SmartVO™ Valve Control Circuits & Power Supply

Quick Start Guide

The same control valve used in every SmartTrak MFC, the appropriately named SmartVO™ "VO for Valve-Only" offers a robust and field-proven, direct-acting electromagnetic proportional control valve technology to perform over a wide variety of temperature and pressure variations in the gas stream. You can even locally adjust response characteristics for multiple applications or system pressure design changes. The SmartVO™ requires a valve control circuit and power supply. For flexibility, the end user can supply their own control circuit and power or they have the option to order this control/power package from Sierra.

Sierra's Valve Control Package Includes:

- Valve Control Circuit (PCA with NEMA 4X enclosure): Dual solenoid valve controller with either 0-5 VDC, 4-20 mA setpoint control or a 0-5 VDC potentiometer setpoint control (see figure 2a).
- Power Supply: 24 VDC +/- 10%

See Options 1, 2, and 3 on page 5 of this document for more information.

Power Requirements

All SmartVO control valves are designed to run on 24 VDC +/- 10%. We offer the 100-T10F, a 24 VDC power supply which can be used for all models. The T10F can power two VO-100L, VO-100M, VO-100HP, or VO-101, but will only power one VO-100H. Figure 1 shows the maximum flow, current and coil resistance at this flow. Note: The maximum output of the T10F is 1.5A (1500 mA). This is why it can only power one VO-100H.

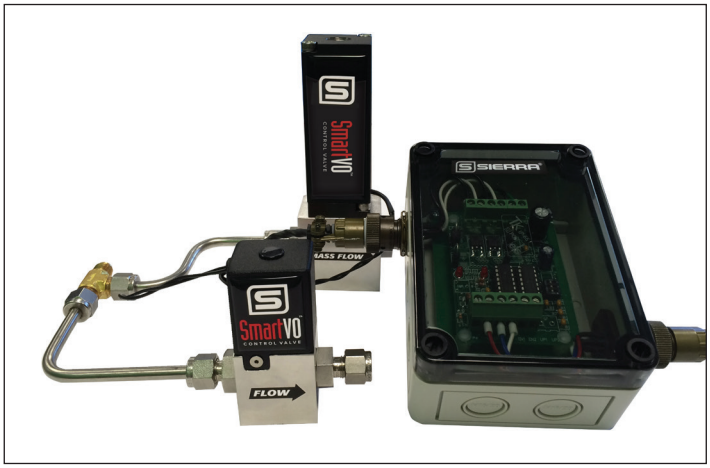
Power Requirements			
	Max flow (slpm)	Current at Max Flow (mA)	Coil Resistance (Ω)
VO-100L	50	264	100
VO-100M	300	629	42
VO-100H	1000	1056	25
VO-100HP	20	629	42
VO-101	0.05	264	100

Figure 1. Maximum flow, current and coil resistance

Valve Control Requirements

A setpoint signal is required to position the valve. This is typically a 0-5 VDC or 4-20 mA analog signal.
Others may be 0-10 or 1-5 VDC, 0-20 mA or RS-232 signals. A valve control circuit is used to convert this setpoint signal into (typically) a pulse-width modulated (PWM) valve control signal. This varies the voltage across the coil to adjust the valve position based on the setpoint signal.

In many cases, the end user will have drive control circuits, especially if the SmartVO is used in an OEM application, where the setpoint is an analog signal from another instrument like a flowmeter, pressure sensor, or temperature sensor.



Dual Solenoid Valve Controller Options (Model Code VC-2 & VC-2C)

Sierra offers the VC-2 dual pulse-width modulated (PWM) solenoid valve controller. The VC-2 PWM valve controller allows you to independently control the power of one or two proportional solenoid valves, up to 5 amps. Use of PWM and low on-resistance transistors allows for high efficiency control with minimal power loss. Selectable PWM frequencies allow for optimal control for your particular valve (See Figure 2b).

