Product Manual

SDM-CVO4

4-Channel Current and Voltage Output Module

RELIABLE SINCE 1974 MONITORING

CAMPBELL SCIENTIFIC®

PLEASE READ FIRST

About this manual

Please note that this manual was originally produced by Campbell Scientific Inc. primarily for the North American market. Some spellings, weights and measures may reflect this origin.

Some useful conversion factors:

Area:	1 in^2 (square inch) = 645 mm^2		**Mass:**	1 oz. (ounce) = 28.35 g
				1 lb (pound weight) = 0.454 kg
Length:	1 in. (inch) = 25.4 mm			
	1 ft (foot) = 304.8 mm		**Pressure:**	1 psi (lb/in^2) = 68.95 mb
	1 yard = 0.914 m			
	1 mile = 1.609 km		**Volume:**	1 UK pint = 568.3 ml
				1 UK gallon = 4.546 litres
				1 US gallon = 3.785 litres

In addition, while most of the information in the manual is correct for all countries, certain information is specific to the North American market and so may not be applicable to European users.

Differences include the U.S standard external power supply details where some information (for example the AC transformer input voltage) will not be applicable for British/European use. *Please note, however, that when a power supply adapter is ordered it will be suitable for use in your country.*

Reference to some radio transmitters, digital cell phones and aerials may also not be applicable according to your locality.

Some brackets, shields and enclosure options, including wiring, are not sold as standard items in the European market; in some cases alternatives are offered. Details of the alternatives will be covered in separate manuals.

Part numbers prefixed with a "#" symbol are special order parts for use with non-EU variants or for special installations. Please quote the full part number with the # when ordering.

Recycling information

At the end of this product's life it should not be put in commercial or domestic refuse but sent for recycling. Any batteries contained within the product or used during the products life should be removed from the product and also be sent to an appropriate recycling facility.

Campbell Scientific Ltd can advise on the recycling of the equipment and in some cases arrange collection and the correct disposal of it, although charges may apply for some items or territories.

For further advice or support, please contact Campbell Scientific Ltd, or your local agent.

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SDM-CVO4 4-Channel Current/Voltage Output Module

1.   Introduction

The SDM-CVO4 is attached to a data logger and outputs variable voltage or current signals under data logger program control. Typical applications include driving remote current-loop display units, retransmitting measured values to industrial control systems, sending control signals to valve controllers, and providing excitation voltages or currents to external sensors.

NOTE   This manual provides information only for CRBasic data loggers. For retired Edlog data logger support, see an older manual at *www.campbellsci.com/old-manuals*.

2.   Precautions

The potential voltage difference between the data logger and the SDM-CVO4 outputs is considered to be non-hazardous (less than 50 V). Therefore, the SDM-CVO4 is not a safety risk to the user.

As with the data logger, ensure that the device has a good connection to an earth grounding point to allow the safe discharge of transient voltages and also ensure proper screening of the device. The SDM-CVO4 has two **G** terminals on the black connector used for data logger connections. Use one of these grounds to connect the device directly to the enclosure ground lug to ensure the lowest resistance path to ground.

When the SDM-CVO4 is used in applications where the potential difference between the data logger and the output terminals exceeds 50 V RMS AC, 74 VDC, careful consideration has to be taken to ensure safe operation and compliance with local safety regulations. For such applications Campbell Scientific does not supply the device as a stand-alone device which will meet all safety requirements. The SDM-CVO4 is supplied as a component for the user to install in a system that is, itself, designed to comply with such regulations. The following guidance is given to help users meet the requirements of such regulations.

The SDM-CVO4 is designed such that the internal safety barrier meets the requirements of BS EN 61010-1 (similar to IEC 950). However, the method of wire connection and earthing facilities prevents the unit being claimed as compliant with such standards, when supplied as a stand-alone unit.

To meet the safety requirements of most countries, wires carrying hazardous voltages, terminated in screw terminals must be housed in an enclosure requiring a tool to open it, and the enclosure must have international symbols on the outside warning of high voltages. An additional warning label, in the local language, may be required stating that the source of hazardous voltage must be turned off before the enclosure is opened.

