OPERATING MANUAL

SMVI

Intelligent Control Valve

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SMVI Intelligent Control Valve

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Aalborg® reserves the right to make changes to information and specifications in this manual without notice.

⚠ CAUTION:

This product is not intended to be used in life support applications!

⚠ CAUTION:

Some of the IC devices used in the SMVI are static-sensitive and may be damaged by improper handling. When adjusting or servicing the device, use of a grounded wrist strap is recommended to prevent inadvertent damage to the integral solid-state circuitry.

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1. UNPACKING THE SMVI MOTORIZED VALVE

1.1 Inspect Package for External Damage

Your **SMVI Intelligent Control Valve** was carefully packed in a sturdy cardboard carton, with anti-static cushioning materials to withstand shipping shock. Upon receipt, inspect the package for possible external damage. In case of external damage to the package contact the shipping company immediately.

1.2 Unpack the Motorized Valve

Open the carton carefully from the top and inspect for any sign of concealed shipping damage. In addition to contacting the shipping carrier please forward a copy of any damage report to your distributor or Aalborg® directly.

When unpacking the instrument please make sure that you have all the items indicated on the Packing List. Please report any shortages promptly.

1.3 Returning Merchandise for Repair

Please contact the customer service representative of your distributor or Aalborg® if you purchased your Motorized Valve directly, and request a **Return Authorization Number (RAN). Equipment returned without an RAN will not be accepted.** Aalborg® reserves the right to charge a fee to the customer for equipment returned under warranty claims if the instruments are tested to be free from warrantied defects.

Shipping charges are borne by the customer. Items returned "collect" will not be accepted!

It is mandatory that any equipment returned for servicing be purged and neutralized of any dangerous contents including but not limited to toxic, bacterially infectious, corrosive or radioactive substances. No work shall be performed on a returned product unless the customer submits a fully executed, signed SAFETY CERTIFICATE. Please request form from the Service Manager.

2. INSTALLATION

2.1 Primary Gas Connections

Prior to connecting gas lines inspect all parts of the piping system including ferrules and fittings for dust or other contaminants. Be sure to observe the direction of gas flow as indicated by the arrow on the front of the meter when connecting the gas system to be monitored.

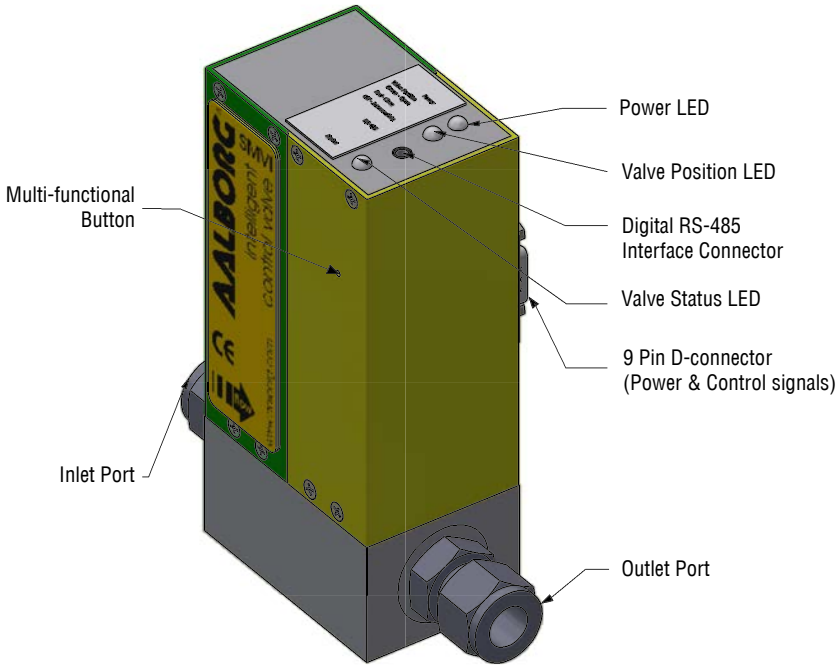
Insert tubing into the compression fittings until the ends of the properly sized tubing home flush against the shoulders of the fittings. Compression fittings are to be tightened according to the manufacturer's instructions to one and one quarter turns. Avoid over tightening which will seriously damage fittings.

SMVI Motorized Valves are supplied with standard 3/8 inch (SMVI-20), 1/2 inch (SMVI-30), or 3/4 inch (SMV-40) inlet and outlet compression fittings.

Using a Helium Leak Detector or other equivalent method perform a thorough leak test of the entire system. (All SMV's are checked prior to shipment for leakage within stated limits. See specifications in this manual.)

SMVI Ports and LED Description

Figure 1



2.2 Electrical Connections

2.2.1 Power Supply Connections

The AC to DC power supply requirements for SMVI Intelligent Control valves are 12 to 24 Vdc, with maximum load current at least 800 mA (unipolar power supply), and maximum ripple below 150 mV P-P. Operating power and valve control signals are supplied via the 9-pin "D" connector located at the side of the valve.

DC Power (+) ---------- pins 5 & 9 of the 9-pin D-connector
DC Power (-) ---------- pins 1 & 6 of the 9-pin D-connector

⚠ **CAUTION: Never apply power voltage above 26Vdc. Doing so may damage the SMVI and/or cause faulty operation. If power is supplied via cable with wire AWG gage 23 or above, both pins (5 & 9) for positive and (1 & 6) for negative polarity must be used. For wire gage 22 and below, only one pin for each polarity can be used.**

⚠ **CAUTION: Make sure power is OFF when connecting or disconnecting any cables or wires to or from the system.**

NOTE: The (+) and (-) power inputs are each protected by a 900mA (medium time-lag) resettable fuse. If a shorting condition or polarity reversal occurs, the fuse will cut power to the valve circuit: disconnect the power to the instrument, correct the faulty condition, and reconnect the power. The fuse will reset once the faulty condition has been corrected.

2.2.2 Analog Input Signals Connections

SMVI Intelligent Control Valves are equipped with calibrated 0-5Vdc, 1-5Vdc, 0-10Vdc or 4-20 mA analog input signals. These linear input signals represent 0-100% of the valve opening position when the valve is configured for ***Analog*** control mode and 0-100% of the valve tip motion speed when the valve is configured for ***Direction/Speed*** control mode. The user may select the desired input analog interface type using a local multifunctional button interface or a digital RS-485 communication interface.

CAUTION: When connecting the source signals to the input terminals, do not exceed the rated values shown in the specifications (see Section 3). Failure to do so might cause damage to this device or signal source equipment. Be sure to check if the wiring and the polarity of the power supply are Correct before turning the power ON. Wiring error may cause damage or faulty operation.

Analog Input (+) ---------- pin 4 of the 9-pin D-connector
Analog Input (-) ---------- pin 1 or 6 of the 9-pin D-connector

NOTE: The Analog Control Mode must be selected (see Section 4.1) to control the valve opening position using analog input signal connections. Similarly, the Direction/Speed Control Mode must be selected to control the valve tip motion speed using analog input signal connections.

When 0-5, 1-5 or 0-10 Vdc input is selected the instrument input impedance is about 100 KOhm. When 4-20 mA input is selected the instrument is functioning as current sinking device with input impedance about 250 Ohm.

**NOTE: 0-10 Vdc analog input option requires additional jumper installation on the PCB and cannot be selected on the field using the user multi-functional button or via digital RS-485 interface. If the 0-10 Vdc option is required, it must be specified during the order.*

⚠ **CAUTION: Do not apply to Pin 4 voltages above 10.5 Vdc. Doing so will damage input circuitry. Do not connect instrument input to "loop powered" signal sources, as they usually powered with power supplies above 12 Vdc and will damage instrument.**

2.2.3 Direction Control Input Connections

SMVI Intelligent Control Valves are equipped with ***Direction*** (digital 5V TTL) input signal. This input signal represents the valve tip motion direction when the valve is configured for ***Direction/Speed*** or Step Clock/Direction control mode. The user may select the desired valve control mode using a local multi-functional button interface or a digital RS-485 communication interface.

Direction Input (+) ---------- pin 8 of the 9-pin D-connector
Direction Input (-) ---------- pin 1 or 6 of the 9-pin D-connector

To ensure a stable logic level, when the ***Direction*** input is floating (not connected to anything), the internal 10K pull-up resistor is implemented to prevent unpredictable behavior in the circuit. The ***Direction*** input's input impedance is about 10K.