Valve Control Circuit Options

If you do require a valve control circuit, we offer three versions:

1. Dual solenoid valve controller with 0-5 VDC external setpoint control signal (Model Code: VC-2)
2. Dual solenoid valve controller with 0-5 VDC onboard potentiometer setpoint control signal (Model Code: VC-2P)
3. Dual solenoid valve controller with 4-20 mA setpoint control signal (Model Code: VC-2C)

Figure 2a. NEMA 4X Enclosure for Control Circuit.

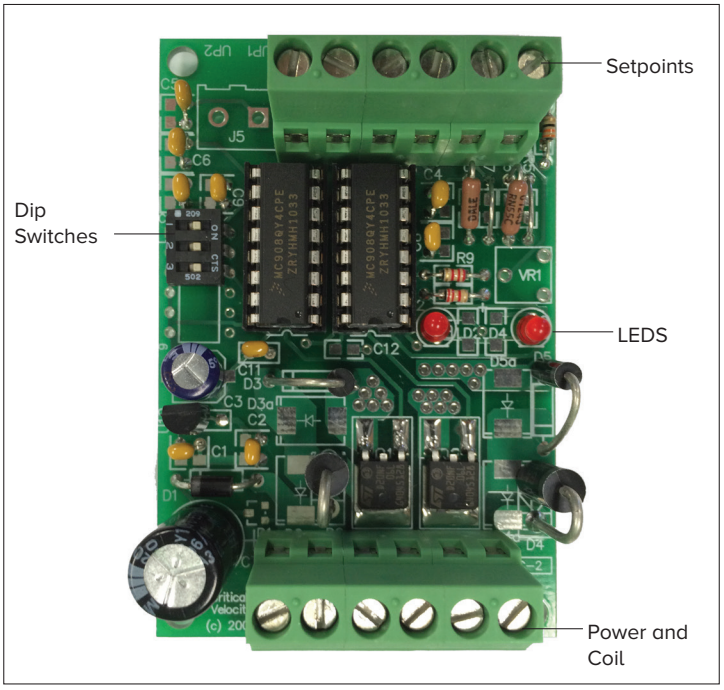


Figure 2b. Dual Solenoid Valve Control Options VC-2 and VC-2C

Setting Up Your Valve Control PCA (Option VC-2 or VC-2C)

Setting up the VC-2, VC-2P or VC-2C consists of four steps:

1. Wire power to the VC-2, VC-2P, or VC-2C.
2. Wire the PWM signal output to the valve coil.
3. Wire a setpoint to the VC-2, VC-2P, or VC-2C.
4. Set the dip switches for the proper PWM frequency.

Step 1: Wire power supply to the VC-2, VC-2P or VC-2C (See Figure 3)

Setting up the VC-2, VC-2P or VC-2C consists of four steps:

- Check power supply is not live.
- Connect power supply (+) to V+ and power supply return (-) to GND.

Step 2: Wire PWM signal output to the valve coil (See Figure 3)

- Connect valve coil wires to O1+, O1-.
- If you have two valves, then the second valve would be connected to O2+, O2-. These connections are directionless with the Smart VO.

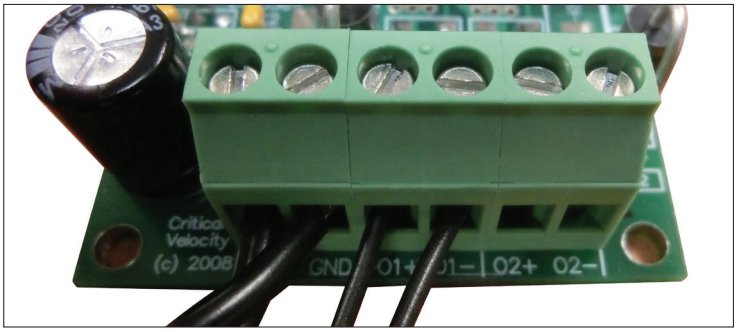


Figure 3. Power Supply and Valve Coil Terminals

Step 3: Wire a setpoint to the VC-2 (Figure 4 and 5 for schematics)