Enclosures designed to house electrical equipment usually meet the standard requirements. The ENC12/14, ENC14/16, and ENC16/18 enclosures meet these requirements if fitted with a padlock and with the correct labels on the door.

Ensure that metal parts on the outside of the enclosure that might come in contact with active high voltage circuits are connected to a safety ground. The ground lug on Campbell Scientific enclosures is not an issue because it normally is the point of contact to a good ground point.

Ensure that the cables and their connectors are rated to a high enough voltage and assembled in a safe fashion. Provide adequate strain relief at the point of exit from the enclosure.

If using an external device that has a high voltage, include a breaker system that disconnects the device from the voltage source if the system insulation breaks down.

With a system made to these requirements, the maximum recommended continuous operating voltage between the data logger and input is 240 VAC. This value is derived from the voltage rating of the terminal blocks used and an internal suppression capacitor.

The unit is designed to withstand a transient flash test of 1500 V RMS AC, for two seconds. However, the following design aspects can influence the test results.

- To help suppress emissions of electromagnetic interference, the isolation barrier is bridged by a 1nF, class 'Y' safety capacitor. This is rated to withstand a 2700 V, 2 second flash test, but will fail if exposed to voltages in excess of 240 V RMS for long periods.

- A spark gap protects the capacitor and opto-isolation component that bridges the barrier from transients and static. The spark gap has a 2500 VDC nominal breakdown voltage. If this device is at the low end of its tolerance band (±10%), combined with the normal tolerance of flash test devices, the spark gap could fire during a 1500 VAC flash test, which may cause an indication of failure. Testing at a slightly lower voltage will confirm whether there is a true fault or not.

For questions about the safety of your installation, first seek advice from your local safety advisor and then Campbell Scientific if you require further technical details.

CAUTION   To ensure safe and correct operation, the SDM-CVO4 *must* be installed where there is no risk of water ingress or condensation.

3.   Initial Inspection

Upon receipt of the SDM-CVO4, inspect the packaging and contents for damage. File any damage claims with the shipping company. Immediately check package contents against the shipping documentation. Contact Campbell Scientific about any discrepancies.

4. Quickstart

A video that describes data logger programming using Short Cut is available at: *www.campbellsci.com/videos/cr1000x-datalogger-getting-started-program-part-3*. *Short Cut* is an easy way to program your data logger to measure the sensor and assign data logger wiring terminals. *Short Cut* is available as a download on *www.campbellsci.com*. It is included in installations of *LoggerNet*, *RTDAQ*, *PC400*, or *PC200W*.

The following procedure shows using *Short Cut* to program the device.

1. Open *Short Cut* and click **Create New Program**.

2. Double-click the data logger model.

3. For each sensor, type the sensor model name in the **Available Sensors and Devices** box, double-click the model name, set the **Properties**, and wire the sensor to the data logger according to the **Wiring** tab. Refer to the sensor manuals for more information.