⚠ **CAUTION: If nothing is connected to Pin 8, and the valve control mode is set for Direction/Speed or Step Clock/Direction control mode, the Direction input will be in the High logic state, representing the valve needle motion Up to the Open position.**

⚠ **CAUTION: Do not apply to Pin 8 voltages above 12.0 Vdc. Doing so will damage input circuitry.**

Valve tip behavior based on Direction Control Input state:
Valve tip motion direction to ***CLOSE (DOWN)***: TTL Logic Low (<0.8 Vdc);
Valve tip motion direction to ***OPEN (UP)***: TTL Logic High (> 2Vdc).

The Direction Control Input logic state is only applicable (affect valve behavior) when the ***Direction/Speed*** or ***Step Clock/Direction*** control mode is selected.

2.2.4 Step Clock Control Input Connections

SMVI Intelligent Control Valves are equipped with **Step Clock** (digital 5V TTL) input signal. When the valve is configured for **Step Clock/Direction** control mode, each falling edge on this input generates one step motion for the valve tip. The direction of this motion (**Up** to **Open** or **Down** to **Close**) will depend on the logic state of the Direction Control input. The user may select the desired valve control mode using a local multi-functional button interface or a digital RS-485 communication interface.

Step Clock Input (+) ---------- pin 2 of the 9-pin D-connector
Step Clock Input (-) ---------- pin 1 or 6 of the 9-pin D-connector

To ensure a stable logic level, when the ***Step Clock*** input is floating (not connected to anything), the internal 10K pull-up resistor is implemented to prevent unpredictable behavior in the circuit. The ***Step Clock*** input's input impedance is about 10K.

⚠ **CAUTION: Do not apply to Pin 2 voltages above 12.0 Vdc. Doing so will damage input circuitry.**

The ***Step Clock*** Control Input logic state is only applicable (affect valve behavior) when the ***Step Clock/Direction*** control mode is selected.

2.2.5 Valve CLOSE/OPEN override inputs

It may be necessary to override valve control to the fully **CLOSE** or **OPEN** position. Valve **CLOSE** (pin 3) and PURGE (pin 7) override control signals can accomplish this action.

To **CLOSE** valve, pin 3 on the 9-pin "D" connector must be connected to GND (pin 1 or pin 6). A **GREEN** light of the valve position LED on the top valve cover will indicate a **CLOSE** valve condition. To **PURGE** valve, pin 7 on the 9-pin "D" connector must be connected to GND (pin 1 or pin 6). A **RED** light of the valve position LED on the top valve cover will indicate a fully **OPEN** valve condition.

Both valve **Open** and **Close** override control inputs have internal 2K pull-up resistors to +5Vdc to ensure a stable logic level. Open collector NPN transistors, electromechanical or solid-state relays can be used to activate the valve override control signals.

⚠ **CAUTION: Do not apply to Pin 3 and 7 voltages above 5.5 Vdc. Doing so will damage input circuitry.**

2.2.6 Digital RS-485 Communication Interface Connections

Standard digital RS-485 interface implemented using galvanically isolated RS-485 transceiver with high common-mode transient immunity allows direct digital communication with PLC or PC and provides access to all configuration and process variable parameters.

The default baud rate is 9600 baud (user-selectable see **Section 3**, Specifications).

Stop bit: 1
Data bits: 8
Parity: ..... None
Flow Control: ..... None

The RS-485 converter/adapter must be configured for: multi-drop, 2-wire, half duplex mode (see Figure 2). The transmitter circuit must be enabled by TD or RTS (depending on which is available on the converter/adapter). Settings for the receiver circuit should follow the selection made for the transmitter circuit in order to eliminate echo.

PC or PLC RS-485 host adapter	SMVI Audio Connector/cable wire color
RS-485 B- line T(-) or R(-)	**pin 3 on 3-pin Audio-connector, middle section or "ring" SMVI, (cable WHITE wire)**
RS-485 A+ line T(+) or R(+)	**pin 2 on 3-pins Audio-connector, the tip" section SMVI, (cable RED wire)**
RS-485 GND (if available)	**pin 1 on 3-pin Audio-connector, the PC or PLC RS-485 host adapter SMVI Audio Connector/cable wire color "sleeve" section SMVI (GND), (Shield wire)**

Each SMVI instrument is supplied with a default 3-foot length of communication cable (AALBORG P/N: **CBL-A485)** Stereo 3.5 mm plug to three stripped wires. If custom length cable is required, it can be assembled using the connection diagram shown in **Figure 2.**

When the SMVI device is set as the last device on the long (> 100 meters) RS-485 bus segment, the 120 Ω bus termination resistor must be connected between the RS-485 (+) and (-) terminals close (< 6 feet) to this device.

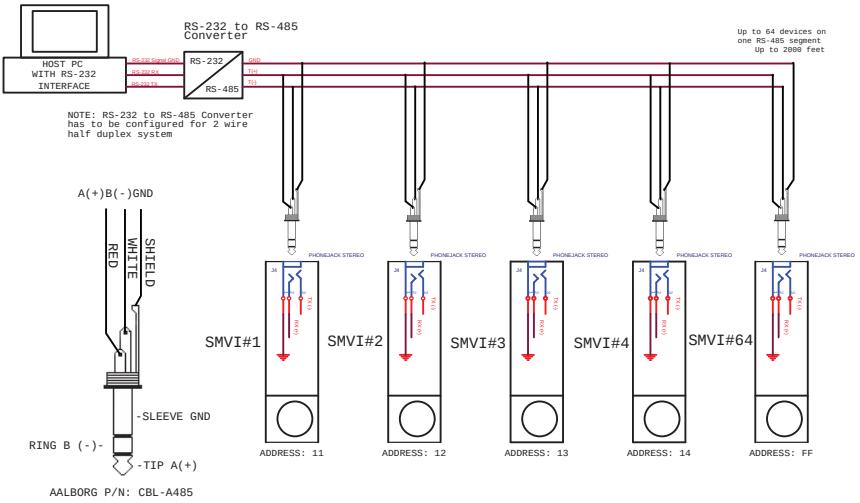
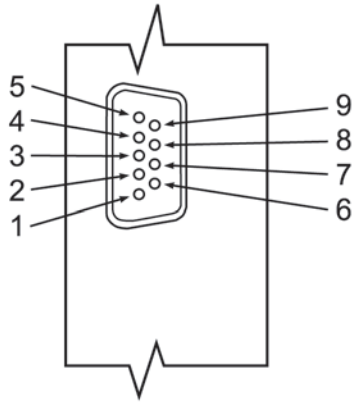


Figure 2 SMVI RS-485 Communication Interface Connections

During normal operation, the valve remains in the last position as it is de-energized. By default, after powering up, the valve will be automatically closed within the first 2-3 seconds and then resume control operation according to the selected operating mode and applied control signals.

PIN FUNCTION



1 Common, Power Supply Minus (-).

2 Step Clock Control Input (5V TTL Active Falling Edge) **Do not exceed 5.5VDC.**

3 Valve Close Override Input (TTL Active Low). **Do not exceed 5.5VDC.**

4 Analog Input (0-5 Vdc, 1-5Vdc, 0-10Vdc, 4-20 mA). **Do not exceed 10.5VDC.**

5 Power Supply Plus (+). Universal 12 to 24 Vdc. **Do not exceed 26VDC.**

6 Common, Power Supply Minus (-). Same as pin 1. Can be used as a reference for pin 4.

7 Valve Open Override Input (TTL Active Low). **Do not exceed 5.5VDC.**

8 Direction Control Input (Digital 5V TTL). **Do not exceed 5.5VDC.**

9 Power Supply Plus (+). Universal 12 to 24 Vdc. **Do not exceed 26VDC.** Same as pin 5.

FIGURE 2.a - 9-PIN "D" CONNECTOR PINOUTS FOR GFM TRANSDUCER.

Important Notes:

In general, "D" Connector numbering patterns are standardized. There are, however, some connectors with nonconforming patterns and the numbering sequence on your mating connector may or may not coincide with the numbering sequence shown in our pin configuration table above. It is imperative that you match the appropriate wires in accordance with the correct sequence regardless of the particular numbers displayed on your mating connector.

