the signal: 0–100 % of the signal range is 0–100 % opening.
Digital RS-485 (opening position)	RS-485 commands	Sets the opening sent in the command, 0.00–100.00 % in steps of 0.01 %. All other parameters are also accessible.
Direction/Speed	Direction input, pin 8; analogue input, pin 4	Moves the needle up (open) or down (close) as the direction input says, at a speed proportional to the analogue signal: 0–100 % of the signal range is 0–100 % of the needle speed. This is the control mode of the earlier SMV valve.
Step Clock/Direction	Step clock input, pin 2; direction input, pin 8	Moves the needle one microstep at each falling edge on the step clock input, up or down as the direction input says.

The analogue input accepts 0–5 V DC, 1–5 V DC, 4–20 mA or 0–10 V DC. You select the first three with the push-button or over RS-485. The 0–10 V DC input needs a jumper on the circuit board: it cannot be selected in the field and must be specified with the order.

Signals below the analogue dead band count as zero, so that noise on the input does not move the valve. The dead band is 0.4 % of full scale as delivered (EEPROM index 58, command `AI,B`). Below it the valve closes in Analogue mode and the needle stands still in Direction/Speed mode.

Close and open overrides

Two inputs on the 9-pin D connector override every control mode: CLOSE (pin 3) closes the valve, and OPEN, also called PURGE (pin 7), opens it fully. Each is active when connected to GND and has no effect when left open. Wiring is in Close and open override inputs (p. 12), use in Closing the valve (p. 14) and Opening the valve fully (p. 14).

Connections, controls and indicators

The inlet and outlet ports are on the valve block at the bottom. The electrical connections, the push-button and the indicator lights are on the housing above it.

Part	Function
Inlet port, outlet port	Process connections; the size depends on the model (Process connections (p. 9)).
9-pin D connector, on the side	Power supply and control signals (Pin assignment (p. 11)).
RS-485 interface connector, on top	3-pin audio jack for the digital interface (RS-485 connection (p. 12)).
Multi-function push-button	Micro switch behind a small hole on the left side. Shows and selects the control mode and the analogue input (Multi-function push-button (p. 14)).
Power LED, on top	Power indicator.
Valve position LED, on top	Green: the close override is active, the valve is closed. Red: the open override is active, the valve is fully open.
Valve status LED, on top	Red, amber and green flashes that answer the push-button (Table 4-1 (p. 15)).

Behaviour without power

The valve keeps the position it had when the power went off. As delivered, it closes by itself within the first 2–3 s after the power returns and then resumes control in the selected mode. The close at power-up can be switched off over RS-485 (command PC).

Models and supplied items

The SMVI comes in three sizes: the SMVI20 for up to 200 sL/min of air (21.11 °C, 1013.25 mbar), the SMVI30 for up to 500 sL/min and the SMVI40 for up to 1000 sL/min. Each size comes in aluminium (A) and in 316 stainless steel with a PTFE-lined housing (S). The SMVI40 has 3/4 in FNPT ports; the SMVI40C is the same size with 3/4 in compression fittings. Water flows and Cv values are in Flow capacity (p. 20), the order code in Ordering information (p. 26).

Each valve is supplied with a communication cable, 3 ft long, with a 3.5 mm stereo plug at one end and three stripped wires at the other. Check the delivery against the packing list.

CHAPTER 3

Installation

Plumb the valve into the line in the marked flow direction, tighten the fittings without forcing them, and leak-test the whole system before you apply process pressure. Then, with the power switched off, wire the power supply and the control signals of your control mode to the 9-pin D connector, and the RS-485 cable to the audio jack if you use the digital interface.

Unpacking and inspection

The valve is shipped in a sturdy carton with anti-static cushioning. When it arrives:

1. Inspect the outside of the carton and report any damage to the carrier immediately.
2. Open the carton carefully from the top and check the valve for hidden transport damage.
3. Report any hidden damage to the carrier and send a copy of the damage report to Analyt-MTC.
4. Check the contents against the packing list and report anything missing to Analyt-MTC straight away.

To send a valve back to Analyt-MTC for repair, follow Sending in a valve (p. 27).

Process connections

Inlet and outlet have the same connection, which depends on the model:

Model	Inlet and outlet
SMVI20	3/8 in compression fittings
SMVI30	1/2 in compression fittings
SMVI40	3/4 in FNPT ports
SMVI40C	3/4 in compression fittings

The valve has two 8-32 UNC-2B threaded holes for table mounting; their positions are in Figure 7-8 (p. 25).

Connecting the line

1. Inspect the pipework, fittings and ferrules and remove any dust or other contamination.
2. Find the flow direction marked on the valve and connect the supply to the inlet side.
3. On compression fittings, push the tubing into each fitting until the tube end sits against the shoulder of the fitting.

   NOTICE

   Excessive force on the fittings seriously damages them. Do not over-tighten.

4. Tighten each compression fitting by one and a quarter turns, following the fitting manufacturer's instructions.
5. Leak-test the whole installation with a helium leak detector or an equivalent method. Every valve is leak-tested before shipment to the limits in Pressure and temperature (p. 22).

Operating limits

Keep the line within these limits; details are in Specifications (p. 20):

- operating pressure up to 500 psig (35 bar g);
- pressure difference across the valve never more than 50 psid (3.45 bar);
- gas and ambient temperature 32 to 122 °F (0 to 50 °C).

Electrical connections

Before you wire

Power and all control signals pass through the 9-pin D connector on the side of the valve. Which control inputs you wire depends on the control mode (Table 2-1 (p. 7)); in Digital RS-485 mode the valve needs only the power supply and the RS-485 cable.

NOTICE

Connecting or disconnecting a cable with the power on can damage the valve. Switch the power off before you connect or disconnect any cable.

NOTICE

Some components are sensitive to electrostatic discharge. A discharge can damage them. Wear a grounded wrist strap when you wire, adjust or service the valve.

NOTICE

A wiring error or a signal above the rated value of an input can damage the valve or the signal source, or make the valve operate incorrectly. Check the wiring and the polarity of the power supply before you switch the power on, and keep every input within the limits in Pin assignment (p. 11).

