

Digital Valve Control Module (VCM)



User's Manual

This manual contains important information for the safe and effective operation of the Swagelok® digital valve control module. Users should read and understand its contents before operating the valve control module.

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Safety

Signal Words Used in this Manual

NOTICE Statements that indicate a hazardous situation which, if not avoided, could result in damage to the equipment or other property.

Introduction

The Swagelok VCM uses a sophisticated control and monitoring system to operate up to six pneumatic stream selecting valves or other discrete valves. This compact system reduces complicated cabling and minimizes overall power consumption.

The solenoid pilot valves are connected to a common air supply inlet and a common exhaust or vent. Each pilot valve is also connected to a dedicated outlet used to actuate an external, pneumatic stream selecting valve or other discrete valve.

An indicator LED shows activation status for each pilot valve. Additionally ODVA-compliant DeviceNet indicators show module and network status.

Each VCM contains a DeviceNet network interface. The interface includes power for energizing the electronics inside the VCM and the communication signals, which allow a programmable logic controller (PLC) or similar system controller to exchange digital data with the VCM. Using the DeviceNet network, each pilot valve can be commanded to open a pneumatic flow path between the supply inlet and the associated outlet. The VCM pilot valves are normally closed and will open a flow path between the exhaust and the associated outlet in this position. See Fig. 1.

The VCM is available with proximity sensor inputs and various ingress protection options. Inputs connect to proximity sensors integrated into the external valves actuated by the VCM. The VCM can be configured to monitor the sensor inputs and return the sensor state as part of the DeviceNet poll message response.