Make sure power is OFF when connecting or disconnecting any cables in the system.

The power input is protected by a 900mA M (medium time-lag) reset-table fuse. If a shorting condition or polarity reversal occurs, the fuse will cut power to the valve circuit. Disconnect the power to the unit, remove the faulty condition, and reconnect the power. The fuse will reset once the faulty condition has been removed.

⚠ **CAUTION: Use of the SMVI Intelligent Control Valve in a manner other than that specified in this manual or in writing from Aalborg®, may impair the protection provided by the equipment.**

3. SMVI SPECIFICATIONS

MATERIALS OF CONSTRUCTION:

ALUMINUM MODELS:	Aluminum housings and valve blocks, PFA closing pins.
STAINLESS STEEL MODELS:	316 stainless steel valve blocks, PTFE-lined Aluminum Housing blocks, and PFA closing pins.

Available SEALS options: FKM, Buna, EPR, FFKM.

MAXIMUM FLOW RATES:

SMVI20 200 sL/min (air), 5.6 L/min (water);

SMVI30 500 sL/min (air), 14.2 L/min (water);

SMVI40 1000 sL/min (air), 28 L/min (water).

CONNECTIONS: 3/8", 1/2", ¾" compression, and 3/4" FNPT.

ELECTRICAL CONNECTIONS: 9-pin "D" connector located at the side of the valve.

POWER INPUT: universal 12 to 24 Vdc @ 800mA (maximum current). Power input is protected by a 900 mA resettable fuse.

DIRECTIONAL AND STEP CLOCK CONTROL SIGNAL: Digital 5V TTL (10K input impedance). Do not apply more than 5.5 Vdc.

Direction Control Input:	CLOSE (DOWN):	TTL Logic Low (<0.8 Vdc);
	OPEN (UP):	TTL Logic High (> 2Vdc).

Step Clock Control Input: TTL Active Low
(Motor performs one step at each falling edge).

Valve CLOSE/OPEN override inputs: TTL Active Low (<0.8Vdc). Do not apply more than 5.5 Vdc.

SUPPORTED ANALOG CONTROL SIGNALS:

Linear 0 to 5Vdc, 1-5Vdc, 0-10 Vdc (100K input impedance);

Linear 4-20 mA (250 input impedance).

DIGITAL INTERFACE: isolated RS-485 transceiver (two wires, half duplex).

RESPONSE TIME: 100ms time constant.

PRESSURE DROP @ 100% FULL-SCALE FLOW:

SMVI30 @ 200 sl/min 5 PSID (350 mbar differential)
SMVI30 @ 500 sl/min 7 PSID 490 mbar differential)
SMVI40 @ 1000 sl/min 10 PSID (700 mbar differential)

MAXIMUM OPERATING PRESSURE: 500 PSIG (35 bars).

MAXIMUM DIFFERENTIAL PRESSURE: 50 PSIG (3.45 bars).

ENVIRONMENTAL (PER IEC 664): Installation Level II; Pollution Degree II.

GAS AND AMBIENT TEMPERATURE: 32 °F to 122 °F (0 °C to 50 °C).

INGRESS PROTECTION: IP40.

EXTERNAL LEAK INTEGRITY: 1 x 10^{-7} sccs He maximum
to the outside environment.

INTERNAL LEAK IN CLOSE POSITION: up to 0.5% of full-scale range @ 30 PSID.

WETTED MATERIALS:

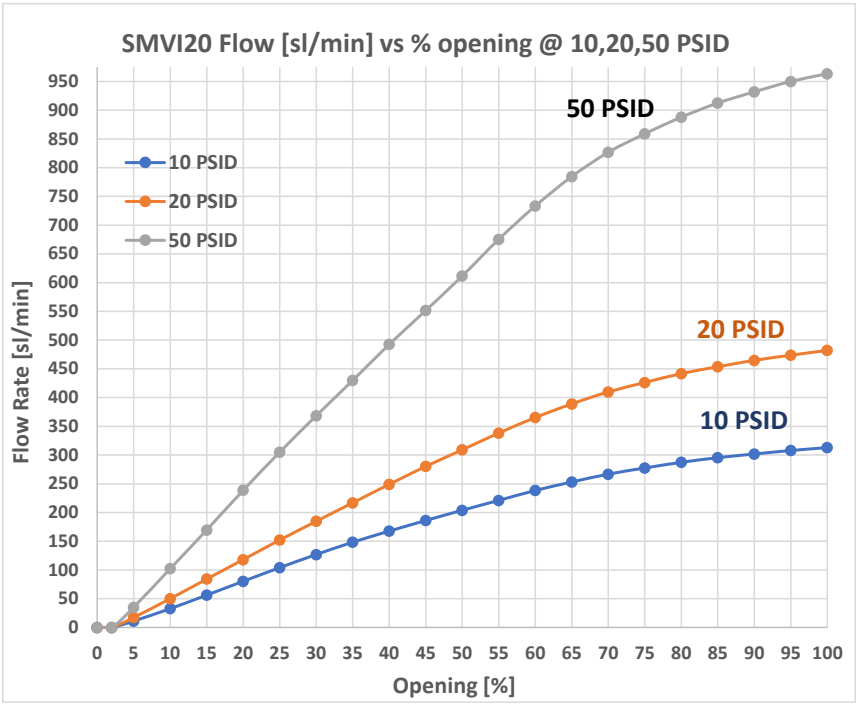
SMVI20-A/SMVI30-A/SMVI40-A: Anodized aluminum, brass, and 316 stainless steel with FKM O-rings seals; BUNA-N®, EPR, or FFKM O-rings are optional.

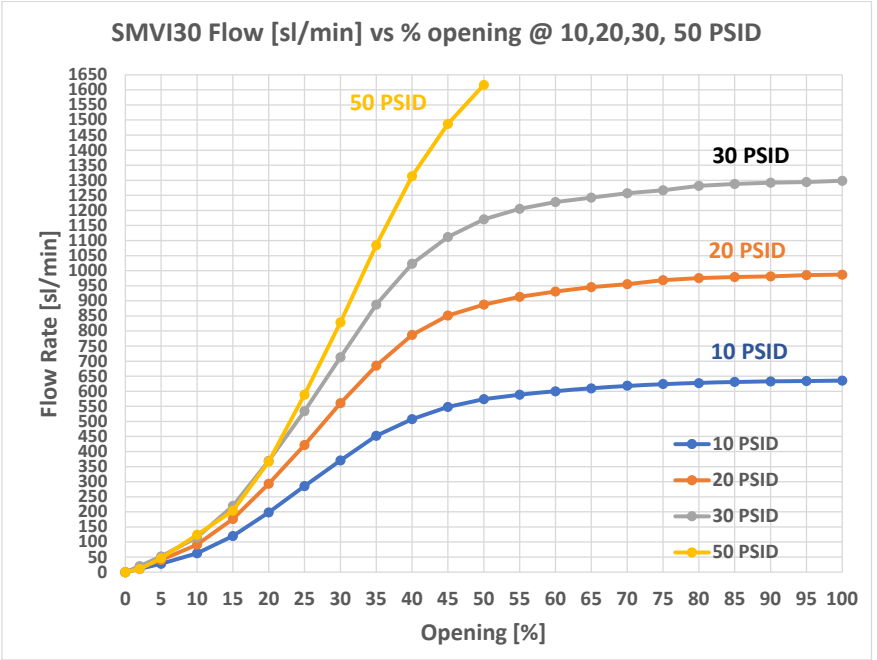
SMVI20-S/SMVI30-S/SMVI40-S: 316 stainless steel with FKM O-rings seals; BUNA-N®, EPR, or FFKM O-rings are optional.