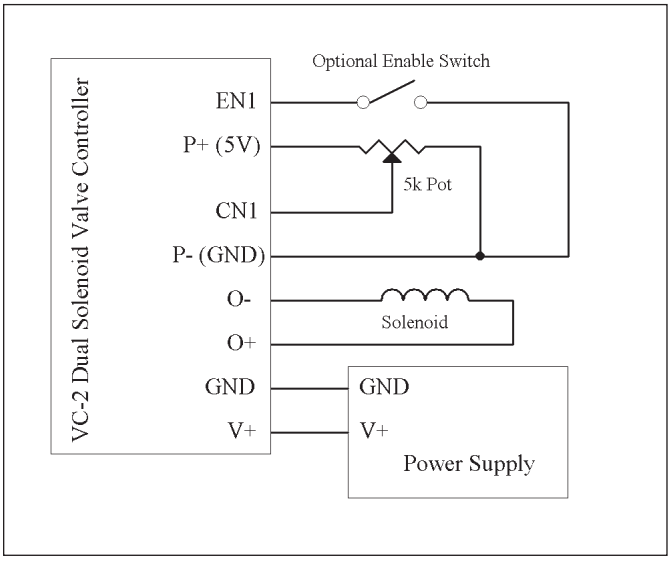


Figure 4. Setpoint Signal Wiring

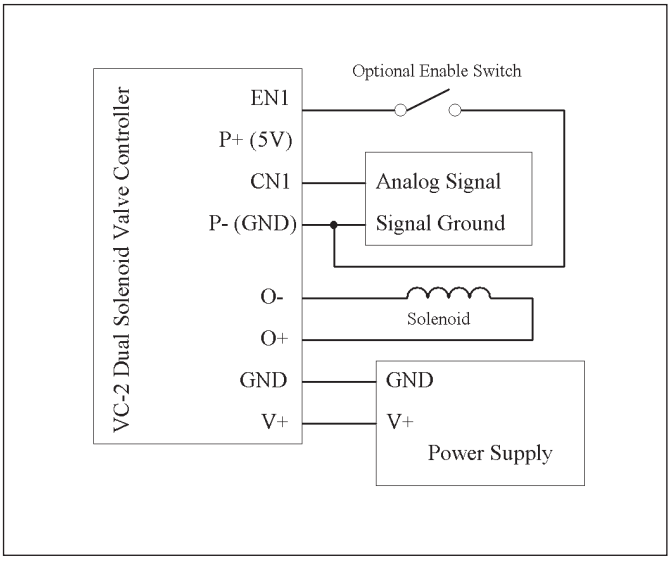


Figure 5. Potentiometer Connections

- Connect external setpoint to CN1+ and P-. The same is true for both 0-5 VDC (VC-2) and 4-20mA (VC-2C) in this configuration (See Figure 4).
- Alternative setpoint signal control for VC-2P only is to connect a potentiometer high to P+ (5 VDC signal), potentiometer low to P-, and the wiper to CN1. This will attenuate a 5 VDC signal to some fraction between 0-5 VDC. It is recommended the potentiometer used is between 1 and 30 kOhm, with 10 kOhm being the nominal value (See Figure 5).
- If you are using two valves: setpoint signal to CN1 will NOT control second valve (O2+/O2-). To use the same setpoint signal for both valves: jump signal from CN1 to CN2 (See Figure 6).
- To use independent setpoint signal for each: Connect separate setpoint signal to CN2 and P-. This can also be done with a potentiometer wiper to CN2 and P+/P- per note above (See Figure 7).
- Note if using a Sierra supplied T10F only ONE high flow valve can be powered