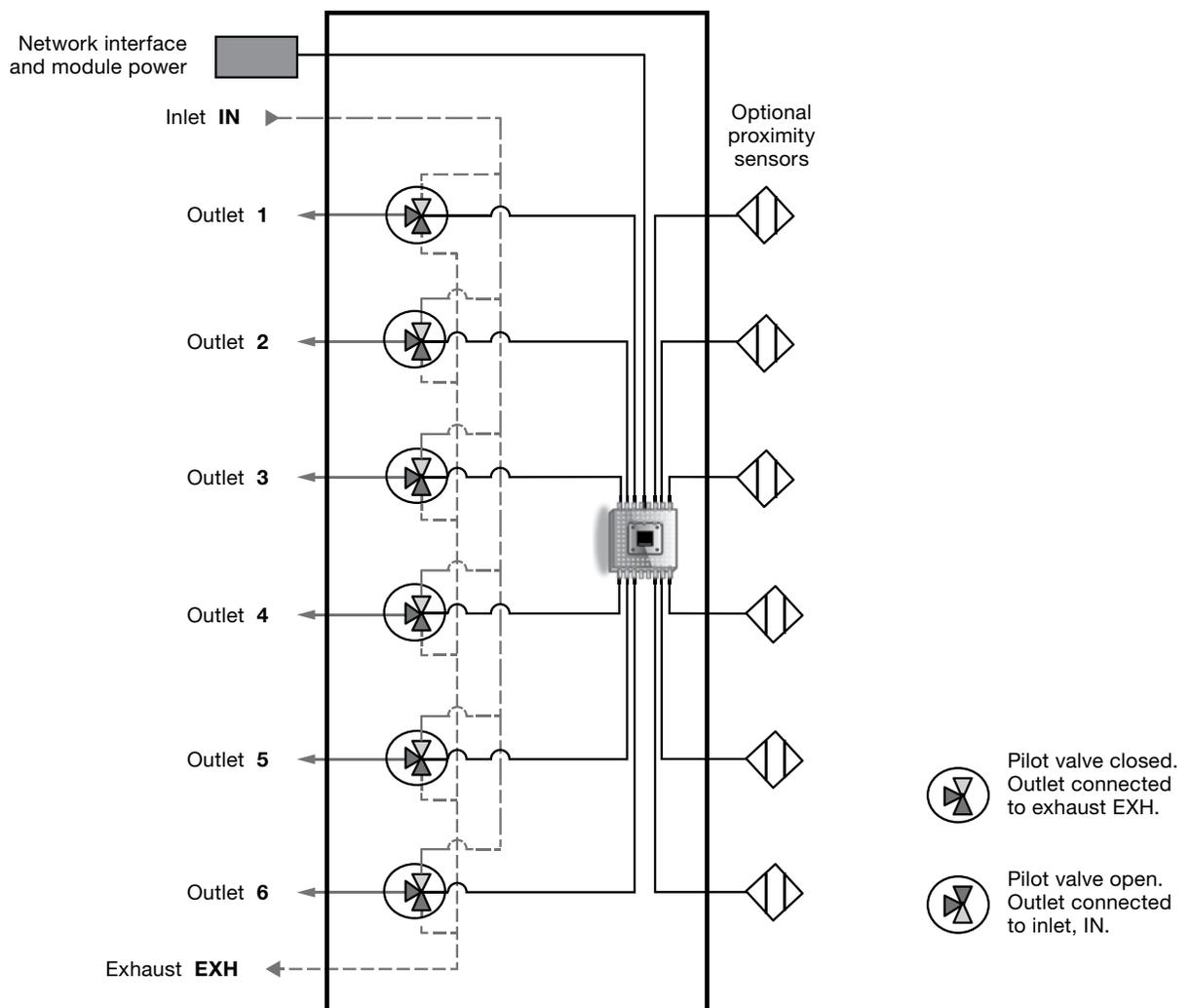


Fig. 1 VCM Schematic

Product Information

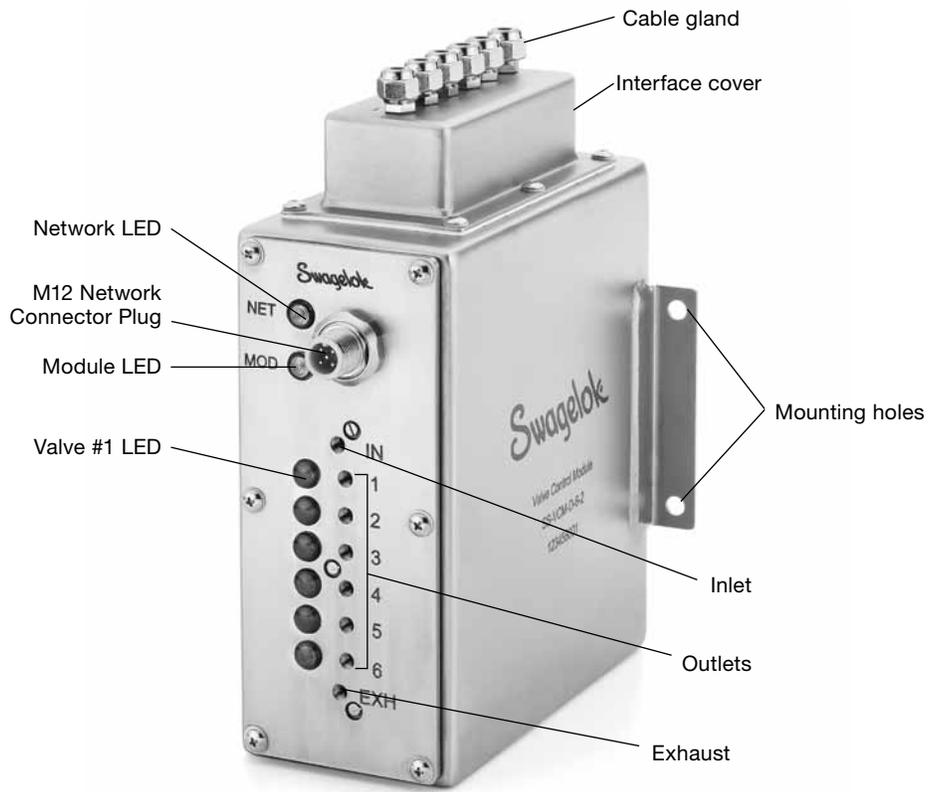


Fig. 2 MS-VCMD-6-2

Specifications

Power		
Voltage	24 V (dc), nominal	
Current	< 310 mA (dc) at 24 V (dc)	
Wattage	< 7.5 W at 24 V (dc)	
Temperature		
Operating (Ambient)	Minimum	23°F (-5°C)
	Maximum	122°F (50°C)
Media	Minimum	23°F (-5°C)
	Maximum	122°F (50°C)
Storage	Minimum	-4°F (-20°C)
	Maximum	140°F (60°C)
Weight	3.5 lb (1.6 kg)	
Ingress Protection	IP64	
Inlet Air	Pressure	40 to 116 psig (1.6 to 7.9 bar)
	Air Quality	Filtered compressed air, lubricated or unlubricated, grade of filtration 40 µm
Entity Parameters	See control drawing VCM-DN-0011-SCHEDULE on page 6.	
Supported Communication Baud Rates	Auto-baud function, allowing the device to detect the speed of network traffic. It is compatible with 125, 250, and 500 kbaud rates.	

Note: Before installing the VCM in a hazardous location, review the control drawing on page 6. This will help ensure all electrical connections to and from the VCM comply with safety requirements. For an electronic copy of this document, see Swagelok.com