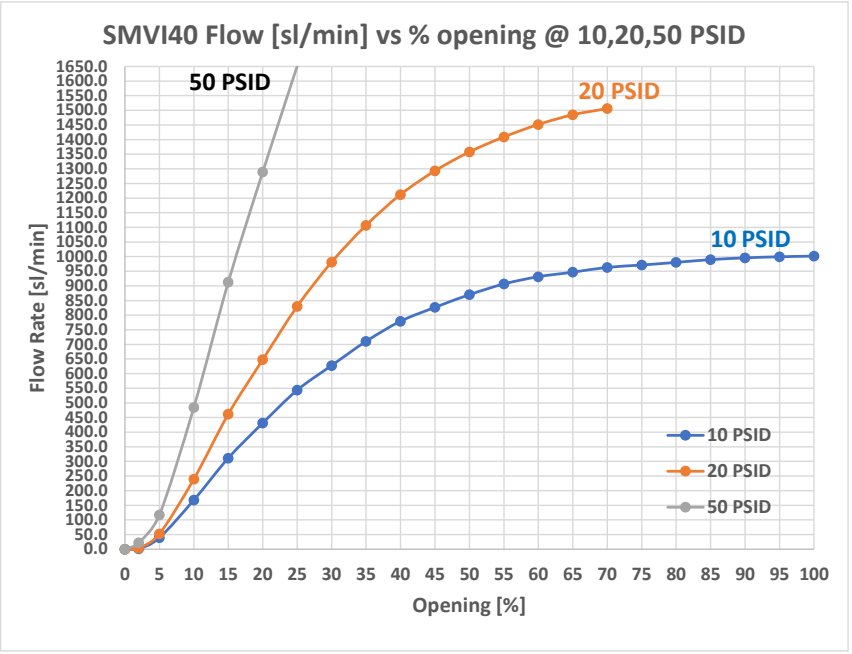
3.1 CE Compliance

Any model SMVI bearing a CE marking on it, is in compliance with the below stated test standards currently accepted.

EMC Compliance with 2014/30/EU as amended. CISPR11
Emission Standard: EN61000-6-3, Group 1, Class A
EN 55011:2009+A1:2010
Immunity Standard: EN61000-6-1, IEC EN 61000-4-2, IEC EN 61000-4-3
EN 61000-4-4:2004+A1:2010
EN 61000-4-6:2013


SMVI20 Flow [sl/min] vs % opening @ 10,20,50 PSID
Flow Rate [sl/min]
Opening [%]
10 PSID
20 PSID
50 PSID
50 PSID
20 PSID
10 PSID


SMVI30 Flow [sl/min] vs % opening @ 10,20,30, 50 PSID
Flow Rate [sl/min]
Opening [%]
50 PSID
30 PSID
20 PSID
10 PSID
10 PSID
20 PSID
30 PSID
50 PSID



FLOW RATE FOR SMVI							
MODEL NUMBERS	MAXIMUM FLOW RATE (at 10 psi differential pressure, 70 °F)				Cv	CONNECTIONS	ORIFICE SIZE
	AIR		H_2O				
	[sL/min]	[scfh]	[L/min]	GPM			
SMVI20	200	424	5.6	1.48	0.336	3/8" compression fitting	3/8"
SMVI30	500	1060	14.2	3.75	0.855	3/8" compression fitting	3/8"
SMVI40	1000	2119	28	7.4	1.735	3/4" FNPT	1/2"

4. OPERATING INSTRUCTIONS

4.1 Valve Auto (Normal Operation)

A high-precision linear stepping motor actuator drives the valve spindle with the needle tip. The standard resolution of the stepping motor actuator-driven needles is 0.000125"/step. In default 1/16 microstepping mode, the resolution is 0.0000078125"/step. The needle travel distance between fully closed and fully open valve positions is approximately 0.2", representing about 25500 micro steps.

NOTE: The valve flow rate is not linearly proportional to the valve opening position. Please refer to the flow rate vs. valve opening position curves for different differential pressures across the valve.

The valve can be controlled using one of the four operating modes:

1. Analog Interface (0-5Vdc, 1-5 Vdc, 4-20mA, 0-10Vdc* options are supported).The valve opening is linearly proportional to the control analog signal in this mode.

NOTE: Analog Input has an Analog Dead Band parameter (EE index 58) that overrides any noise on the analog input to zero. The default Analog Dead Band parameter value is equal to 0.4% FS. The valve position will be zero (Close) when the analog input signal value is below 0.4% of the full-scale value.

2. Digital RS-485 Interface (via optically isolated transceiver using proprietary ASCII commands set). In this mode, the user can control the valve by sending the command with the desired valve opening position expressed in % of valve full opening (0.00 to 100.00% with 0.01% resolution).

3. Direction / Speed (legacy SMV valve proprietary mode). In this mode, the valve is controllable using digital TTL ***"Direction"*** and analog (0-5Vdc, 1-5 Vdc, 4-20mA, 0-10Vdc* options are supported) ***"Speed"*** signals.

Valve tip behavior based on ***Direction*** control input state:
Motion direction to **CLOSE (DOWN): TTL Logic Low** (<0.8 Vdc);
Motion direction to **OPEN (UP): TTL Logic High** (> 2Vdc).
Valve tip behavior based on ***Speed*** analog control input level value:
Based on the selected analog Input signal interface type (0-5Vdc,

1-5Vdc, 0-10Vdc, or 4-20 mA), it represents linearly proportional 0-100% of the valve tip motion speed. The user may select the desired input analog interface type using a local multi-functional button interface or a digital RS-485 communication interface.

4. Step Clock / Direction. In this mode, the valve is controllable using digital TTL (low-active) ***"Step"*** and ***"Direction"*** signals. With each falling edge on the ***"Step Clock"*** input, the valve needle will move one microstep to close or open direction based on the logic level applied to the ***"Direction"*** input.

NOTE: The 100% valve tip motion speed equals 991.8 full steps/ sec. The Analog Input has an Analog Dead Band parameter (EE index 58) that overrides any noise on the analog input to zero. The default Analog Dead Band parameter value is equal to 0.4% FS. The valve tip motion speed will be zero when the analog input signal value is below 0.4% of the full-scale value.

4.2 Valve CLOSE Override Control

It may be necessary or desirable to close the valve momentarily without changing the currently active control signals. To CLOSE valve, pin 3 on the 9-pin "D" connector must be connected to GND (pin 1 or pin 6). A GREEN light of the valve position LED on the top valve cover will indicate a CLOSE valve position Conversely, when the connection is left open, or pin 3 remains unconnected to GND (floating), the valve remains active (executes currently active control signals). The valve will remain active when the VALVE OFF pin remains "floating." This feature is compatible with open collector NPN transistor switches, which are common in the output ports of programmable controllers (PLC) and similar devices. The simplest way to utilize the VALVE CLOSE OVERRIDE control feature is to connect a toggle switch between pin 3 (VALVE CLOSE OVERRIDE) and GND (pins 1 or 6) of the SMVI 9-pin D-connector.

4.3 Valve OPEN Override Control

Opening the valve momentarily may be necessary or desirable without changing the currently active control signals. To OPEN the valve, pin 7 on the 9-pin "D" connector must be connected to GND (pin 1 or pin 6). The valve position LED on the top valve cover will indicate an OPEN valve condition by constant RED light.

Conversely, when the connection is left open, or pin 7 remains unconnected to GND (floating), the valve remains active (executes currently active control signals). The valve will remain active when the VALVE OPEN OVERRIDE pin remains "floating." This feature is compatible with open collector NPN transistor switches, common in the output ports of programmable controllers (PLC) and similar devices. The simplest way to utilize the VALVE OPEN OVERRIDE control feature is to connect a toggle switch between pin 7 (VALVE OPEN OVERRIDE) and GND (pins 1 or 6) of the SMVI 9-pin D-connector.

Note: The valve stays OPEN even if power is no longer applied. To CLOSE the valve when power is applied, connect pins 3 and 1 together.