Power supply

The valve runs on any DC supply from 12 to 24 V DC. The supply must deliver at least 800 mA and have a ripple below 150 mV peak-to-peak. If one supply feeds several valves, its current rating must cover all of them.

Pins	Function
5 and 9	Power supply plus (+)
1 and 6	Power supply minus (−), GND

With wires of 23 AWG or thinner, connect both plus pins (5 and 9) and both minus pins (1 and 6). With wires of 22 AWG or thicker, one pin per polarity is enough.

NOTICE

A supply voltage above 26 V DC can damage the valve or make it operate incorrectly. Never apply more than 26 V DC to the power pins.

Fuse protection

The plus and the minus power input are each protected by a resettable 900 mA fuse with a medium time lag. A short circuit or reversed polarity trips it and cuts the power to the valve electronics. To

recover, disconnect the power, correct the fault and reconnect the power; the fuse resets itself once the fault has been removed.

Pin assignment

Pin	Function	Maximum
1	Common, power supply minus (GND)	–
2	Step clock input, 5 V TTL, active on the falling edge	5.5 V DC
3	Close override input, TTL, active low	5.5 V DC
4	Analogue input: 0–5 V DC, 1–5 V DC, 0–10 V DC or 4–20 mA	10.5 V DC
5	Power supply plus, 12–24 V DC	26 V DC
6	Common, power supply minus (GND), same as pin 1; reference for pin 4	–
7	Open (purge) override input, TTL, active low	5.5 V DC
8	Direction input, digital 5 V TTL	5.5 V DC
9	Power supply plus, 12–24 V DC, same as pin 5	26 V DC

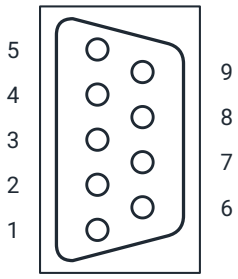


Figure 3-1. Pin numbering of the 9-pin D connector on the valve.

Note
Most D connectors are numbered the same way, but not all. The numbers moulded on your mating connector may not match the numbering above. Wire each conductor by its function, following this pin assignment, whatever numbers your connector shows.

Analogue input

Connect the analogue signal to pin 4 (+) and pin 1 or 6 (−). In Analogue mode it sets the valve opening, in Direction/Speed mode the needle speed. The input type (0–5 V DC, 1–5 V DC or 4–20 mA) is selected with the push-button or over RS-485; the 0–10 V DC input is set at the factory and must be ordered.

With a voltage input the input impedance is about 100 kΩ. With the 4–20 mA input the valve sinks the current through an input impedance of about 250 Ω.

NOTICE

More than 10.5 V DC on pin 4 damages the input circuit, and a loop-powered signal source, usually supplied with more than 12 V DC, damages the valve. Keep pin 4 at or below 10.5 V DC and never connect it to a loop-powered source.

Direction input

Connect the direction signal to pin 8 (+) and pin 1 or 6 (−). It is a digital 5 V TTL input with an input impedance of about 10 kΩ, and it acts only in Direction/Speed and Step Clock/Direction mode:

- logic low, below 0.8 V DC: the needle moves down and the valve closes;
- logic high, above 2 V DC: the needle moves up and the valve opens.

NOTICE

More than 5.5 V DC on pin 8 damages the input circuit. Keep the direction signal at or below 5.5 V DC.

NOTICE

An internal 10 kΩ pull-up resistor holds an unconnected direction input high. In Direction/Speed or Step Clock/Direction mode the valve then moves towards open. Connect pin 8 before you use either mode.

Step clock input

Connect the step clock signal to pin 2 (+) and pin 1 or 6 (−). It is a digital 5 V TTL input with an internal 10 kΩ pull-up resistor and an input impedance of about 10 kΩ. In Step Clock/Direction mode each falling edge moves the needle by one microstep, in the direction set by pin 8. In the other modes the input has no effect.

NOTICE

More than 5.5 V DC on pin 2 damages the input circuit. Keep the step clock signal at or below 5.5 V DC.

Close and open override inputs

Connecting pin 3 to GND (pin 1 or 6) closes the valve; connecting pin 7 to GND opens it fully. Both inputs have internal 2 kΩ pull-up resistors to +5 V DC, so they have no effect when left open. They can be switched by an open-collector NPN transistor, an electromechanical relay or a solid-state relay.

NOTICE

More than 5.5 V DC on pin 3 or pin 7 damages the input circuit. Keep both override inputs at or below 5.5 V DC.

RS-485 connection

The digital interface uses a galvanically isolated RS-485 transceiver with high common-mode transient immunity. It connects the valve directly to a PLC or a PC and gives access to all configuration and process parameters. The connector is a 3-pin audio jack; the cable supplied with the valve has a 3.5 mm stereo plug and three stripped wires:

Table 3-1 RS-485 cable

Plug section	Pin	Wire	Host adapter
Tip	2	Red	RS-485 A+ line, T(+) or R(+)
Ring (middle)	3	White	RS-485 B− line, T(−) or R(−)
Sleeve	1	Shield	RS-485 GND, signal common, if the adapter has one

For another cable length, make up a cable to this table. Set the RS-485 converter or adapter of the host to multi-drop, two-wire, half-duplex operation. Its transmitter must be enabled by TD or by RTS, whichever the adapter offers, and its receiver set to follow the transmitter, so that the host does not read back its own messages (echo).