Control Drawing

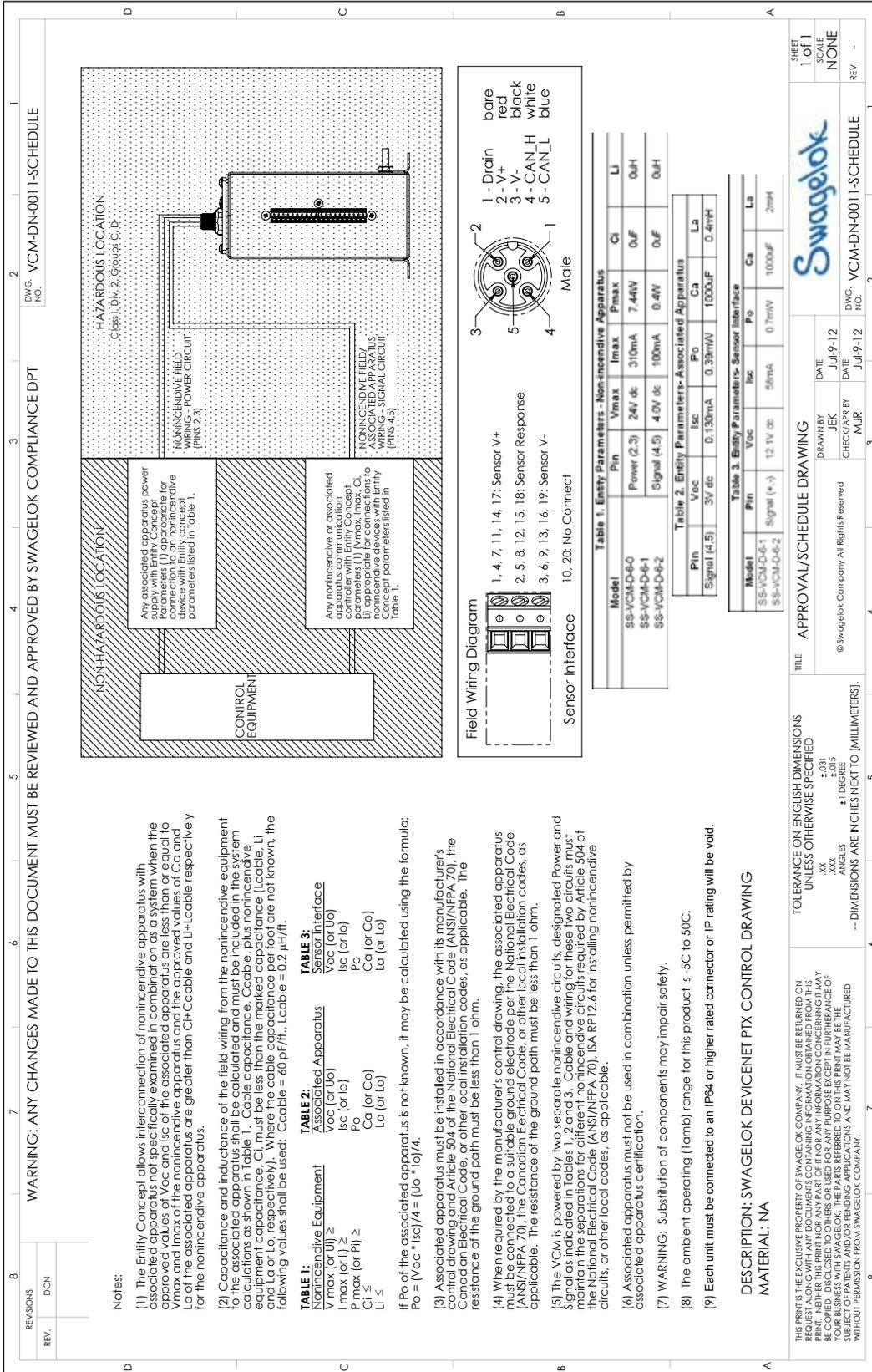


Fig. 3 VCM-DN-0011 SCHEDULE

Installation

Mounting

The VCM can be mounted using the mounting holes located on the feet of the enclosure. Mounting holes on the feet of the device are 0.22 inches (5.6 mm) in diameter, and can accommodate a #10 or M5 machine screw. Tighten the screws to wrench tight.

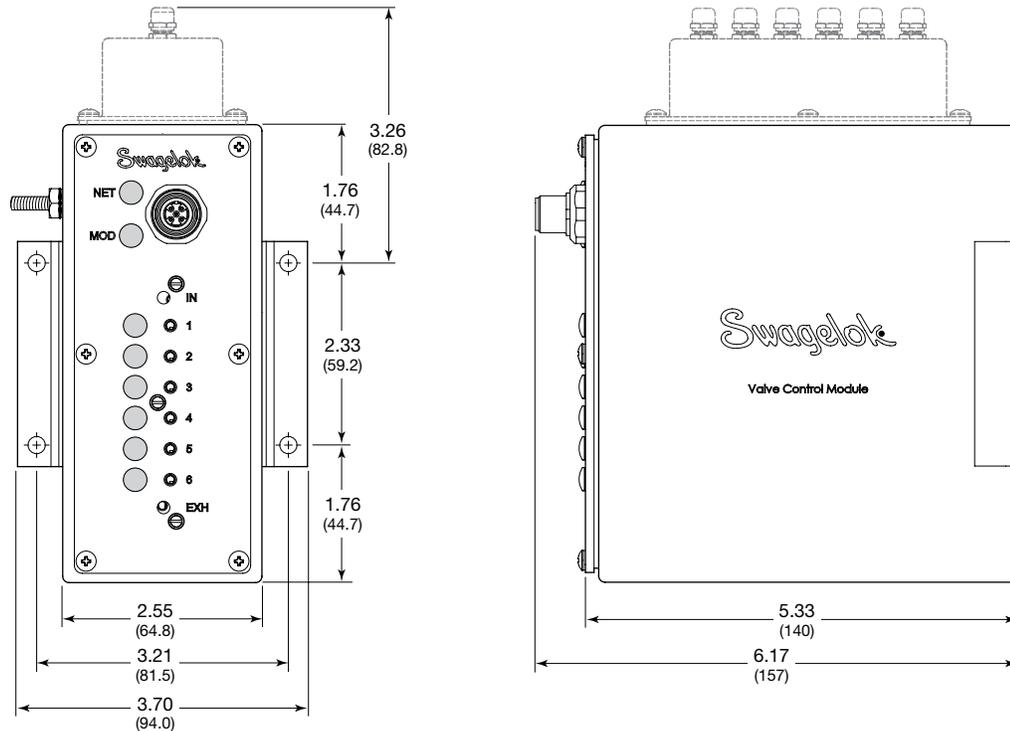


Fig. 4 Mounting Diagram

Grounding

The VCM must be grounded while in operation. This unit can be grounded either through the surface to which it is mounted (in the event that the VCM is mounted to a grounded plate), or a grounding wire attached to the ground lug on the side of the VCM. The ground lug is a #10-32 thread and can accommodate a #10 ring lug connector. The grounding wire should be at least 12 AWG wire. The total resistance between the VCM and ground should be less than 1 Ω .