TABLE II

SMVI VALVE OPERATING MODES SUMMARY

Operating Mode	Required Control Input Signals	Supported Interface Options	Description/Notes
Analog Interface (valve % of opening position control)	Input (+) pin 4 Input (-) pin 1 or 6 of the 9-pin D-connector	0-5 Vdc, 1-5Vdc, 0-10Vdc*, 4-20 mA	Input signals represent 0-100% of the valve opening position
Digital RS-485 Interface (all parameters including % of opening)	RS485 B- line T/R-	pin 3, "ring" of the RS-485 connector	Baud rate: 9600 (default), user-selec table. Data bits: 8 Stop bits: 1 Parity: None Flow Control: None
	RS485 A+ line T/R+	pin 2, "tip" of the RS-485 connector	
	RS485 GND (signal common)	pin 1, "sleeve" of the RS-485 connector (shield wire)	
Direction/Speed (legacy SMV valve mode)	Direction (+) pin 8 Direction (-) pin 1 or 6 of the 9-pin D-connector	CLOSE (DOWN): 5V TTL Logic Low (<0.8 Vdc); OPEN (UP): 5V TTL Logic High (> 2Vdc).	The internal 10K pull- up resistor is implemented to prevent unpredictable behavior in the circuit.
	Speed (+) pin 4 Speed (-) pin 1 or 6 of the 9-pin D-connector	0-5 Vdc, 1-5Vdc, 0-10Vdc*, 4-20 mA	Input signals represent 0-100% of the valve tip motion speed
Step Clock / Direction	Step Clock (+) pin 2 Direction (-) pin 1 or 6 of the 9-pin D-connector	5V TTL Logic Input, each falling edge on this input generates one micro-step motion for the valve tip	The internal 10K pull-up resistor is implemented for both inputs to prevent unpredictable behavior in the circuit. The direction of the valve tip motion (Up to Open or Down to Close) will depend on the logic state of the Direction Control input.
	Direction (+) pin 8 Direction (-) pin 1 or 6 of the 9-pin D-connector	CLOSE (DOWN): 5V TTL Logic Low (<0.8 Vdc); OPEN (UP): 5V TTL Logic High (> 2Vdc).	

NOTE: *The 0-10 Vdc analog input option requires additional jumper installation on the PCB and cannot be selected on the field using a multi-functional button or via a digital RS-485 interface. If the 0-10 Vdc option is required, it must be specified during the order.*

5. MULTI-FUNCTIONAL PUSH-BUTTON OPERATION

The SMVI provides the user with a micro push-button switch accessible via a small hole on the left side of the instrument (see Figure 1). This switch can be used to indicate currently active or select Valve Control modes and Analog Interface options for the instrument. The micro push-button switch functionality is available on all SMVI models in analog and digital operation modes. Pressing a switch briefly (< 6 sec) will not cause unwanted actions but will indicate the currently active **Valve Control Mode** by several **Red** LED flashes [1-4]. The response will be as shown below:

One flash represents **ANALOG POSITION CONTROL**
Two flashes represent **DIGITAL POSITION CONTROL**
Three flashes represent **DIRECTION / SPEED CONTROL**
Four flashes represent **STEP CLOCK / DIRECTION CONTROL**

Releasing the switch during the 6 to 12 seconds time window (period) will indicate the currently active **Analog Interface** option by several **Amber** LED flashes [1-4]. The response will be as shown below:

One	flash represents	**0-5 Vdc**
Two	flashes represent	**0-10 Vdc**
Three	flashes represent	**1-5 Vdc**
Four	flashes represent	**4-20 mA**

Releasing the switch during the 12 to 18-second time window (period) will switch the User Push Button ***(UPB)*** in the **Valve Control** option selection mode. This **UPB** mode will be indicated with the **Green** LED flashing every 2 seconds. Users can start pushing the UPB during the next 16 seconds. Users can select **Valve Control Mode** settings based on the number of times the ***UPB*** is pressed. When ***UPB*** is pressed, the **Green** LED is turned on. Do not release ***UPB*** until the **Green** LED turns off to validate the selection. Once the Green LED is off, it counts as a single count press. When the ***UPB*** is released, the **Red** LED is turned on (ready for the subsequent pressing). Continue pressing the ***UPB*** with the same pattern if more than one press is required based on the desired **Valve Control** mode. Refer to **Table III** for more details regarding **Valve Control Mode** selection.

NOTE: If the user does not press UPB or keeps it pressed for a shorter time interval than required, no action will take place, and the UPB entry will reset to the default state after 16 seconds have elapsed (the Green LED turns to a constantly on state).

Releasing the switch during the 18 to 24-second time window (period) will switch the **User Push Button (UPB)** in the **Analog Interface** option selection mode. This UPB mode will be indicated by the **Red** LED flashing every 2 seconds. Users can start pushing the ***UPB*** during the next 16 seconds. Users can select **Analog Interface** option settings based on the number of times the ***UPB*** is pressed. When ***UPB*** is pressed, the **Green** LED is turned on. Do not release UPB until the **Green** LED turns off to validate the selection. Once the **Green** LED is off, it counts as a single count press. When the ***UPB*** is released, the **Red** LED is turned on (ready for the subsequent pressing). Continue pressing the ***UPB*** with the same pattern if more than one press is required based on the desired **Analog Interface** option. Refer to **Table III** for more details regarding **Analog Interface** option selection.

NOTE: If the user does not press the Push-Button within a 16-second timeframe or keep the push-button pressed for the required time (approximately 2 seconds or until Green LED turns Off), no action will take place. Push-Button entry will reset to the default state and the Green LED turns to constantly On state.

TABLE III:

Status LED Indications using the Multi-Function Push-Button During Normal Running Mode

STATUS LED INDICATION	TIME PUSHED	INSTRUMENT ACTION
Red flashing On/Off every 2 seconds Com. Port Status: **1 – Analog Opening** **2 – Digital Opening** **3 – Direction/Speed** **4 – Step Clock/Direction**	**1-6** seconds	Pressing a switch briefly (< 6 sec) will not cause unwanted actions but will indicate the currently active **Valve Control Mode** by several Red LED flashes [1-4]. 1 time - **Analog Opening** Control 2 times - **Digital Opening** Control 3 times - **Direction/Speed** Control 4 times - **Step Clock/Direction** Control
Amber flashing On/Off every 2 seconds 1 time - **0-5Vdc** 2 times - **0-10 Vdc*** 3 times - **1-5 Vdc** 4 times - **4-20 mA**	**6-12** seconds	Releasing the switch during the **6 to 12** seconds time window (period) will indicate the currently active **Analog Interface** option by several **Amber** LED flashes [1-4]. 1 time - **0-5 Vdc** 2 times - **0-10 Vdc*** 3 times - **1-5 Vdc** 4 times - **4-20 mA**
Green LED flashing On/ Off approximately every 2 seconds. The user has **16 seconds** to select the **Valve Control Mode.** **1 - Analog Opening** **2 - Digital Opening** **3 - Direction/Speed** **4 - Step Clock/Direction**	**12-18** seconds	Releasing the switch during the **12 to 18-** second time window (period) will switch the **User Push Button (UPB)** in the **Valve Control** option selection mode. This **UPB** mode will be indicated with the **Green** LED flashing every 2 seconds. The user can start push-button entry during the next **16** seconds. Users can select **Valve Control Mode** settings based on the number of times the **UPB** is pressed. When UPB is pressed, the **Green** LED is turned on. Do not release **UPB** until the **Green** LED turns off to validate the selection. Once the **Green** LED is off, it counts as a single count press. When the **UPB** is released, the **Red** LED is turned on (ready for the subsequent pressing).
Red LED flashing On/Off approximately every **2 seconds.** The user has **16 seconds** to select the **Analog Interface** option. **1** time - **0-5Vdc** **2** times - **0-10 Vdc*** **3** times - **1-5 Vdc** **4** times - **4-20 mA**	**18-24** seconds	Releasing the switch during the **18 to 24**-second time window (period) will switch the **User Push Button (UPB)** in the **Analog Interface** option selection mode. This **UPB** mode will be indicated by the **Red** LED flashing every 2 seconds. Users can start pushing the **UPB** during the next **16** seconds. Users can select **Analog Interface** option settings based on the number of times the **UPB** is pressed. When the UPB is pressed, the **Green** LED is turned on. Do not release UPB until t the **Green** LED turns off to validate the selection. Once the **Green** LED is off, it counts as a single count press. When the UPB is released, the Red LED is turned on (ready for the subsequent pressing). Continue pressing the **UPB** with the same pattern if more than one press is required based on the desired **Analog Interface** option.

6. RS-485 SOFTWARE INTERFACE COMMANDS

6.1 General

The SMVI instrument has an RS-485 interface. The protocol described below allows for communications with the unit using either a custom software program or a “dumb terminal.” All values are sent as print ASCII characters.

The start character is always '!' . The command string is terminated with the equivalent of a carriage return; line feeds are automatically stripped out by the SMVI firmware. (See Paragraph 2 for information regarding communication parameters and cable connections.)

6.2 Commands Structure

The structure of the command string is as follows:

!<Addr>,<Cmd>,Arg1,Arg2,Arg3,Arg4<CR> Example: !11,F<CR>

Where:

! Addr Start character and RS-485 device address in the ASCII representation of hexadecimal (00 through FF are valid). **

Cmd The one- or two-character command (see examples below).