4. In the **Available Sensors and Devices** box, type SDM-CVO4 or locate the device in the **Calculations** > **Control** folder. Double-click **Device for Current/Voltage Input from SDM-CVO4**. The **SDM-CVO4 Address** defaults to 0. Type the correct **SDM-CVO4 Address** if it has been changed from the factory default value. Select the **Number of Outputs** and **Output Range**. For each measurement, click the **Source Measurement** box and select the variable name, type the sensor-output upper limit in the **High Value for Engineering Units** and the sensor-output lower limit in the **Low Value for Engineering Units**. For example, the wind speed output for the 03002 Wind Sensor is 0 to 50 m/s; therefore, type 50 for the **High Value for Engineering Units #1** and type 0 for the **Low Value for Engineering Units #1**.
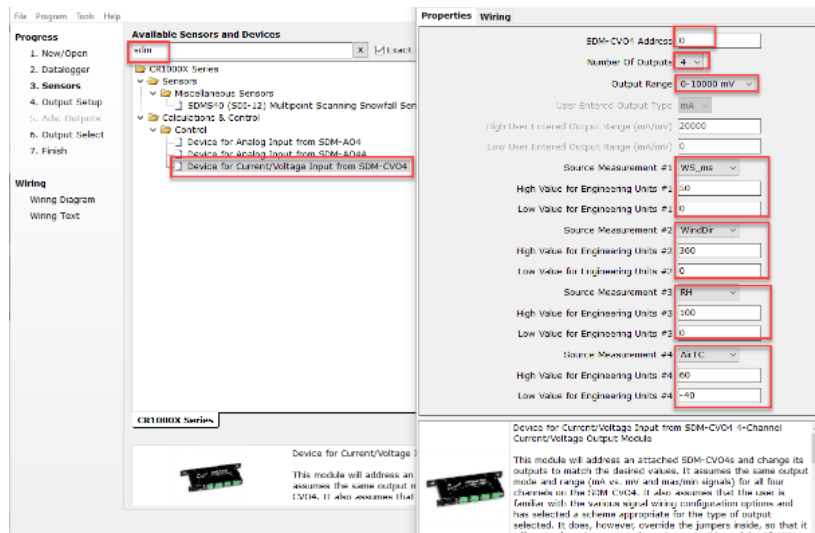
5. Click the **Wiring** tab to see how the device is to be wired to the data logger. Click **OK** after wiring the device.
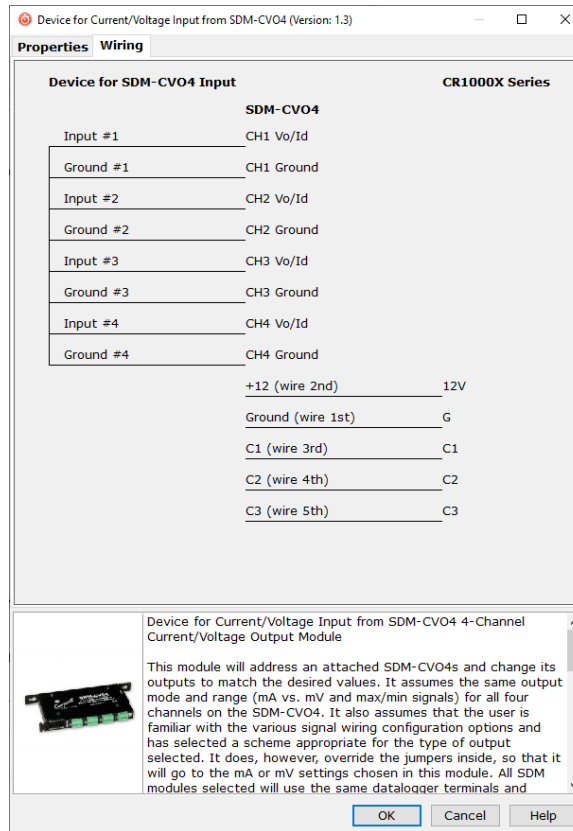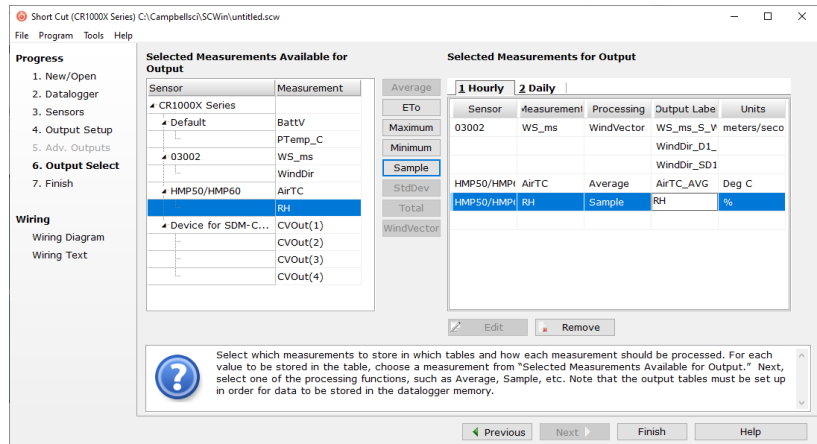