Air Supply Quality

The supply air must be filtered to ensure that particles larger than 40 μm have been removed. The air can be lubricated or unlubricated.

Power Supply

Power supply voltage must be within the range of the DeviceNet standard, which states:

24 volts $\pm 1\%$ or adjustable to 0.2 %. Use of a lower voltage network power supply will decrease the reliability of the network and may make it inoperable. Swagelok validated the performance of the VCM operating at 11, 24, and 28 V (dc).

Note: Due to cable lengths and other devices operating on a network, the supply voltage at the device may not be the same as at the power supply.

Hazardous Location Power Supply

It is required that a Class 2 power supply be used when the VCM is used in Class 1 Division 2 hazardous locations. Class 2 power supplies have a maximum power outlet of 100 W.

DeviceNet Network Cable

Cable Length

DeviceNet network cable lengths are defined in ODVA's *DeviceNet Planning and Installation Manual*, chapter 1, www.odva.org. Using cable lengths longer than those recommended can result in degradation of signal integrity and decrease of supply voltage.

Hazardous Location Cable Length

To use the cable in a hazardous location, the total inductance and capacitance of the network must be below the values set by the power supply being used. The total value can be determined by adding together the inductance and capacitance values of the devices on the network along with that of the cable.

The Swagelok VCM adds 0 μ H and 0 μ F to the network.

Cable parameters can be determined from the manufacturer's datasheet. Assume values of 60 pF/ft and 0.2 μ H/ft when that information is not available.

Cable Bend Radius

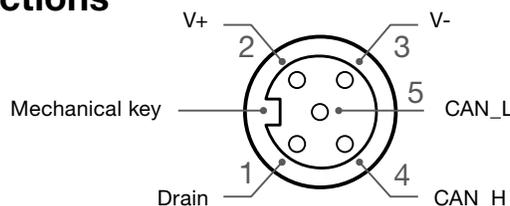
The DeviceNet network cable should not be bent too tightly, as this causes excess strain on the cable and the attachment point on the device. After the cable has been installed, the bend radius can be adjusted as long as it is not smaller than its fixed radius. Typical cables and their bend radii are presented in the table below. These values may change based on the manufacturer's recommendations.

Cable Bend Radii			
Cable Type	Nominal Cable Dia	Installation Bend Radius	Fixed Bend Radius
Thick Cable	0.41 in. (10.4 mm)	8.20 in. (210 mm)	2.87 in. (73.0 mm)
Thin Cable	0.24 in. (6.1 mm)	4.80 in. (122 mm)	1.70 in. (43.0 mm)

Connecting the Cable

Connect the micro M12 connector end of the network cable to the network interface plug on the VCM. Connect the opposite end to the system network.

Tubing Connections



V+ = 24 V (dc) supply
 V- = Ground
 CAN_H = High signal of CAN differential signal
 CAN_L = Low signal of the CAN differential signal
 Drain = Cable shield, ground at the power supply end

Fig. 5 M12 Female Connector End

The VCM accommodates #10-32 thread connections (ex. face sealed push-to-connect) for 1/8 in. flexible tubing. Face sealed push-to-connects should be installed according to the manufacturer's instructions.

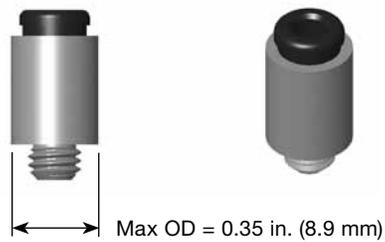


Fig. 6 #10-32 Push-to-Connect Fittings

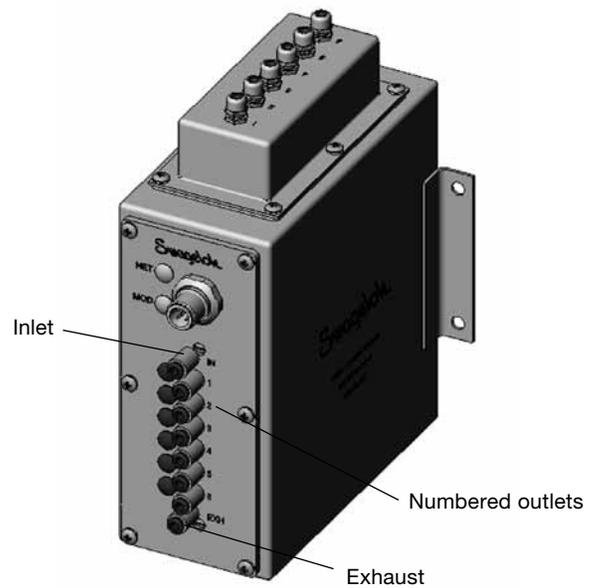


Fig. 7 VCM with #10-32 Push-to-Connect Fittings

1. Connect supply air to the inlet.

Notice: Do not exceed 116 psig (7.9 bar).

2. Connect system valves to any of the numbered outlets. It is not necessary to cap unused outlets.
3. Connect the exhaust to a system vent line.

Proximity Sensor

The Swagelok VCM model number SS-VCM-D-6-2 is designed to work with the Bi 1-EG05-AP6X proximity sensor manufactured by Turck Inc. These sensors can be added as an option to the applicable Swagelok valve at the time of purchase. An alternate option is a compatible three-wire, 12 V (dc), PNP proximity sensor.