Arg1 to Arg4 The command arguments (see examples below). Multiple arguments are comma-delimited.
Some commands do not have arguments or they are optional.

CR Carriage Return character.

NOTE: The default RS-485 address for all instruments shipped from the factory is 11. Do not assign the same RS-485 address to two or more devices on the same RS-485 bus. If two or more devices with the same address are connected to one RS-485 network, a communication collision on the bus will result, leading to communication errors.

NOTE: Address 00 is reserved for global addressing. Do not assign the global address to any device. When commands with the global address are sent, all devices on the RS-485 bus execute the command but do not reply with an acknowledgement message.

Several examples of commands are shown below. All assume that the SMVI instrument has been configured for decimal address 18 (12 hex) on the RS-485 bus:

1. To get currently selected valve Control Mode:
   !12,CM<CR>
   The instrument will reply:
   !12,CM:0<CR> (assuming the current Control Mode is "Analog Position" control.

2. To get currently selected valve Analog Interface option:
   !12,AI,M<CR>
   The instrument will reply:
   !12,AIM:0<CR> (assuming 0-5 Vdc analog interface option is active).

3. To set valve opening position to 30% (assuming Control Mode is Digital):
   !12,VP,30.0<CR>
   The instrument will reply:
   !12,VP:1,30.0<CR> (assuming the valve Control Mode is Digital).

4. To read the valve Motor Status register:
   !12,S<CR>
   The instrument will reply:
   !12,S:0xE7F3,0x1F<CR>
   (Note: actual value of the Motor Status register will depend on motor operation mode and valve tip position).

5. To read current valve home position status:
   !12,V<CR>
   The instrument will reply:
   !12,V:C<CR> (assuming the valve is in home CLOSE position).

6. To read valve Absolute position (in micro steps) and speed parameters:
   !12,S<CR>
   The instrument will reply:
   !12,25356,25355,238<CR>
   where: 25356 is valve current absolute position in micro steps;
   25355 is valve target absolute position according to current valve position in %FR in micro steps; 238 is valve motor current speed in steps per second.

TABLE IV: AALBORG SMVI ASCII SOFTWARE INTERFACE COMMANDS

Note: An "*" indicates power up default settings.
An "**"indicates optional feature not available on all models

COMMAND NAME	DESCRIPTION	No.	COMMAND SYNTAX					
			Command	Argument 1	Argument 2	Argument 3	Argument 4	Response
Control Mode	Reads / Set the valve **Control Mode** parameter The supported values for **Control Mode** parameter: 0 - Analog valve opening control mode 1 - Digital valve opening control mode 2 - Speed / Direction control mode 3 - Clock Step / Direction control mode	1	**CM**	NO ARGUMENT (read only)				CM:<Value> (Actual valve Control Mode parameter value [0-3].) Example: CM:0
				<Value> **[0 to 3]**				CM:<Value> (Actual valve Control Mode parameter value [0-3]. Example: CM:0
Analog Interface	Reads / Set the valve **Analog Interface** option parameters The supported values for **Analog Interface Mode** parameter: 0 - 0-5Vdc 1 - 0-10 Vdc 2 - 1 - 5 Vdc 3 - 4-20 mA The supported values for **Analog Interface Damping** parameter: 0 - 100 The supported values for **Analog Interface Dead Band** parameter: 0.0 to 2.0% (default value is 0.4%)	2	**AI**	**M**	NO ARGUMENT (read only)			AIM:<Value> (Actual valve Analog Interface Mode prameter value [0-3].) Example: AIM:0
					<Value> **[0 to 3]**			
				D (Damping)	NO ARGUMENT			AID:<Value> (Actual Analog Interface Damping parameter value. Example: AID:10
					<Value> **[0 to 100]**			
				B (Dead Band)	No Argument (read only)			AIB:<Value> (Actual Analog Interface Dead Band parameter value. Example: AIB:0.40
					<Value> [0 to 2%]			

COMMAND NAME	DESCRIPTION	No.	COMMAND SYNTAX					
			Command	Argument 1	Argument 2	Argument 3	Argument 4	Response
Valve Opening Position	Read / Set the valve **Tip Opening Position** in % of valve full span (0 - 100%). 0% - Valve is fully closed. 100% - Valve fully open. Response Parameters: <M Value > Active Valve Control Mode [0-3]. <P Value> Valve Tip Opening Position [0-100%]	3	**VP**	NO ARGUMENT (read only)				VP:<M Value>, <P Value> Where: <M Value> Active Control Mode <P Value> Actual Opening Position Example: VP:1, 50.000 Control Mode: Digital Opening Position: 50.000%
				<Value> (0 to 100%)				
Valve Home Position	Read valve **Home Position** The supported values for **Valve Home Position** parameter: **C - Home Close** **O - Home Open** **I - Intermediate**	4	**V**	NO ARGUMENT (read only)				V:<Value> (Actual valve Home Position) Example: V:C Valve in Home Close position.
Valve Absolute Position	Read valve **Absolute Position** The instrument reply with 3 parameters: **Actual Absolute Position** (0 to -25### micro steps) **Target Absolute Position** (0 to -25### micro steps) Actual Motor Speed (0 to 992 motor full steps per second) **Note: The actual maximum value of the Absolute Position depends on the valve factory adjustment and may differ for each valve.**	5	**AP**	NO ARGUMENT (read only)				AP:<A Value>,<T Value>, <S Value> Example: AP:-11576,-11576, 0.00 Assuming the valve actual and target position equal to -11576 micro steps and motor speed is 0.00 steps/sec.

COMMAND NAME	DESCRIPTION	No.	COMMAND SYNTAX					
			Command	Argument 1	Argument 2	Argument 3	Argument 4	Response
Valve Close Override at Power Up	Read / Set the valve **Close Override at Power Up** parameter (0 - Disabled; 1 - Enabled) The supported values for **Close Override at Power Up** parameter are: 0 - Disabled 1 - Enabled	6	**PC**	NO ARGUMENT (read only)				PC:<Value> Where: < Value> is equal to 0 or 1 Example: PC:1 During power up event valve first will be forced to Close position
				<Value> (0 to 1)				
Analog Input ADC counts	Read raw and average **Analog Input ADC** counts	7	**A**	NO ARGUMENT (read only)				A:<R Value> , <A Value) <R Value> Raw ADC counts <A Value> Average ADC counts Example: A:351, 352
Valve Mark Position	Read valve **Mark Position** (valve tip in fully open position) The instrument reply with 2 parameters: **Actual Absolute Position** (0 to -25### micro steps) **Mark Position** (0 to -25### micro steps)	8	**MP**	NO ARGUMENT (read only)				MP:<A Value>,<M Value> Example: AP:0,-25376 Assuming the valve actual position equal to -0 micro steps (closed) and Mark position is -25376 micro steps.
Valve Hard HiZ State	Immediately disables the motor power bridges (high-impedance state). When bridges are disabled the **HiZ** flag is raised. When the motor is stopped, a **Hard HiZ** command forces the bridges to enter highimpedance state.	9	**HZ**	NO ARGUMENT (read only)				HZ:Done

<table>
<tr><th>COMMAND NAME</th><th>DESCRIPTION</th><th>No.</th><th colspan="5">COMMAND SYNTAX</th></tr>
<tr><th></th><th></th><th></th><th>Command</th><th>Argument 1</th><th>Argument 2</th><th>Argument 3</th><th>Argument 4</th><th>Response</th></tr>
<tr><td>Motor and Valve status Registers</td><td>Read Motor and Valve hardware status registers

Motor Status Register Bits description:
Bits Parameter Description</td><td>10</td><td>S</td><td>NO ARGUMENT (read only)</td><td></td><td></td><td></td><td>S:<M Register>,<V Register>
Where:
<M Register> is Motor Status Register
<V Register> is Valve Status Register