6. In **Output Setup**, type the scan rate, meaningful table names, and **Data Output Storage Interval**.
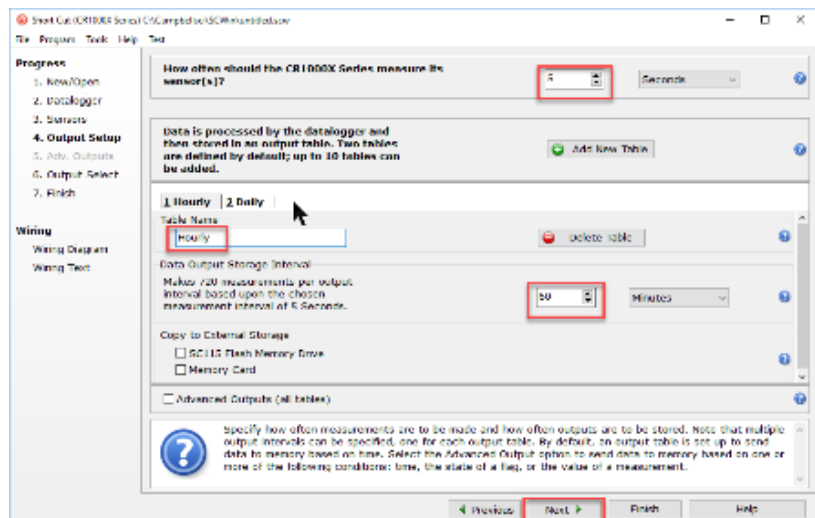
7.   Select the output options.

8.   Click **Finish** and save the program. Send the program to the data logger if the data logger is connected to the computer.

9.   If the sensors are connected to the data logger, check the output of the sensors in data display in *LoggerNet*, *RTDAQ*, *PC400*, or *PC200W* to make sure it is making reasonable measurements.

5.   Overview

The SDM-CVO4 includes four channels for connecting the external devices. Each output can be set to 0 to 10 V or 0 to 20 mA by the data logger. The output can be scaled and limited to 4 to 20 mA by the data logger program if required by the application.

Typical applications include driving remote current-loop display units, re-transmitting measured values to industrial control systems that have current or high voltage inputs, sending control signals to valve controllers and providing excitation voltages or currents to external sensors.

Each output is isolated both from the data logger and the other channels on the SDM-CVO4, thereby avoiding ground loop problems that might otherwise occur.

In the current mode, the output can either act as a 2-wire current controller, where the loop is powered from a remote voltage source, or generate a 0 to 20 mA current source using a voltage output derived from its power supply.

The SDM-CVO4 is a synchronously addressed data logger peripheral. The data logger SDM terminals are used to address the SDM-CVO4 and send data that defines the desired voltage/current output of the four channels. The output levels are set by four values stored in variables in the data logger. Up to sixteen SDM-CVO4s or other SDM peripherals may be connected and addressed from the same three terminals.

Features:

- Expands data logger current/voltage output capability

- Provides four independent current or voltage outputs

- Drives remote current-loop display units

- Retransmits measured values to industrial control systems that have current or high-voltage inputs

- Sends control signals to valve controllers

- Provides excitation voltages or currents to external sensors

- Compatible CRBasic data loggers: CR6, CR3000, CR1000X, CR800 series, CR1000

5.1   Power Considerations

The SDM-CVO4 power requirements are large compared to most Campbell Scientific products, especially when driving significant loads. Care must be taken to ensure that the power supply can cope with this higher demand.

Alkaline batteries are *not* recommended for long term applications.

The SDM-CVO4 has two internal power supplies, one for channels 1 and 2 and one for channels 3 and 4. It only turns on the power supply for channels 3 and 4 if sent an instruction that sets the output of those channels. If channels 3 and 4 are not used, the power consumption is approximately 20 mA lower than when all outputs are used.

Where supported by the data logger, and when the application allows it, the SDM-CVO4 can be shut down to reduce its consumption to less than 0.5 mA. In this state, all outputs are switched off.