Table 3-2 Serial settings

Baud rate	9600 as delivered; 1200–115 200 selectable (command CB)
Data bits	8
Stop bits	1
Parity	None
Flow control	None

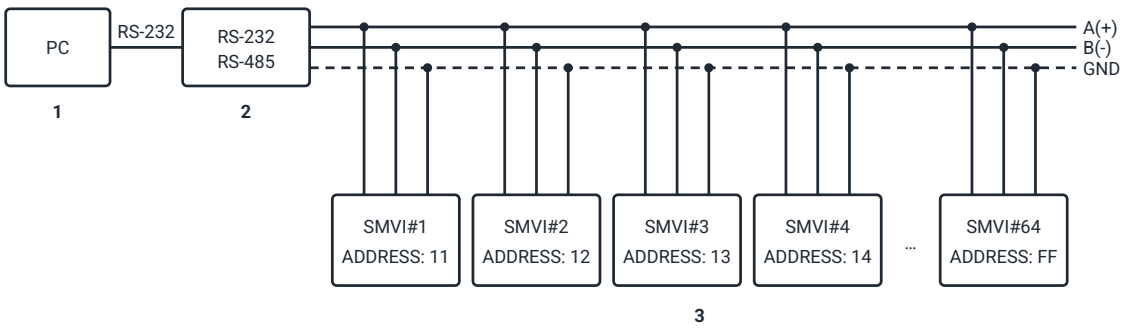


Figure 3-2. RS-485 bus. 1 Host PC with RS-232 interface; 2 RS-232 to RS-485 converter, set for two-wire half-duplex operation; 3 up to 64 devices on one RS-485 segment, up to 2000 ft. Each valve has its own address.

When the valve is the last device on a long RS-485 segment (more than 100 m), connect a 120 Ω termination resistor between its RS-485 (+) and (−) terminals, less than 6 ft from the valve.

Every valve leaves the factory with RS-485 address 11. Give each device on a bus its own address before you connect them together (Addresses (p. 16)).

CHAPTER 4

Operation

Once the valve is plumbed in and wired, switch on the power. As delivered, the valve closes itself within the first 2–3 s and then follows the control signals of the selected control mode.

Normal operation: the control modes

In normal operation (auto) pins 3 and 7 are left open and the valve follows the signals of its control mode (Table 2-1 (p. 7)):

- **Analogue.** The analogue signal on pin 4 sets the opening: the bottom of the signal range closes the valve, the top opens it fully. A signal below the dead band, 0.4 % of full scale as delivered, closes the valve.
- **Digital RS-485.** The host sends the opening in percent, for example `!12,VP,30.0<CR>` for 30 % (Command reference (p. 17)).
- **Direction/Speed.** Pin 8 sets the direction, high to open, low to close. The analogue signal on pin 4 sets the needle speed, from 0 to 100 %; 100 % is 991.8 full steps per second. Below the dead band the needle stands still.
- **Step Clock/Direction.** Each falling edge on pin 2 moves the needle by one microstep, in the direction set by pin 8.

Closing the valve: close override

You can close the valve for a moment without changing the control signals. Connect pin 3 (close override) to GND (pin 1 or 6): the valve closes, and the valve position LED on top of the valve lights green. When pin 3 is released and left open, the valve follows its control signals again.

A toggle switch between pin 3 and GND switches the flow off and on by hand. For automatic control, drive pin 3 from an open-collector NPN output, such as a DC output of a programmable logic controller (PLC).

Opening the valve fully: open override

To open the valve fully for a moment, for example to purge the line, connect pin 7 (open override, purge) to GND (pin 1 or 6). The valve position LED on top of the valve lights red. When pin 7 is released and left open, the valve follows its control signals again. As for pin 3, a toggle switch or an open-collector NPN output can drive pin 7.

> **Note**
> The valve stays open if the power is switched off while the open override is active. To close it, switch the power on and connect pin 3 to pin 1.

Multi-function push-button

The push-button sits behind a small hole on the left side of the valve. It works in every control mode. How long you hold it decides what it does. The valve status LED answers with flashes, so release the button inside the time window you want:

Table 4-1 Push-button functions

Hold for	Function	Status LED answer
Less than 6 s	Show the control mode	Red flashes: 1 Analogue, 2 Digital RS-485, 3 Direction/Speed, 4 Step Clock/Direction
6–12 s	Show the analogue input	Amber flashes: 1 0–5 V DC, 2 0–10 V DC, 3 1–5 V DC, 4 4–20 mA
12–18 s	Select the control mode	Green flashes every 2 s: enter the number of presses within 16 s (procedure below)
18–24 s	Select the analogue input	Red flashes every 2 s: enter the number of presses within 16 s (procedure below)

A short press only shows the setting; it changes nothing.

Selecting the control mode or the analogue input

1. Hold the push-button for 12 to 18 s to select the control mode, or for 18 to 24 s to select the analogue input, then release it. The status LED flashes green (control mode) or red (analogue input) every 2 s.
2. Within the next 16 s, press and hold the push-button until the green LED lights and goes off again, about 2 s. That counts as one press.
3. Release the button. The red LED lights: the valve is ready for the next press.
4. Repeat steps 2 and 3 until the number of presses matches your choice: 1 Analogue, 2 Digital RS-485, 3 Direction/Speed, 4 Step Clock/Direction; or, for the analogue input, 1 0–5 V DC, 3 1–5 V DC, 4 4–20 mA.

Note
Without a press within 16 s, or with a press released before the green LED goes off, nothing changes. The push-button returns to its normal state and the green LED stays on.

The 0–10 V DC input (2 presses) needs a jumper on the circuit board. It cannot be selected with the push-button or over RS-485 and must be specified with the order.

Power-up and power loss

The valve does not close when it loses power: it stays in the position it had when the power went off, open or closed. When the power returns, the valve closes by itself within the first 2–3 s and then resumes control in the selected mode. The close at power-up is set with the RS-485 command PC; as delivered it is on.

NOTICE

After a power failure the valve can remain open, and the gas or liquid keeps flowing until the power returns. If the flow must stop when the power fails, install a separate shut-off valve that closes on power loss.

CHAPTER 5

Communication

Over RS-485 a host reads and sets every parameter of the valve and, in Digital RS-485 mode, sets its opening. The host can run custom software or a plain terminal: every command and reply is a line of printable ASCII characters. Wiring and serial settings are in RS-485 connection (p. 12).

Command format

A command starts with `!` and ends with a carriage return. The valve ignores line feeds.