Example:
S:0x7E1E, 0x10</td></tr>
<tr><td colspan="9">
<table>
<tr><td>0</td><td>High Impedance State [HiZ]</td><td>0 - Disabled; 1 - Enabled</td></tr>
<tr><td>1</td><td>Motor is Busy [BUSY]</td><td>1 - Disabled; 0 - Enabled</td></tr>
<tr><td>2</td><td>Home Position switch is Active [SW_F]</td><td>0 - Open; 1 - Close</td></tr>
<tr><td>3</td><td>H. Position switch turn-on event [SWEVN]</td><td>0 - Active; 1 - Not Active</td></tr>
<tr><td>4</td><td>Motor Direction [DIR]</td><td>0 - Reverse (Up) 1 - Forward (Down)</td></tr>
<tr><td>5,6</td><td>Motor Motion State [MOT_ST]</td><td>0 - Not Active; 1 - Active</td></tr>
<tr><td>7</td><td>Command Can't be performed [NOTPERF]</td><td></td></tr>
<tr><td>8</td><td>Wrong Command [WRONG_CMD]</td><td>0 - Not Active; 1 - Active</td></tr>
<tr><td>9</td><td>Under voltage Lockout or Reset [UVLO]</td><td>0 - Active; 1 - Not Active</td></tr>
<tr><td>10</td><td>Thermal Warning Event [TH_WRN]</td><td>0 - Active; 1 - Not Active</td></tr>
<tr><td>11</td><td>Thermal Shutdown Event [TH_SD]</td><td>0 - Active; 1 - Not Active</td></tr>
<tr><td>12</td><td>Over current Detection Event [OCD]</td><td>0 - Active; 1 - Not Active</td></tr>
<tr><td>15</td><td>Motor in Step-Clock Mode [SCK_MOD]</td><td>0 - Not Active; 1 - Active</td></tr>
</table>
Motor Motion State bits [5,6]:
0,0 Stopped
0,1 Acceleration
1,0 Deceleration
1,1 Constant speed
</td></tr>
<tr><td colspan="9">Valve Status Register Bits description:
<table>
<tr><th>Bits</th><th>Parameter Description</th></tr>
<tr><td>0</td><td>Home Close Time Out Flag [HC_TO]</td></tr>
<tr><td>1</td><td>Home Open Time Out Flag [HO_TO]</td></tr>
<tr><td>2</td><td>EEPROM Initialization Event Flag [EE_INIT]</td></tr>
<tr><td>3</td><td>Fatal Error Flag [FE]</td></tr>
<tr><td>4</td><td>Valve HOME CLOSE Switch Activated Flag [HC_ACT]</td></tr>
<tr><td>5</td><td>Valve HOME OPEN Switch Activated Flag [HO_ACT]</td></tr>
<tr><td>6</td><td>Valve Force Close Override input is active [HC_OVR]</td></tr>
<tr><td>7</td><td>Valve Force Open Override input is active [HO_OVR]</td></tr>
</table>
NOTE: The corresponding event is active if the Valve Status Register Bit is set to 1.
</td></tr>
</table>

COMMAND NAME	DESCRIPTION	No.	COMMAND SYNTAX					
			Command	Argument 1	Argument 2	Argument 3	Argument 4	Response
Com. Port Baud Rate	Read / Set the valve **Communication Port Baud Rate** parameter. Supported values for UART baud rate parameter are:1200,2400,4800,9600*, 19200, 38400, 57600, 115200 **Note:** If the baud rate value changed, the instrument power must be cycled for the new value to take effect.	11	**CB**	NO ARGUMENT (read only)				CB:<Value> Where: < Value> is current UART baud rate Example: CB:9600 **Note:** If the baud rate value changed, the instrument power must be cycled for the new value to take effect.
				<Value> (1200, 2400, 4800, 9600*, 19200, 38400, 57600, 115200)				
Maintenance Pilot Timer	Read / Reset **Maintenance Pilot Timer.**	12	**T**	NO ARGUMENT (read only)				T:<Value> Example: T:12.5 Where: <Value> time in
				Z (reset timer)				T:Z
Read Diagnostic Registers	**Read** Instrument **Diagnostic Registers** For Arg. 0 instrument reply with 2 parameters: **ADC Raw Counts** (0 to 4095) **ADC Average Counts** (0 to 4095.0) For Arg. 1 instrument reply with 1 parameter: **Analog Input** scaled in % of full scale range.	13	**READ**	**0** (read only)				ADC0:<R Value>,<A Value> Example: ADC0:2, 1.8
				1 (read only)				SP_A:<Value> Where: <Value> is Analog Input value in %FS Example: SP_A: 25.00
Read EEPROM Memory Index	Read the value of the specified EEPROM Index. Read Only command.	14	**MR**	0-119 (EEPROM Memory Index) (read only)				<Value> Example: MR,2 command returns instrument Model Number SMVI20-AVD6-AA

COMMAND NAME	DESCRIPTION	No.	COMMAND SYNTAX					
			Command	Argument 1	Argument 2	Argument 3	Argument 4	Response
Write EEPROM Memory	Writes specified in the Arg. 2 value to the specified in the Arg. 1 EEPROM Index location. **Warning: Use carefully! It can cause the instrument to malfunction. EEPROM addresses from 0 to 39 are write-protected. The instrument EEPROM parameters were set in the factory to ensure the best performance. Only change EEPROM parameters if instructed by factory technical support representatives.**	15	**MW**	40 to 119 (EEPROM Memory Index) **NOTE: Indexes 0 to 39 are write protected**	<Value>			COMMAND: <Value> MWMW,XXX,<Value> where: XXX= EEPROM INDEX Command Example: MW,43,12 Reply Example: MW,43,12 **Above example changes instrument RS-485 address in EEPROM index 43 to 12.**
	UART Error Codes: 1 – Command Not Supported or Back Door is not enabled. 2 – Wrong# of Arguments 3 – Address is Out of Range (MR or MW commands) 4 – Wrong# of the characters in the Argument 5 – Attempt to alter Write-Protected Area in the EEPROM 6 – Proper Command or Argument not found 7 – Wrong value of the Argument 8 – Manufacturer-specific information EE access KEY (wrong key or key is disabled)							

7. TROUBLESHOOTING

7.1 Common Conditions

Your SMVI motorized valve was thoroughly checked at numerous quality control points during and after manufacturing and assembly operations.

It was carefully packed to prevent damage during shipment. Should you feel that the instrument is not functioning properly please check for the following common conditions first:

✓ Are all cables connected correctly?

✓ Are there any leaks in the installation?

✓ Is the power supply correctly selected according to requirements? When several instruments are used a power supply with appropriate cur rent rating should be selected.

✓ Were the connector pinouts matched properly? When interchanging with other manufacturers' equipment, cables and connectors must be carefully wired for correct pin configurations.

7.2 Troubleshooting Guide

INDICATION	LIKELY REASON	REMEDY
no response to "speed" and "direction" control signals	inadequate gas pressure	apply appropriate gas pressure
	cable or connector malfunction	check cables and all connections or replace
	valve out of adjustment	return to factory for repair / replacement
valve does not work in OPEN position	incorrect valve adjustment	return to factory for repair / replacement
	pc board defect	return to factory for repair / replacement
	cable or connectors malfunction	check cable and connectors or replace
valve does not work in CLOSE position	incorrect valve adjustment	return to factory for repair / replacement
	pc board defect	return to factory for repair / replacement
	cable or connectors malfunction	check cable and connectors or replace

For best results it is recommended that instruments are returned to the factory for servicing. See section 1.3 for return procedures.

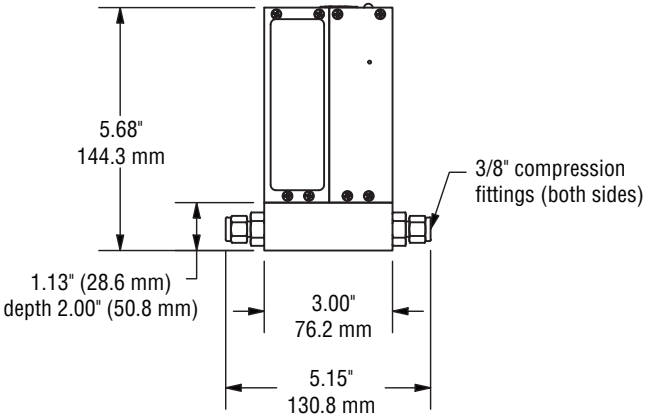
7.3 Technical Assistance

Aalborg® Instruments will provide technical assistance over the phone to qualified repair personnel. Please call our Technical Assistance at 800-866-3837. Please have your Serial Number and Model Number ready when you call.