6. Specifications

Operating voltage:	12 VDC nominal (8 V to 16 V)
Current drain at 12 VDC:	Typical active quiescent current 27 or 54 mA, depending on operating mode (no load on output ports). To estimate the total current, add the quiescent current to the sum of all output currents multiplied by 1.5.
	For example, if each port is at 10 mA output, the total = 54 + (1.5*4*10) = 114 mA. The device can be shut down to <0.5 mA with all outputs off.
Maximum total SDM cable length:	6 m (20 ft) if the **SDMSpeed()** CRBasic instruction is not used. Longer cable lengths may be acceptable if **SDMSpeed()** is used.
Operating temperature:	–25 to 50 °C standard (–40 to 80 °C optional)
Size:	176 mm wide x 111 mm high x 24 mm deep
	234 mm wide x 111 mm high x 24 mm deep when fitted with brackets for mounting in enclosure. Mounting brackets have two holes at 203.2 mm (8 in) spacing for screw fixings.
Weight:	370 g
EMC status:	Complies with EN55022-1:1998 and EN50082-1:1998

6.1 Voltage Mode Output

Range:	0 to 10,000 mV
Resolution:	2.5 mV
Maximum output current:	30 mA per channel
Minimum load current:	5 µA if output < 200 mV
Accuracy (23 °C):	±0.02% of set voltage + (± 2.5 mV)
Accuracy (–25 to 50 °C):	±0.13% of set voltage + (± 2.5 mV)

6.2 Current Mode Output

Range:	0 to 20 mA
Resolution:	5 µA
Minimum output current (leakage):	5 µA at 50 °C
Accuracy (23 °C):	±0.02% of full scale range + (± 5 µA).
Typical accuracy (–25 to 50 °C):	±0.1% of full scale range + (± 5 µA)
Worst case accuracy (–25 to 50 °C):	±0.15% of full scale range + (±5 µA)

Minimum voltage drop across the internal current regulating circuit:	2.5 V at 20 mA current flow
Maximum voltage into I$_d$ relative to channel ground:	20 VDC
	When in current mode, the **V$_o$** terminal outputs an unregulated voltage source at 15 V nominal (±10%), 30 mA maximum load.
	Please contact Campbell Scientific for the accuracy specification on extended temperature tested units.

6.3   Isolation

Design criteria:	The unit has an internal isolation barrier and components rated to provide signal isolation for transients up to 1500 VAC (RMS), 2500 VDC nominal. The isolation is between any output and the SDM-CVO4 ground connection and between individual output channels.
	Protection components are built-in, which will break down at voltages close to this limit (see Section 2, *Precautions (p. 1)*).
Tested isolation:	Each channel is tested for isolation resistance at 500 VDC. Pass level > 10 MΩ.
Maximum recommended continuous operating voltage:	240 VAC RMS differential between an output and data logger ground - providing all issues relating to local regulations for safe installation and operation are followed (see Section 2, *Precautions (p. 1)*).

7.   Installation

Prior to installing the device, set the output mode (current or voltage) of each channel by positioning internal jumpers (see Section 7.3, *Output Mode Setting (p. 13)*). Also set the SDM address of the module (see Section 7.4, *SDM Address Setting (p. 14)*) and consider safety issues specific to the installation (see Section 2, *Precautions (p. 1)*).

7.1   Connection to a Data Logger

For data logger connections, see TABLE 7-1.

<table>
<tr><th colspan="4">TABLE 7-1. Data Logger to SDM-CVO4 Connections</th></tr>
<tr><th>Connection Order</th><th>SDM-CVO4</th><th>Data Logger</th><th>Function</th></tr>
<tr><td>First</td><td>+12</td><td>12 V on data logger or external supply</td><td>Power</td></tr>
<tr><td>Second</td><td>G</td><td>⏚ or G</td><td>Common Ground</td></tr>
<tr><td></td><td>C1</td><td>SDM-C1 (CR3000) or C1 (other data loggers)</td><td>Data</td></tr>
<tr><td></td><td>C2</td><td>SDM-C2 (CRCR5000) or C2 (other data loggers)</td><td>Clock</td></tr>
<tr><td></td><td>C3</td><td>SDM-C3 (CRCR5000) or C3 (other data loggers)</td><td>Enable</td></tr>
</table>

Multiple SDM-CVO4s may be wired in parallel by connecting the SDM and power connections from one SDM-CVO4 to the next.