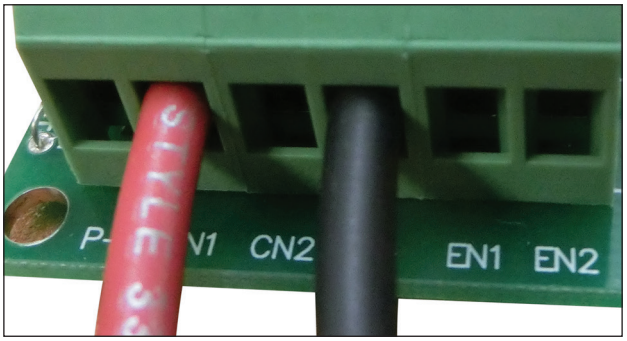


Figure 6. Setpoint Signal

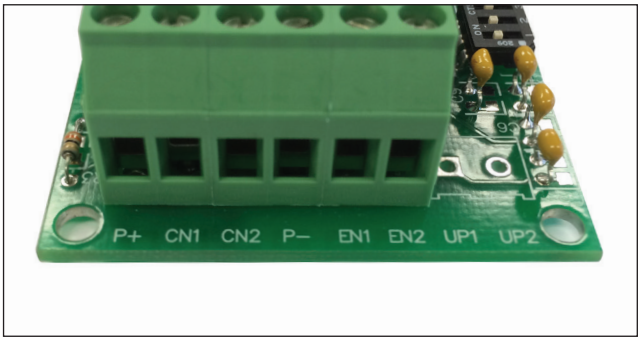


Figure 7. Setpoint Terminal Board

- UP1 and UP2 are not used
- EN1 and EN2 are output enabled and not generally used. The output is enabled by default and is internally pulled up. Bringing the EN pin low immediately brings the PWM output to 0%. Allowing the pin to return to high re-enables the PWM output at the previous duty cycle.

Operational Notes

- The on-board LED's will flash slowly during normal operation. The LED will flash quickly when an error is detected.
- For the valve control circuit VC-2 (0-5 VDC): There is a built-in dead-band that sets the duty cycle to: 0% for any voltage level < 0.10 V. 100% for any voltage level > 4.90 V.
- For the valve control circuit VC-2C: (4-20 mA control): A current between 4 and 20 mA applied to CN1 (CN2) and the P- pins will produce a varying pulse width from 0 – 100% at the output. Any current less than 4 mA will produce no output and indicates a disconnected or failed signal wire. The LED will flash quickly when the controller detects less than 4 mA.

Step 4: Set up dip switches

- The dip switches are used to set up the PWM frequency to the valve coil (See Figure 7). Sierra has done extensive testing and recommends the settings below (See Figure 8). If the VC-2 is purchased as a package with SmartVO and application conditions are provided, Sierra will set up the optimal frequency for the application at the factory. In general, 1.5 Hz is recommended.