Note: The SS-VCM-D-6-0 model does not have any capability to interface with proximity sensors.

Terminal Strip with Sealed Enclosure, IP64 (SS-VCM-D-6-2)

For the SS-VCM-D-6-2 model, the proximity sensor wires must be passed through the enclosure before attachment to the proximity sensor terminal strip.

1. Use a Number 1 Phillips screwdriver to remove the six enclosure mounting screws. Remove the enclosure and gasket.

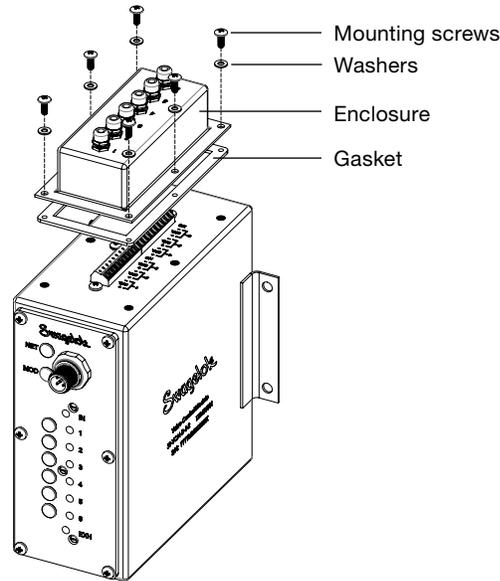


Fig. 8 Remove Enclosure

2. Use an 8 mm wrench to loosen a cable gland nut.

Note: Use a backup wrench to ensure the fitting body does not loosen from the enclosure.

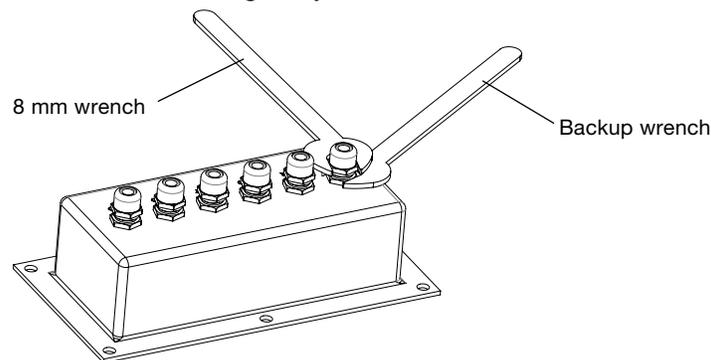


Fig. 9 Loosen a Cable Gland Nut

3. Pass the sensor wire through the cable gland body and enclosure gasket.

Note: In order to seal properly, the cable diameter must be between 0.080 and 0.13 inch (2.0 to 3.3 mm).

4. Connect each wire to the appropriate input on the terminal strip. Connect a brown, a black, and a blue wire for each valve to be controlled by the VCM.
 - a. Loosen the set screw for each wire.
 - b. Insert the wire in the appropriate location. See Fig. 10.
 - c. Tighten the set screw.

Note: Put a strain relief in place to prevent the wires from being accidentally pulled out.

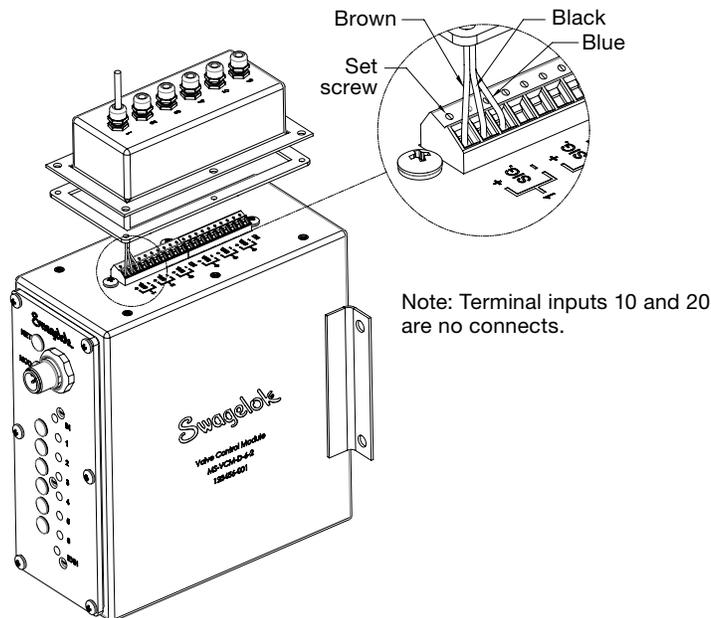


Fig. 10 Connect Wire to Terminal Strip

5. Repeat steps 2 through 4 for each proximity sensor to be attached to the VCM.
6. Place the enclosure and gasket against the VCM body, lining up both with the mounting holes.
7. Tighten each cable gland nut on the enclosure to 1.00 in.·lb (0.11 N·m) to maintain IP rating.
8. Insert the six enclosure mounting screws with PTFE washers. Tighten the screws hand-tight in the pattern shown.