!<Addr>,<Cmd>,Arg1,Arg2,Arg3,Arg4<CR>

`<Addr>`	Address of the valve on the bus, two hexadecimal digits in ASCII, `00` to `FF`
`<Cmd>`	Command of one or two characters, or `READ` (Table 5-1 (p. 17))
`Arg1` to `Arg4`	Arguments, separated by commas. Some commands have none, some have optional ones.
`<CR>`	Carriage return

The valve answers with the same address and command, a colon and the value, for example `!12,CM:0<CR>`. A command without an argument reads a parameter; the same command with an argument sets it.

Addresses

Every valve leaves the factory with address 11. The address is stored at EEPROM index 43 and changed with the command `MW`: `MW,43,12` sets it to 12.

NOTICE

Two devices with the same address on one RS-485 bus answer at the same time. Their replies collide and communication fails. Give every device on a bus its own address.

Note

Address 00 is the global address. Every device on the bus carries out a command sent to 00, and none of them replies. Never assign 00 to a device.

Examples

The examples assume a valve with address 12 (hexadecimal; 18 in decimal).

Task	Command	Reply
Read the control mode	`!12,CM<CR>`	`!12,CM:0<CR>`: Analogue
Read the analogue input	`!12,AI,M<CR>`	`!12,AIM:0<CR>`: 0–5 V DC
Set the opening to 30 % (Digital RS-485 mode)	`!12,VP,30.0<CR>`	`!12,VP:1,30.0<CR>`
Read the status registers	`!12,S<CR>`	`!12,S:0xE7F3,0x1F<CR>`; the values depend on the motor state and the needle position
Read the home position	`!12,V<CR>`	`!12,V:C<CR>`: valve closed

Command reference

Table 5-1 lists the commands without the address frame: `CB` stands for `!<Addr>,CB<CR>`, `CB,19200` for `!<Addr>,CB,19200<CR>`. Values marked * are the settings as delivered.

Table 5-1 Commands

No.	Command	Function and values	Reply
1	`CM` `CM,<0–3>`	Read or set the control mode: 0 Analogue (opening), 1 Digital (opening), 2 Speed/Direction, 3 Step Clock/Direction.	`CM:<value>`, e.g. `CM:0`
2	`AI,M` `AI,M,<0–3>`	Read or set the analogue input: 0 0–5 V DC, 1 0–10 V DC, 2 1–5 V DC, 3 4–20 mA.	`AIM:<value>`, e.g. `AIM:0`
	`AI,D` `AI,D,<0–100>`	Read or set the damping of the analogue input, 0–100.	`AID:<value>`, e.g. `AID:10`
	`AI,B` `AI,B,<0–2>`	Read or set the dead band of the analogue input, 0.0–2.0 % (0.4 %*).	`AIB:<value>`, e.g. `AIB:0.40`
3	`VP` `VP,<0–100>`	Read or set the opening in percent of the full span: 0 % fully closed, 100 % fully open. The reply gives the active control mode (0–3) and the opening.	`VP:<mode>,<opening>`, e.g. `VP:1, 50.000`: Digital, 50.000 %
4	`V`	Read the home position: C home close, O home open, I intermediate.	`V:<value>`, e.g. `V:C`
5	`AP`	Read the absolute position: actual position and target position, each 0 to −25### microsteps, and the motor speed, 0–992 full steps per second. The largest position depends on the factory adjustment of each valve.	`AP:<actual>,<target>,<speed>`, e.g. `AP:-11576,-11576, 0.00`
6	`PC` `PC,<0–1>`	Read or set the close at power-up: 0 off, 1 on (the valve is closed first when the power comes on).	`PC:<value>`, e.g. `PC:1`
7	`A`	Read the analogue input in ADC counts, raw and averaged.	`A:<raw>,<average>`, e.g. `A:351, 352`
8	`MP`	Read the mark position, the position of the needle fully open: actual position and mark position, each 0 to −25### microsteps.	`MP:<actual>,<mark>`, e.g. `MP:0,-25376`: valve closed, mark at −25376 microsteps
9	`HZ`	Hard HiZ: switch the motor power bridges off at once (high-impedance state). The HiZ flag is raised. With the motor stopped, the bridges go to the high-impedance state.	`HZ:Done`
10	`S`	Read the motor status register and the valve status register (Table 5-2 (p. 18), Table 5-3 (p. 18)).	`S:<motor>,<valve>`, e.g. `S:0x7E1E, 0x10`
11	`CB` `CB,<baud>`	Read or set the baud rate: 1200, 2400, 4800, 9600*, 19200, 38400, 57600 or 115200. A new baud rate takes effect after the power has been switched off and on.	`CB:<value>`, e.g. `CB:9600`
12	`T` `T,Z`	Read the maintenance pilot timer, or reset it with `Z`.	`T:<time>`, e.g. `T:12.5`; `T:Z`
13	`READ,0` `READ,1`	Read the diagnostic registers. 0: ADC counts, raw (0–4095) and averaged (0–4095.0). 1: analogue input in percent of full scale.	`ADC0:<raw>,<average>`, e.g. `ADC0:2, 1.8`; `SP_A:<value>`, e.g. `SP_A: 25.00`
14	`MR,<0–119>`	Read the EEPROM index given. Read only.	`<value>`; `MR,2` returns the model number, e.g. `SMVI20-AVD6-AA`
15	`MW,<40–119>,<value>`	Write the value to the EEPROM index given. Indexes 0–39 are write-protected.	`MW,<index>,<value>`, e.g. `MW,43,12`

NOTICE

The EEPROM parameters are set at the factory for the best performance, and a wrong value written with `MW` can make the valve malfunction. Change an EEPROM parameter only when Analyt-MTC technical support tells you to.