NOTE   The CR6 allows SDM operation through control terminals **C1**, **C2**, and **C3** as shown in TABLE 7-1. In addition, the **U** terminals on the CR6 may be used in the same manner. **U1** to **U3**, **U5** to **U8**, and **U9** to **U11** are usable in the same **Data**, **Clock**, **Enable** order as the **C** terminals.

NOTE   If the total cable length connecting SDM-CVO4s to SDM-CVO4s, other SDMs and the data logger exceeds 6 m, the SDM baud rate may need to be reduced to ensure reliable operation. Please contact Campbell Scientific for more information.

The transient protection of the SDM-CVO4 relies on a low resistance path to earth. Ensure that the ground return wire has a low resistance. Connect the SDM-CVO4 directly to the enclosure earth ground terminal.

CAUTION   Make sure the SDM-CVO4 ground wire connects to the data logger **G** terminal and not the ⏚ (analogue ground) terminal.

The SDM-CVO4 uses spring-loaded terminal blocks to provide quick, vibration resistant, connections. To attach wires, insert a small screwdriver into either the top or front slot, as appropriate, and push to open the terminal spring. Strip insulation from the wire to give 7 to 9 mm bare wire. Push the wire into the opening, and, while holding it in position, withdraw the screwdriver to release the spring. The wire will now be firmly held in place. See FIGURE 7-1 and FIGURE 7-2.

FIGURE 7-1. Use of the Spring-Loaded Terminal Blocks (Top Position)
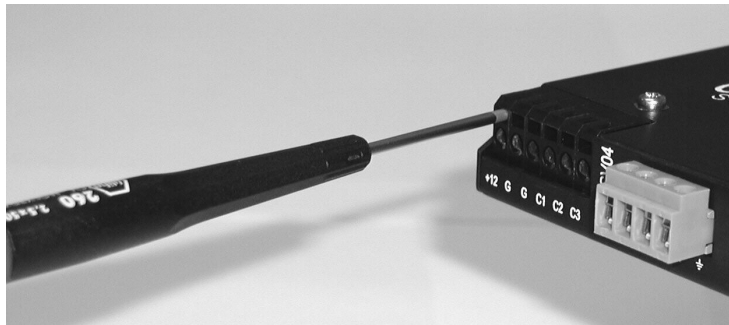
FIGURE 7-2. Use of the Spring-Loaded Terminal Blocks (Front Position)

Only insert one solid-core wire into one terminal unless the wires are soldered or clamped together. When inserting more than one stranded wire, twist the bare ends together before insertion.

7.2   Output Device Connections

Each output channel provides terminals labeled V_o, I_d, and $\perp$ (FIGURE 7-3). The two $\perp$ terminals are internally connected; two are provided for convenience.

FIGURE 7-3. Closeup of Channel 4 Terminals

7.2.1 Voltage Output Mode

The V_o terminal is the output for either the preset voltage signal, when the channel operates in the voltage mode or uses an unregulated 15 VDC power source in the current mode.
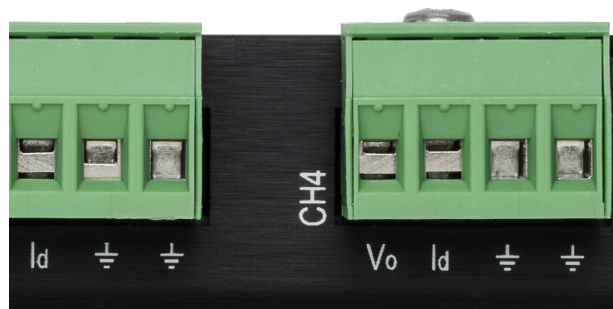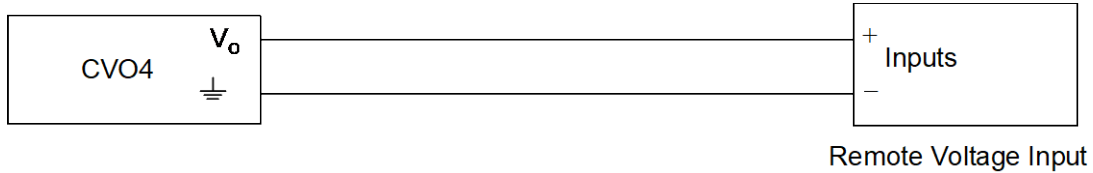
In the voltage mode, two wires connect the remote device is a simple two wire connection:

Remote Voltage Input

7.2.2 Current Output Mode

The I_d terminal is the input for the current being controlled. In current output mode, arrange to sink current into the terminal with a positive current flowing relative to the ground terminals. (In voltage output mode, this terminal has no function.)

Several connections are possible in the current mode. Connection to remote current inputs depends on whether a remote voltage source powers the loop current or the SDM-CVO4 powers the loop current.

The connections for using a remote voltage source to power the loop current depends on the ground referencing requirements of the remote voltage source; see the following diagrams:
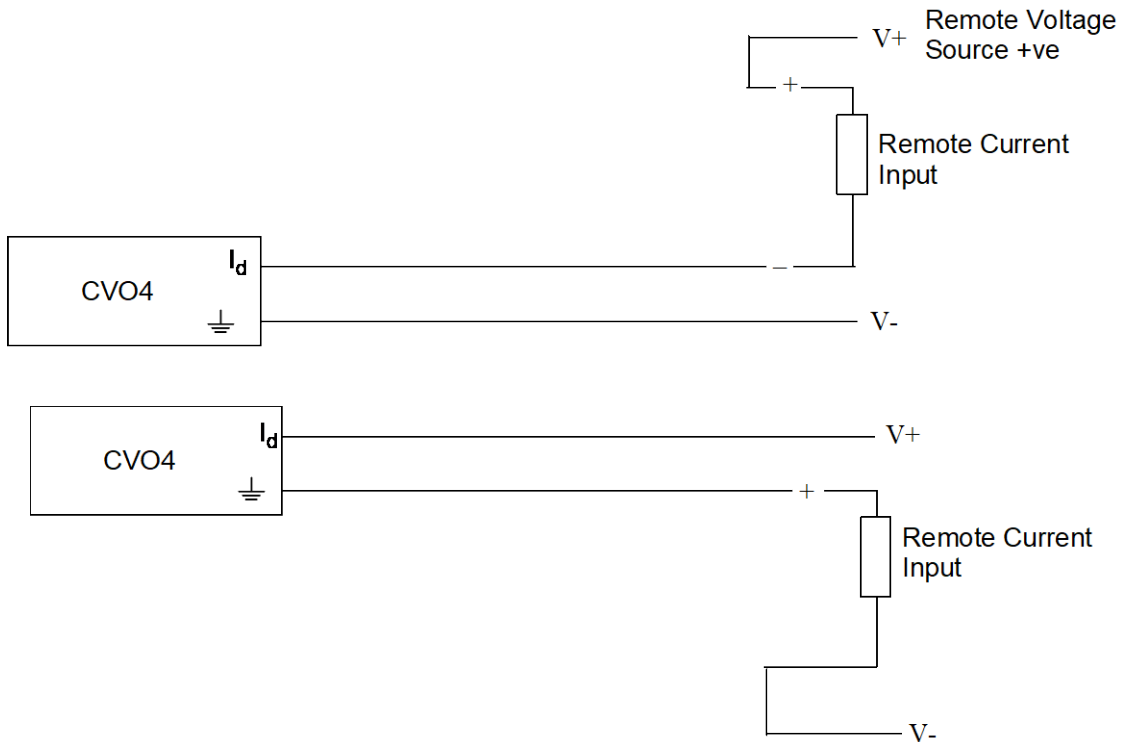
The following shows the connections when the SDM-CVO4 provides the voltage source to drive the loop:
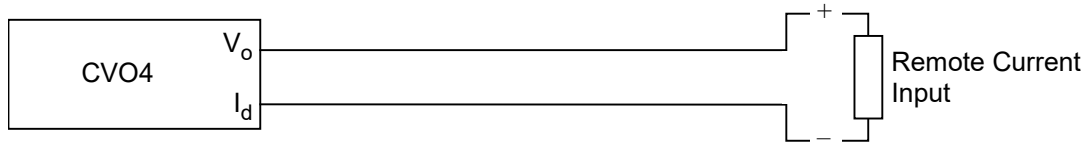
When connecting the SDM-CVO4 to a remote current input, consider whether the voltage supply is high enough to allow the maximum current to flow (20 mA) through all of the series resistances in the current loop. Allow for a minimum 2.5 V drop between the I_d and ⏚ terminal of the SDM-CVO4. Add this value to the estimated drop of 20 mA flowing through the total resistance of the cable in the loop, plus any voltage drop in the remote device (normally the voltage drop across a fixed sense resistor).