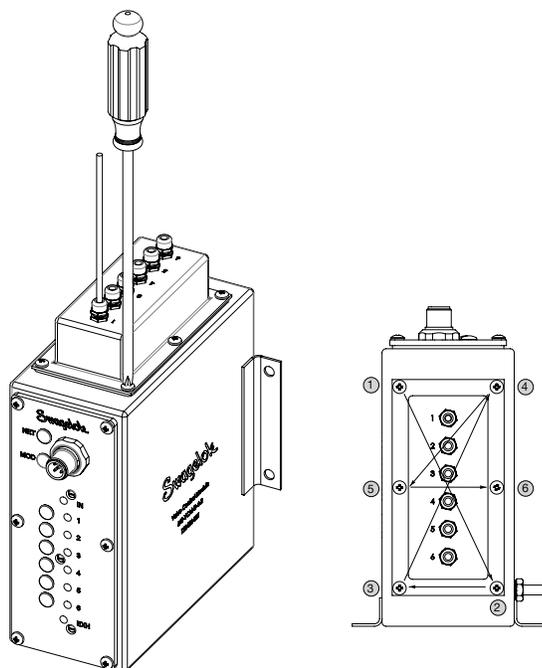


Fig. 11 Tighten Enclosure Screws

9. Cap any unused cable glands using the caps and O-rings provided to maintain IP rating.
10. Remove the cable gland nut using a 8 mm wrench. Slide an O-ring onto the cable gland body until it is seated at the base of the threads.
11. Thread on a cap and tighten to 1.00 in.·lb (0.11 N·m) using a 10 mm wrench.

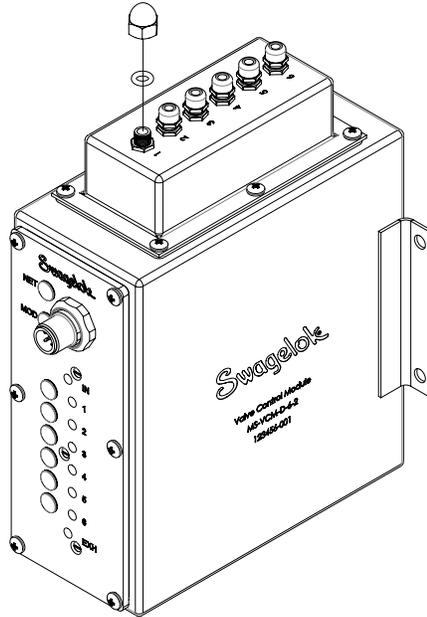


Fig 12 Cap and O-ring Assembly

Setup

Notice: The VCM must be disconnected from the system while performing setup functions.

Electronic Data Sheet (EDS)

1. Download the electronic data sheet (EDS) file from www.swagelok.com.
Note: Altering the EDS in any way voids the product warranty.
2. Open your network configuration tool, such as RSNetWorx™ for DeviceNet.
3. Register the EDS using the network configuration tool.
4. Connect the VCM to the network.
5. Scan the network for the VCM, and click on the device.
6. Use the network configuration tool to set the fields.

General Tab

Device Address (MAC ID)

The VCM will have a factory set address of 63 when initially powered on. Addresses between 0 and 63 are valid DeviceNet addresses. Do not duplicate addresses. Duplicate addresses will cause the devices at that address to be unable to communicate with the network. As noted, new devices will be set to address 63, so it is recommended to leave that address open to accommodate new hardware.

Assign higher priority devices a low network address as the lowest network address will be given priority during network arbitration.

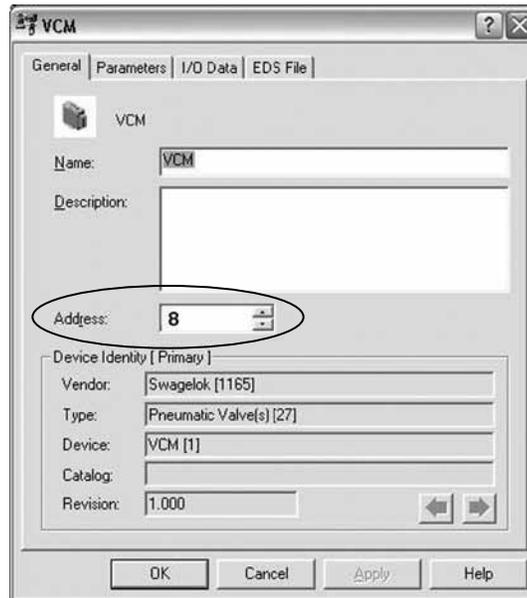


Fig 13 General Tab

Parameter Tab

These fields can be set for each of the attached valves. Select the valve to edit and then the desired field(s).

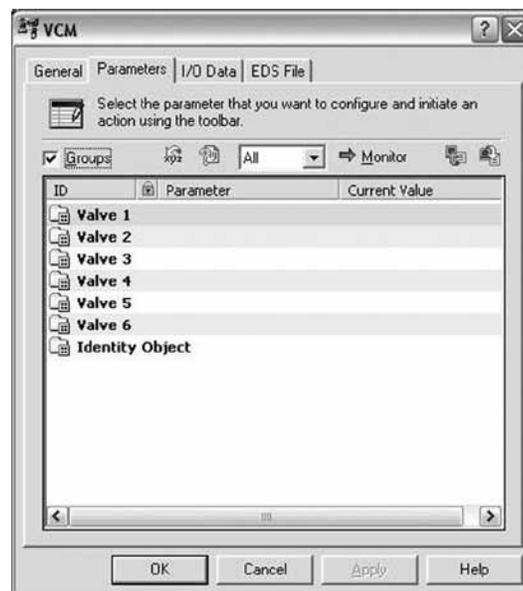


Fig 14 Parameter Tab

Fault and Idle Actions

The VCM can be configured to go into a known state, or maintain its last commanded state, in the event of a Fault or Idle state. The dropdown options are:

- **Fault Value**—The Fault Value parameter will determine whether the valve is turned on or off during a fault with a 1 indicating the valve will be on and a 0 indicating the valve is off.
- **Hold Last State**—The valve will remain in the last commanded state in the event of a fault.