Status registers

Table 5-2 Motor status register

Bit	Meaning	Name	Values
0	High-impedance state	HiZ	0 disabled, 1 enabled
1	Motor busy	BUSY	1 disabled, 0 enabled
2	Home position switch active	SW_F	0 open, 1 close
3	Home position switch turn-on event	SWEVN	0 active, 1 not active
4	Motor direction	DIR	0 reverse (up), 1 forward (down)
5, 6	Motor motion state	MOT_ST	(0, 0) stopped; (0, 1) acceleration; (1, 0) deceleration; (1, 1) constant speed
7	Command cannot be performed	NOTPERF	0 not active, 1 active
8	Wrong command	WRONG_CMD	0 not active, 1 active
9	Undervoltage lockout or reset	UVLO	0 active, 1 not active
10	Thermal warning event	TH_WRN	0 active, 1 not active
11	Thermal shutdown event	TH_SD	0 active, 1 not active
12	Overcurrent detection event	OCD	0 active, 1 not active
15	Motor in step-clock mode	SCK_MOD	0 not active, 1 active

Table 5-3 Valve status register

Bit	Flag, set to 1 while the event is active	Name
0	Home close time-out	HC_TO
1	Home open time-out	HO_TO
2	EEPROM initialisation event	EE_INIT
3	Fatal error	FE
4	Home close switch activated	HC_ACT
5	Home open switch activated	HO_ACT
6	Close override input active	HC_OVR
7	Open override input active	HO_OVR

Error codes

The valve reports these error codes on its serial interface (UART):

Table 5-4 Error codes

Code	Meaning
1	Command not supported, or back door not enabled
2	Wrong number of arguments
3	Address out of range (MR or MW)
4	Wrong number of characters in the argument
5	Attempt to change a write-protected area of the EEPROM
6	Command or argument not found
7	Wrong argument value
8	Manufacturer access key wrong or disabled

CHAPTER 6

Troubleshooting

First checks

Every valve is checked at several points during manufacture and assembly. Before you look at the fault table, rule out these common causes:

- Cables: check that every cable is connected correctly.
- Wiring: compare the cable with the pin assignment (p. 11). A cable taken from another make of instrument is a common culprit, because its pins may be wired differently.
- Supply: the supply must match the requirements in Power supply (p. 10) and deliver the current of every valve connected to it.
- Line: test the connections for leaks.

Fault finding

Likely cause	Remedy
THE VALVE DOES NOT RESPOND TO THE DIRECTION AND SPEED SIGNALS	
Pressure of the gas or liquid not suitable	Apply the correct pressure (Pressure and temperature (p. 22)).
Cable or connector fault	Check all cables and connections; replace if necessary.
Valve out of adjustment	Return the valve for repair or replacement.
THE VALVE DOES NOT OPEN FULLY ON THE OPEN OVERRIDE	
Cable or connector fault	Check the cable and connectors; replace if necessary.
Valve out of adjustment	Return the valve for repair or replacement.
Circuit board defective	Return the valve for repair or replacement.
THE VALVE DOES NOT CLOSE ON THE CLOSE OVERRIDE	
Cable or connector fault	Check the cable and connectors; replace if necessary.
Valve out of adjustment	Return the valve for repair or replacement.
Circuit board defective	Return the valve for repair or replacement.

Over RS-485, the status registers (command `S`, Status registers (p. 18)) and the error codes (Error codes (p. 18)) show what the valve reports.

For best results, return the valve for servicing. For anything beyond the checks above, see Service, warranty and contacts (p. 27).

CHAPTER 7

Specifications

Flow capacity

Maximum flows at a pressure difference of 20 psi across the valve and 70 °F. The aluminium (A) and stainless steel (S) versions of a size have the same flow capacity.

Table 7-1 Maximum flows (sL/min at 21.11 °C, 1013.25 mbar)

	Air		Water				
Model	sL/min	scfh	L/min	gal/min	Cv	Connections	Orifice size
SMVI20	200	424	5.6	1.48	0.336	3/8 in compression fittings	3/8 in
SMVI30	500	1060	14.2	3.75	0.855	1/2 in compression fittings	3/8 in
SMVI40	1000	2119	28	7.4	1.735	3/4 in FNPT; SMVI40C: 3/4 in compression fittings	1/2 in

Pressure drop across the fully open valve at its full-scale flow:

Model	Flow, sL/min	Pressure drop
SMVI20	200	5 psid (350 mbar)
SMVI30	500	7 psid (490 mbar)
SMVI40	1000	10 psid (700 mbar)

Flows in sL/min at 21.11 °C, 1013.25 mbar.

Flow and opening

The flow through the valve is not proportional to the opening. Figures 7-1 to 7-3 show the air flow against the opening at several pressure differences across the valve, as the source gives them; flows in sL/min.

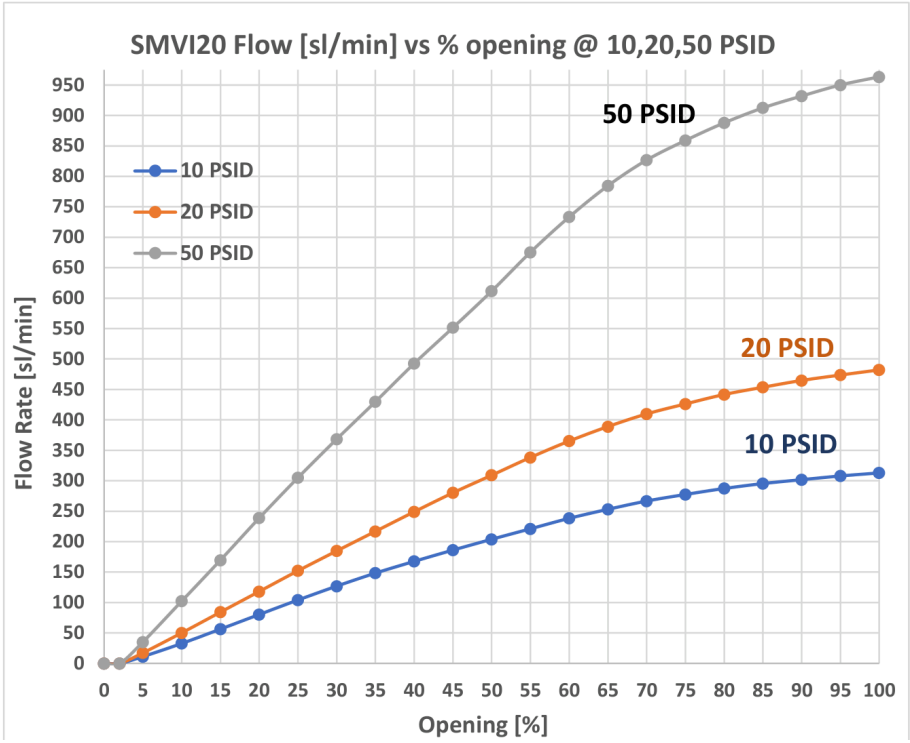


Figure 7-1. SMVI20, flow against opening at 10, 20 and 50 psid.