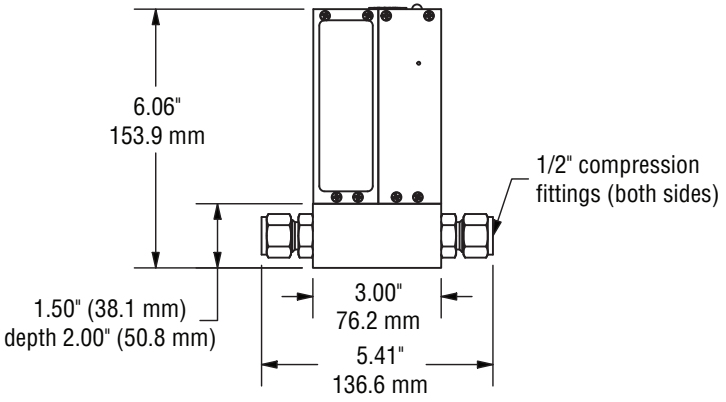
APPENDIX 1

SMVI MOTORIZED VALVE

SMVI20

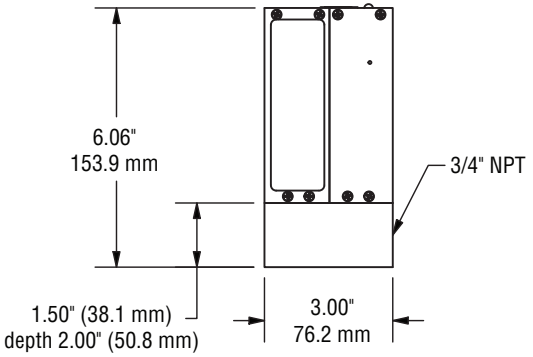


SMVI30

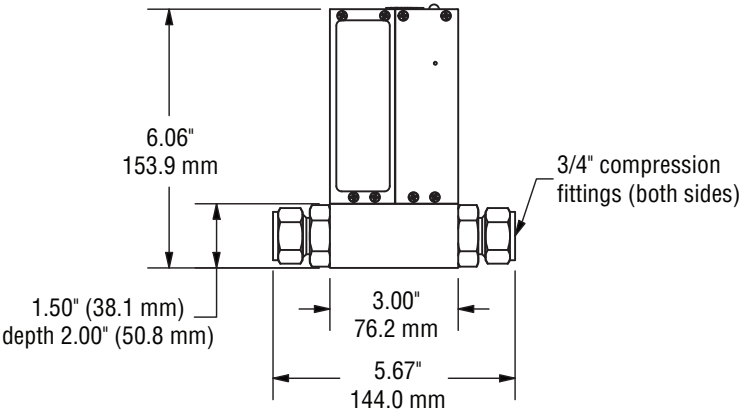


NOTES: Aalborg® reserves the right to change designs and dimensions at its sole discretion at any time without notice. For certified dimensions please contact Aalborg®.

SMVI40

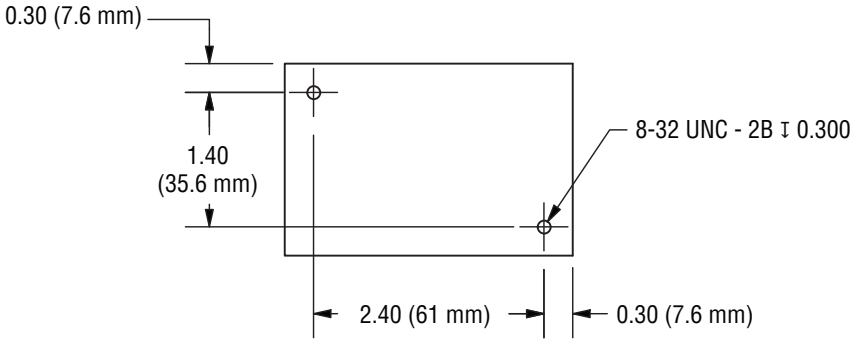


SMVI40C



NOTES: Aalborg® reserves the right to change designs and dimensions at its sole discretion at any time without notice. For certified dimensions please contact Aalborg®.

Table Mounting Holes (Typical)



NOTES: Aalborg® reserves the right to change designs and dimensions at its sole discretion at any time without notice. For certified dimensions please contact Aalborg®.

APPENDIX 2

WARRANTY

Aalborg® SMVI valves are warranted against parts and workmanship for a period of one year from the date of purchase. It is assumed that equipment selected by the customer is constructed of materials compatible with gases or liquids used. Proper selection is the responsibility of the customer. It is understood that gases under pressure present inherent hazards to the user and to equipment, and it is deemed the responsibility of the customer that only operators with basic knowledge of the equipment and its limitations are permitted to control and operate the equipment covered by this warranty. Anything to the contrary will automatically void the liability of Aalborg® and the provisions of this warranty. Defective products will be repaired or replaced solely at the discretion of Aalborg® at no charge. Shipping charges are to be borne by the customer. This warranty is void if the equipment is damaged by accident or misuse, or has been repaired or modified by anyone other than Aalborg® or factory authorized service facility. This war-ranty defines the obligation of Aalborg® and no other warranties expressed or implied are recognized.

NOTE: Follow Return Procedures In Section 1.3.

ASIAN SERVICE FACILITY

Authorized Repair and Service Facility for Aalborg Thermal Mass Flow Systems

AALBORG-Beijing Comity

MEASURE & CONTROL CO.

Floor 1 Tower B Jindayuan Office Building
Xisanqi, Hai Dian District, Beijing, China

Phone: 86-10-6295-0464, 86-10-6295-0465
Fax: 86-10-6295-0466
Website: http://www.comity-tec.com

EUROPEAN SERVICE FACILITY

Authorized Repair and Service Facility for Aalborg Thermal Mass Flow Systems

AALBORG-ANALYT-MTC

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Fax: +49 (0)7631 14740
Website: www.analyt-mtc.de
e-mail: info@analyt-mtc.de

175, avenue d'Alsace
68000 COLMAR
Tel: 03 89 41 47 78
Fax: 03 89 41 59 88
e-mail: ANALYT_MTC@T-online.de

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Aluminum / Brass / Stainless ● Interchangeable Glass Flow Tubes ● Optional Valves

Multiple Tube
Two to Six Channels ● Aluminum or Stainless

PTFE Single and Multiple Tube
Chemically Inert ● 1 to 4 Channels ● Interchangeable Glass Flow tubes

PTFE - PFA
Chemically Inert ● Low to Medium Flow of Corrosive Liquids with PFA Flow Tube

Kits
Aluminum / Stainless / PTFE ● Including Five Glass Flow Tubes and a Set of Floats

Gas Proportioners
Aluminum / Stainless ● Used for Blending Two or Three Gases

Medium Range
Glass Safety Shield ● Dual Air and Water Scale

Optical Sensor Switch
Non-Invasive Means for Detection of a High or Low Flow

High Flow Industrial Stainless Steel Flow Meters
Heavy Duty Stainless Steel ● Direct Reading Air and Water Scales

VALVES

Barstock
Brass or Stainless ● Standard or High Precision

PTFE
Chemically Inert ● Needle or Metering

Proportionating Solenoid
Stainless ● For Controlling Gas or Liquid Flow ● Pulse width Modulated

SMV ● Stepping Motor Valve

PERISTALTIC PUMPS

Fixed RPM Pumps

Pump Heads

Tubing Pumps

Variable Speeds

Dispensing Pumps

Flexible Tubings

ELECTRONIC METERS & CONTROLLERS

Low Cost Mass Flow Meters
Aluminum or Stainless ● With or Without LCD Readout

Low Cost Mass Flow Controllers
Aluminum or Stainless ● With or Without LCD Readout

Mass Flow Controllers
Stainless ● One to Four Channel Systems

Digital Mass Flow Controllers
Auto Zero ● Totalizer ● Alarms ● Built in RS485

Multi Parameter Digital Mass Flow Meters
Displays Flow Pressure and Temperature

Paddle Wheel Meters
For Liquids ● Optional Temperature Measurements

Vortex In-Line and Insertion Flow Meters
Steam / Liquid and Gas Service

Smart Rate / Totalizer / Signal Conditioner
LCD Keypad ● RS232 / 485 ● Pulse Output ● Alarms

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