The Idle Action dropdown options are the same as the Fault Action dropdown options.

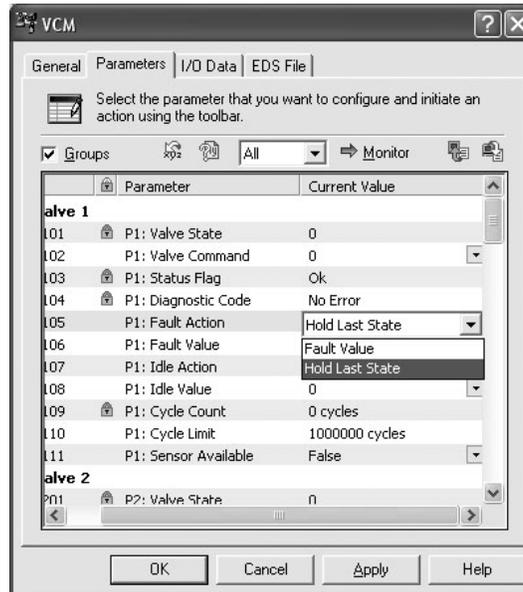


Fig 15 Setting Fault Action

Cycle Count and Limit

The VCM will track how many cycles each valve has had since manufacture. In addition, the user can set the Cycle Limit field to send an alarm at a desired cycle count to plan for maintenance. Setting the Cycle Limit to 0 will make that function inoperative.

NOTE: The cycle count is stored to non-volatile memory each time the cycle count grows by more than 10%. It is not stored each and every time a valve is actuated.

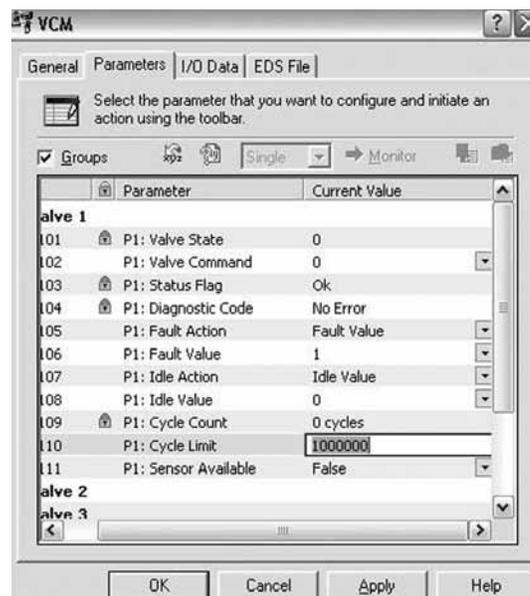


Fig 16 Cycle Count and Limit

Sensor Configuration

The Sensor Available field should be set to True when the valve has a proximity sensor attached. Valves without sensors set to False will provide feedback on the last commanded state. This field cannot be set for the SS-VCM-D-6-0 model but will still display on the screen.

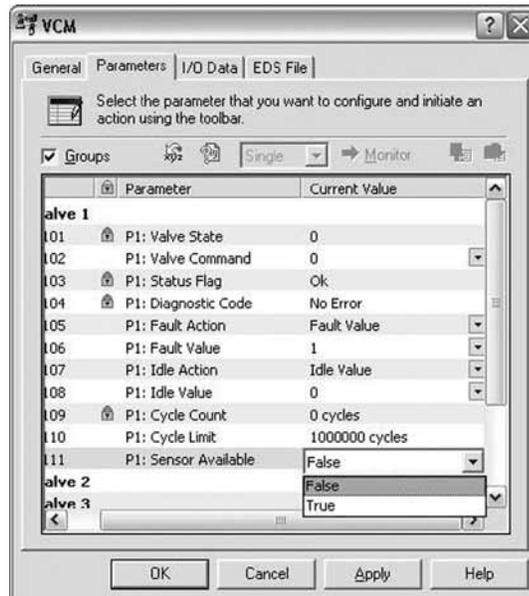


Fig 17 Sensor Available

Operation

1. Connect the VCM to the system.
2. Verify the system air is on.



Fig 18 SS-VCM-D-6-2 connected to a SSV series

Commanding the VCM

The VCM command is a one byte poll request with the valve commands encoded as shown in the table below.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	Valve 6 Command	Valve 5 Command	Valve 4 Command	Valve 3 Command	Valve 2 Command	Valve 1 Command

A valve command of 1 represents an open pilot valve, meaning that pressurized air from the inlet will pass to the system valve attached to the outlet. A command of 0 closes that pilot valve. For example, a poll request of 0x01 will turn on valve 1.

Multiple valves can be turned on simultaneously. A poll message of 0x03 would turn on valves 1 and 2.

Response from the VCM

The VCM will send a two byte response to all poll requests. The first byte is the Status Byte, the second the State Byte. They are described in the tables below.

Status Byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	Valve 6 Cycle Status	Valve 5 Cycle Status	Valve 4 Cycle Status	Valve 3 Cycle Status	Valve 2 Cycle Status	Valve 1 Cycle Status

The Valve # Cycle Status will return a 0 when the valve's cycle count is less than or equal to the cycle limit and a 1 if the cycle limit has been exceeded. If the Cycle Limit has been set to 0, the Valve # Cycle Status should always be 0.

State Byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	Valve 6 State	Valve 5 State	Valve 4 State	Valve 3 State	Valve 2 State	Valve 1 State

The State Byte will return the value of the valve states as they were before the poll request requesting the response.

Note: Due to timing restrictions of the DeviceNet protocol, the State Byte response will **not** reflect the command that was just sent. In order to monitor VCM valve states without changing which valves are on, send an identical poll request.

For example:

Valve 1 is currently open, the user would like to open Valve 4, and verify both valves are actuated.

Poll request: 0x09 (keeps Valve 1 open and opens Valve 4)

Poll response: 0x01 (previous state, Valve 1 open)

Poll request: 0x09 (repeat previous message)

Poll response: 0x09 (VCM state, reflecting last command)

Note: The State Byte will return the value of the sensor if a valve is configured to use a proximity sensor. This means that the poll response may not be the same value as the command sent.

For example, when valve 1 is connected to a normally closed valve with a BI 1-EG05-AP6X sensor and is configured to accept sensor input, the response will look like:

Valve State	Valve Position	Sensor State	Valve Indicator Light	Poll Response
Off	Closed	On	On	1
On	Open	Off	Off	0



Fig 19 Valve Indicator Light

Maintenance

There are no field-maintainable parts within the VCM. Contact your authorized Swagelok representative for assistance.

The following hardware kit is available:

Enclosure Hardware Kit (MS-VCM-KIT1)

This kit contains the components used to attach and seal the interface cover included with the valve control module, SS-VCM-D-6-2. The contents of this kit are included with that model when shipped from the factory.

- 6 screws
- 6 washers
- 1 interface cover gasket
- 6 acorn nuts
- 6 cable gland O-rings
- 6 cable glands and nuts

Connector Kit (MS-VCM-KIT2)

This kit contains eight #10-32 face seal push-to-connect fittings for use when connecting 1/8 in. plastic tubing to the valve control module (VCM).

Troubleshooting

Problem	Cause	Remedy
Module (MOD) LED		
Off	No power applied to the device.	Connect power.
Green	Normal operation.	No action needed.
Flashing Green	Device needs to be configured	Configure device.
Red	Device has an unrecoverable fault.	Cycle power to device. If device fails to recover, contact your authorized Swagelok representative.
Flashing Red	Device has invalid configuration.	Check configuration setup.
Network (NET) LED		
Off	The device has no power or the channel is disabled for communication due to bus off condition, loss of network power, or has been intentionally disabled.	Power-up the scanner, provide network power to channel, and make sure channel is enabled in both the scanner configuration table and module command word.
Green	Normal operation.	No action needed.
Flashing Green	The channel is enabled but no communication is occurring. The two-digit numeric display for the channel indicates an error code that provides more information about the condition of the channel.	Configure scan list table for channel to add device.
Red	The communication channel has failed. The two-digit numeric display for the channel indicates an error code that provides more information about the condition of the channel. This may indicate a defective scanner.	Reset scanner. If failures continue, replace scanner.
Flashing Red	At least one of the devices in the scanner's scan list table has failed to communicate with the scanner. The network has faulted. The two-digit numeric display for the channel indicates an error code that provides more information about the condition of the channel.	Examine the failed device and examine the scan list table for accuracy.
General		
System valves do not actuate.	VCM inlet pressure is too low.	The system valve actuation pressure may be different from the VCM operating pressure. Ensure the inlet pressure is suitable for the system valve.
System valves do not return to normal state	VCM exhaust may be blocked.	Ensure that the VCM exhaust is able to properly vent.
Valve indicator LED is on when valve is closed	The valve has been configured to read the feedback from the proximity sensor.	The valve indicator LED will reflect the value of the sensor not the position of the valve.
System valve is on when the proximity sensor is off.	The valve and sensor have different "polarities."	This is normal system operation.
System valves actuate when the pilot valve is off.	The inlet pressure is too high.	Lower the inlet pressure going to the VCM. Notice: Applying inlet pressure above the VCM product rating can permanently damage the pilot valves.

Glossary

Term	Definition
VCM	DeviceNet Valve Control Module
Supply Inlet	VCM port to which compressed air supply is connected.
Exhaust	VCM port to which exhaust air is vented.
Outlet	VCM port to which compressed air is passed through when the associated pilot valve is actuated. These are the ports which will be connected to the system valves.
System Valve	A pneumatically actuated valve which directly controls flow of media.
Pilot Valve	A small valve that controls actuation air to a system valve. Pilot valves are useful because they allow a small and easily operated feed to control a much higher pressure or higher flow feed, which would otherwise require a much larger force to operate.
PLC	Programmable Logic Controller
Proximity Sensor	A proximity sensor allows the VCM to monitor the system valve state.
DeviceNet	A CAN based, multi-drop network that connects and serves as a communication network between industrial controllers and I/O devices.
Ingress Protection (IP)	A measurement of the device's ability to keep water and dust out of the enclosure.
LED	Light Emitting Diodes
MOD LED	The Module LED (MOD LED) provides feedback on the status of the module.
NET LED	The Network LED (NET LED) provides feedback on the status of the VCM network connection.
Electronic Data Sheet (EDS)	A data file used by node commissioning tools to interpret parameters on the device.
Controller Area Network (CAN)	A message based communication protocol originally designed for automotive application.
Entity Parameters	Values used to determine the suitability of the device for use in hazardous environments.
MAC ID	Media access controller identifier.