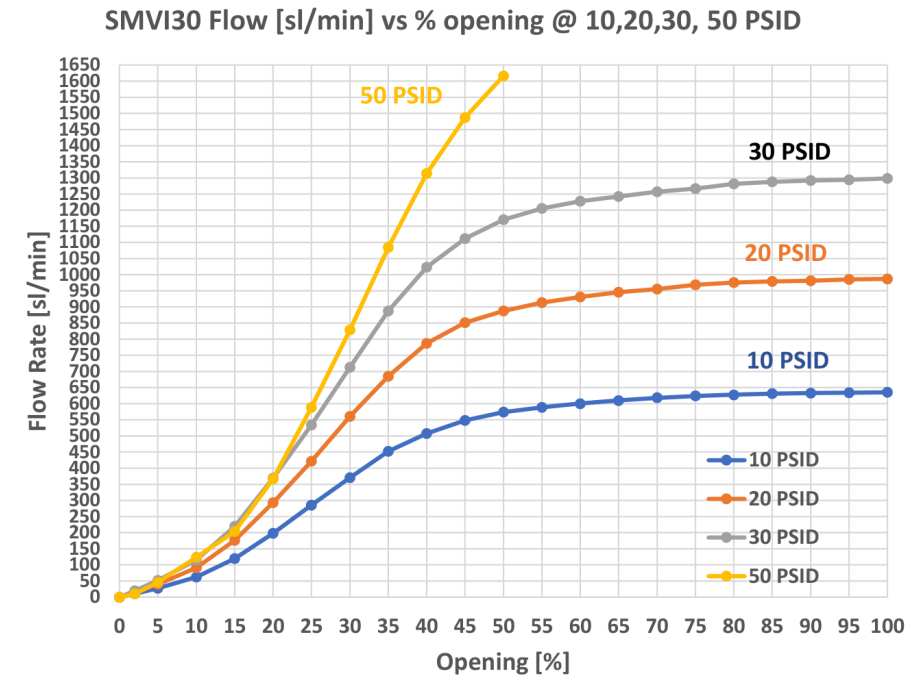


Figure 7-2. SMVI30, flow against opening at 10, 20, 30 and 50 psid.

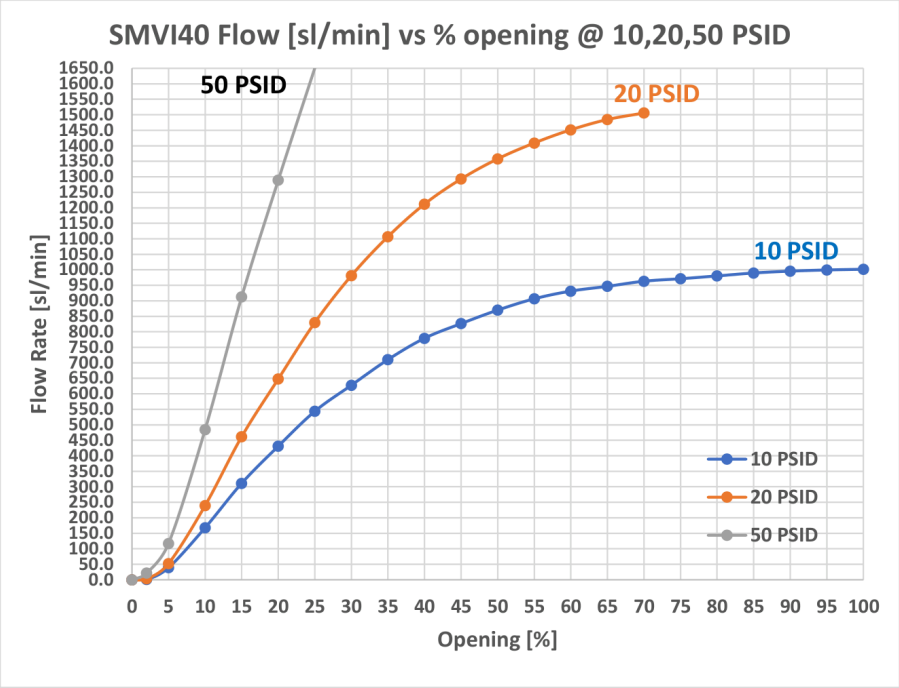


Figure 7-3. SMVI40, flow against opening at 10, 20 and 50 psid.

Pressure and temperature

Maximum operating pressure	500 psig (35 bar g)
Maximum pressure difference	50 psid (3.45 bar)
Gas and ambient temperature	32–122 °F (0–50 °C)
External leak integrity	1×10^{-7} scc/s helium maximum, to the outside
Internal leak, valve closed	Up to 0.5 % of full scale at 30 psid
Response time	100 ms time constant
Duty cycle	Continuous operation (100 % duty cycle) at low pressure differences
Environment	Installation category II, pollution degree 2 (IEC 664)
Ingress protection	IP40