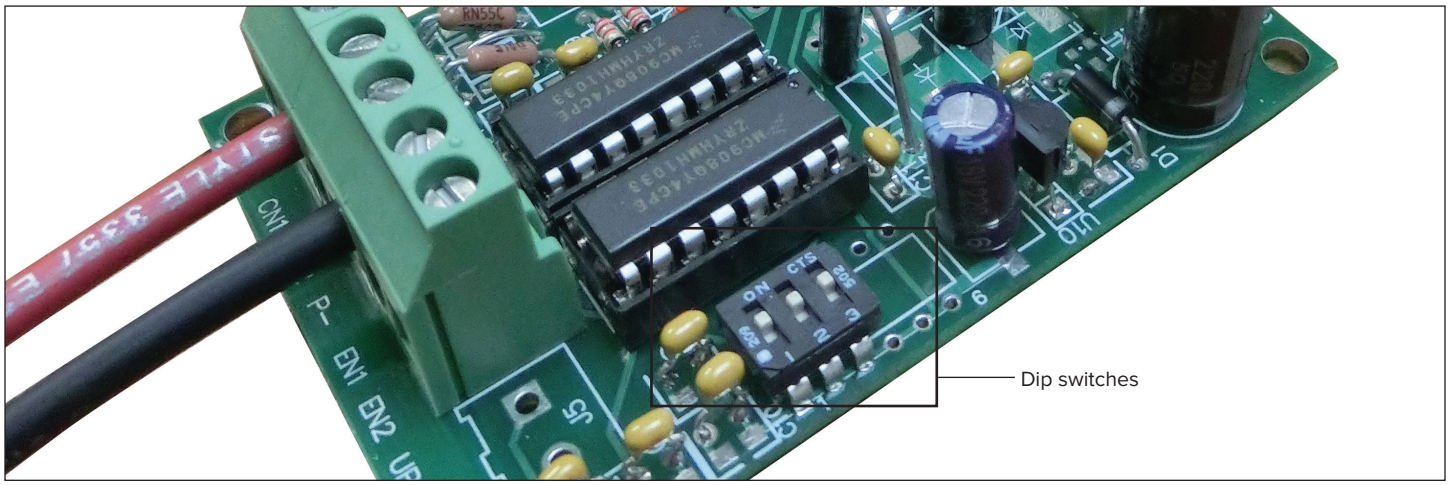


Figure 8. Location of Dip Switches

Recommended Dip Switch Settings			
Frequency	**Switch 1**	**Switch 2**	**Switch 3**
200 Hz	OFF	OFF	ON
400 Hz	OFF	ON	OFF
800 Hz	OFF	ON	ON
1.5 kHz	ON	OFF	OFF
3 kHz	ON	OFF	ON
6 kHz	ON	ON	OFF
12 kHz	ON	ON	ON
24 kHz	OFF	OFF	OFF

Figure 9. Dip Switch Settings

You are now ready to use the valve control circuit to control the SmartVO. Turn on the power and control the valve with the external set-point or potentiometer.

Notes:

- The full VC-2 dual PWM solenoid valve controller from Critical Velocity Enterprises is available here.
- A fuse appropriately rated for the load device is required to ensure safe operation.
- This controller is not reverse-polarity protected. Ensure that it is wired correctly before applying power. Always turn off the power supply before making any changes to the wiring.
- Ground wire pair as well as the Out+ and Out- wire pair.
- Ensure that the controller has adequate air flow for proper cooling. If operating for extended periods of time in high temperature environments, a cooling fan may be necessary.
- Use the shortest possible wiring between the load and controller, and between the controller and the power source. Ensure that the cables carrying the load current are adequately sized. Inadequate power supply filtering or other causes leading to a high impedance path to the power supply will result in higher losses in the filter capacitor and wiring, and may damage the load and/or controller.
- Coil noise or coil whine is a phenomenon of electromagnetic coils like those used in the SmartVO. These coils have a certain resonant frequency when coupled with the rest of the electric circuit, as well as a resonance at which it will tend to physically vibrate. This can be objectionable. Sierra has selected the PWM frequency that minimizes coil noise while maintaining best performance, but this can also be field adjusted as required by selecting the desired frequency using the DIP switches.

Ordering the Power Supply and Valve Control Circuit

To order the valve control circuit option and power supply, reference the price list Option: 1 Valve Control PCA and Option 2: Power Supplies. See the order information below.

Option 1: Valve Control PCA	
VC-2	Dual solenoid valve controller with 0-5 VDC external setpoint control signal.
VC-2P	Dual solenoid valve controller with 0-5 VDC onboard potentiometer setpoint control signal.
VC-2C	Dual solenoid valve controller with 4-20 mA setpoint control signal.

Option 2: Power Supplies	
1 00- T10F ( )	Low, Medium and high flow SmartVO. 24 VDC power supply. Supplied with fly leads, 1.25 Amps, 110-230 VAC, CE approved. Specify plug preference in parentheses: (US) for USA plug, (EU) for Euro plug, (UK) for Great Britain plug. Note while VC-2 will control two valves, T10F can supply power to two VO-100L, VO-100M flows but only one VO-100H

Option 3: Enclosure	
ENCL ( )	NEMA 4X enclosure for valve controller PCA. Specify cord grip or 6 pin in parentheses ( ). Use ADS to specify desired hole pattern.