Electrical

Power supply	12–24 V DC, 800 mA maximum current; ripple below 150 mV peak-to-peak; never more than 26 V DC
Fuses	900 mA, resettable, medium time lag, in the plus and in the minus power input
Connector	9-pin D, on the side of the valve (Pin assignment (p. 11))
Analogue input (pin 4)	0–5 V DC, 1–5 V DC or 0–10 V DC, linear, input impedance 100 kΩ 4–20 mA, linear, input impedance 250 Ω Never more than 10.5 V DC
Direction input (pin 8)	Digital 5 V TTL, input impedance 10 kΩ Close (down): logic low, below 0.8 V DC Open (up): logic high, above 2 V DC Never more than 5.5 V DC
Step clock input (pin 2)	Digital 5 V TTL, input impedance 10 kΩ; one microstep at each falling edge; never more than 5.5 V DC
Close and open override inputs (pins 3 and 7)	TTL, active low (below 0.8 V DC), 2 kΩ pull-up to +5 V DC; never more than 5.5 V DC

Digital interface	Isolated RS-485, two-wire, half duplex; 3-pin audio jack; 9600 baud as delivered (Table 3-2 (p. 12))
Resolution	0.000125 in per full step; 0.0000078125 in per microstep (1/16 microstepping, factory default)
CE marking	A valve that bears the CE marking complies with the EMC Directive 2014/30/EU as amended: emission EN 61000-6-3, Group 1, Class A; CISPR 11, EN 55011:2009+A1:2010 immunity EN 61000-6-1; IEC EN 61000-4-2; IEC EN 61000-4-3; EN 61000-4-4:2004+A1:2010; EN 61000-4-6:2013

Materials and connections

Construction, aluminium models	Aluminium housings and valve blocks, PFA closing pins
Construction, stainless steel models	316 stainless steel valve blocks, PTFE-lined aluminium housing blocks, PFA closing pins
Wetted materials, aluminium models (SMVI20-A, SMVI30-A, SMVI40-A)	Anodized aluminium, brass, 316 stainless steel, FKM O-rings
Wetted materials, stainless steel models (SMVI20-S, SMVI30-S, SMVI40-S)	316 stainless steel, FKM O-rings
Optional O-rings	Buna-N, EPR or FFKM
Process connections	SMVI20: 3/8 in compression SMVI30: 1/2 in compression SMVI40: 3/4 in FNPT SMVI40C: 3/4 in compression

You are responsible for choosing a model and O-ring material that are compatible with your gas or liquid. If in doubt, ask Analyt-MTC before you order.

Dimensions

The drawings give each dimension in inches with millimetres below or in brackets, as the source drawings print them. Call-out 1 marks the process connection, call-out 2 the depth of the valve block. Designs and dimensions can change without notice; for certified dimensions, contact Analyt-MTC.

Table 7-2 Dimensions

Model	Height	Valve block height	Valve block length	Length over fittings	Depth
SMVI20	5.68 in (144.3 mm)	1.13 in (28.6 mm)	3.00 in (76.2 mm)	5.15 in (130.8 mm)	2.00 in (50.8 mm)
SMVI30	6.06 in (153.9 mm)	1.50 in (38.1 mm)	3.00 in (76.2 mm)	5.41 in	2.00 in (50.8 mm)
SMVI40	6.06 in (153.9 mm)	1.50 in (38.1 mm)	3.00 in (76.2 mm)	–	2.00 in (50.8 mm)
SMVI40C	6.06 in (153.9 mm)	1.50 in (38.1 mm)	3.00 in (76.2 mm)	5.67 in (144.0 mm)	2.00 in (50.8 mm)

SMVI20

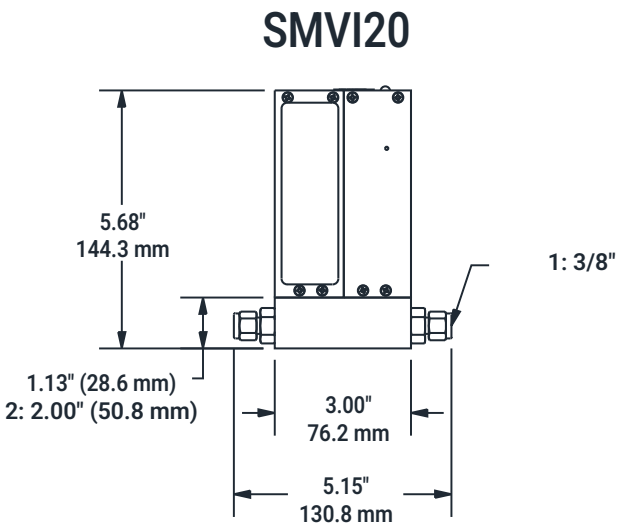


Figure 7-4. SMVI20, front view. 1 Process connection, 3/8 in compression fittings, both sides; 2 Depth.

SMVI30

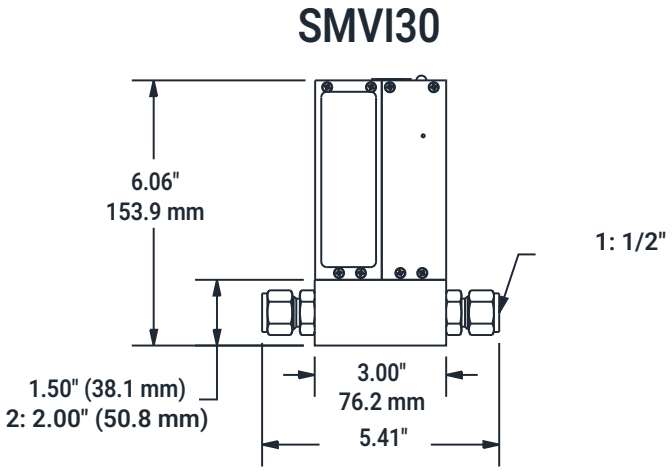


Figure 7-5. SMVI30, front view. 1 Process connection, 1/2 in compression fittings, both sides; 2 Depth.

SMVI40

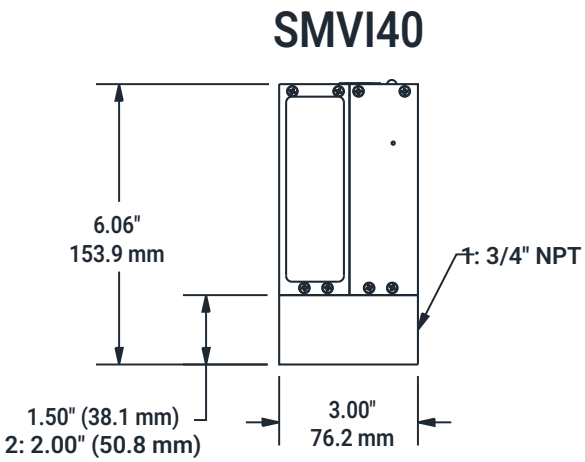


Figure 7-6. SMVI40, front view. 1 Process connection, 3/4 in FNPT port; 2 Depth.

SMVI40C

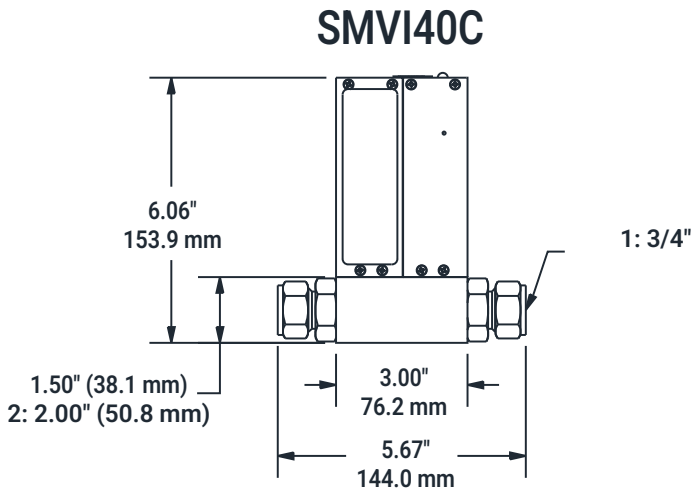


Figure 7-7. SMVI40C, front view. 1 Process connection, 3/4 in compression fittings, both sides; 2 Depth.

Mounting holes

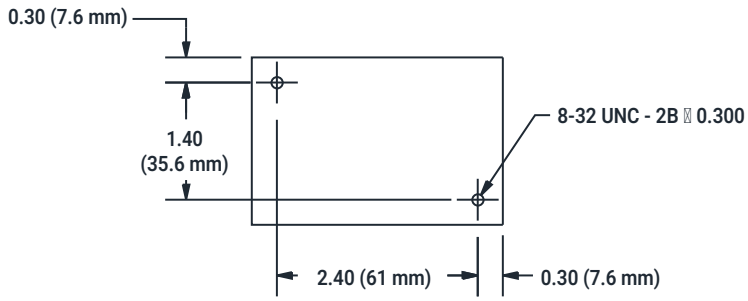


Figure 7-8. Table mounting holes (typical): two 8-32 UNC-2B threads, 0.300 in deep.

CHAPTER 8

Ordering information

Order from Analyt-MTC with the order code. Choose the size for your maximum flow, the material and seals for your gas or liquid, and the control mode and analogue input for your control system.

Order code

The order code is the model number of the valve, which it also returns over RS-485 (command `MR,2`). Example: **SMVI30-SVE6-AA** is an SMVI30 for 500 sL/min (21.11 °C, 1013.25 mbar) in stainless steel, with FKM seals, 1/2 in compression fittings, a universal 12 to 24 V DC power input, Analogue control mode and a 0–5 V DC analogue input.

Table 8-1 Order code, for example SMVI30-SVE6-AA

Position	Codes	Example
Size	20 SMVI20 · 30 SMVI30 · 40 SMVI40	30
Material	A aluminium · S stainless steel	S
Seals	V FKM · B Buna® · E EPR · T PTFE/FFKM	V
Fittings	D 3/8 in compression (SMVI20) · E 1/2 in compression (SMVI30) · F 3/4 in FNPT (SMVI40) · G 3/4 in compression (SMVI40, the SMVI40C)	E
Power	6 universal, 12–24 V DC	6
Control mode	A Analogue (opening) · B Digital RS-485 (all parameters, opening included) · C Direction/Speed · D Step Clock/Direction	A
Analogue input	A 0–5 V DC · B 0–10 V DC · C 1–5 V DC · D 4–20 mA; applies to control modes A and C only	A

The 0–10 V DC analogue input (B) needs a jumper on the circuit board. It cannot be selected later with the push-button or over RS-485, so order it from the start. The other inputs and the control mode can be changed in the field (Multi-function push-button (p. 14)).

Accessories

Table 8-2 Accessories

Description	Order code
RS-485 communication cable, 3 ft, 3.5 mm stereo plug to three stripped wires (one is supplied with each valve)	CBL-A485

CHAPTER 9

Service, warranty and contacts

Repair, replacement and technical support for your valve come from Analyt-MTC. Talk to Analyt-MTC before you send anything: many faults can be traced on the phone.

Contact

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 contact Analyt-MTC

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

- the model number and serial number from the labels on the valve;
- the control mode and analogue input set on the valve;
- a description of the fault and of what you have already checked (Troubleshooting (p. 19)).

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

Sending in a valve

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. Do not put paper forms in the box: the service request carries everything Analyt-MTC needs.

   WARNING

   A valve that has carried hazardous media can hold residues. Residues endanger the people who unpack and service it. Never ship such a valve without purging and neutralizing it.

2. **Decontaminate.** Purge the valve and neutralize all residues of toxic, corrosive, infectious or radioactive media. In the service request, state the substances the valve has been in contact with and their hazards, and confirm the safety declaration online. If you are not sure, do not send it.

3. **Pack the valve alone.** Send the valve without power supply, cables, fittings or case unless they are part of the problem; Analyt-MTC is not responsible for accessories sent. Close the process ports so that nothing enters the flow path, protect the connectors against electrostatic discharge, and pack each valve 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 valve 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 valve 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 valve are those agreed in your order confirmation. Warranty claims are handled by Analyt-MTC: give it the serial number and a description of the fault before you return the valve.

Disposal

Do not dispose of the valve 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.

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AMTC-MN-0049 · Rev. 1 · 2026-10

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