For example, consider the situation where the SDM-CVO4 is powering the loop. The supply voltage output from V_0 is 13.5 (absolute minimum). A remote device with a 250-ohm sense resistor will drop 5 V at 20 mA (using Ohm's law), and the SDM-CVO4 will drop 2.5 V in the loop. Therefore, the maximum allowable voltage drop in the cable of the loop is: 13.5 – 5.0 – 2.5 = 6.0 V. At 20 mA current flow, the loop can have a maximum resistance of 300 ohms. Standard 24 AWG (7/0.2 mm) cable has a typical resistance of 85 ohms per 1000 m. Allowing double this resistance to form a loop (there and back), will mean the total cable length could be as long as 1700 m before the supply voltage started to limit the current flowing.

7.2.3 Shield and Ground Connections

Use shielded (screened) cable when connecting the output to any remote system to reduce noise. The shield is only effective when connected to a good ground reference point.

Because of the isolation barrier, the channel ground terminals are not good ground reference points. Therefore, connect the screen to a good ground point at the remote system rather than on the SDM-CVO4. Do not connect the screen at both ends of the cable as this may cause a ground loop.

The output circuitry of the SDM-CVO4 includes protective components to minimize damage caused by transient voltages induced in the signal cable. The protective components reduce the transient voltages to non-damaging levels relative to the ground terminals on each output channel.

If the ground point voltage exceeds the data logger ground potential by more than 2500 VDC, a secondary level protector provides a path for energy to discharge to the data logger ground. To avoid needing the secondary breakdown, connect a wire to the SDM-CVO4 output ground terminals to provide a low impedance path to ground. However, this risks nullifying the effects of the isolation barrier, such as when the SDM-CVO4 and data logger are connected to the same ground.

Carefully study the ground connections of the entire system when connecting a grounding wire to the output ground terminal, to avoid creating a ground loop/referencing problem or causing a safety issue.

7.2.4 Output Terminal Connectors

The output connections use 4-way, screw terminal fixings. These can be unplugged for ease of wiring, if required.

7.3 Output Mode Setting

An internal jumper sets the output mode for each SDM-CVO4 channel. Voltage and current output modes are available. Open the case to change the mode settings. To do this, first disconnect the device from any source or power, unplug the connectors to disconnect the output connections, then remove the four larger screws from the face of the case. Lay the unit on a flat surface, take anti-static precautions, and lift the top half of the case to expose the circuit board.

FIGURE 7-4 shows the jumper blocks that control the output mode. To operate in current mode, install the channel jumper between the two jumper pins, as shown. If operating in voltage mode, the jumper should not bridge any two pins, but may be stored, if required, by fitting it to just one of the pins, leaving the other half unconnected.

Select channel(s) by fitting jumper (s) between appropriate terminals. (Current mode only.) Jumper shown fitted to `enable' Channel 4.

Jumper shown fitted in the unconnected `stored' position.
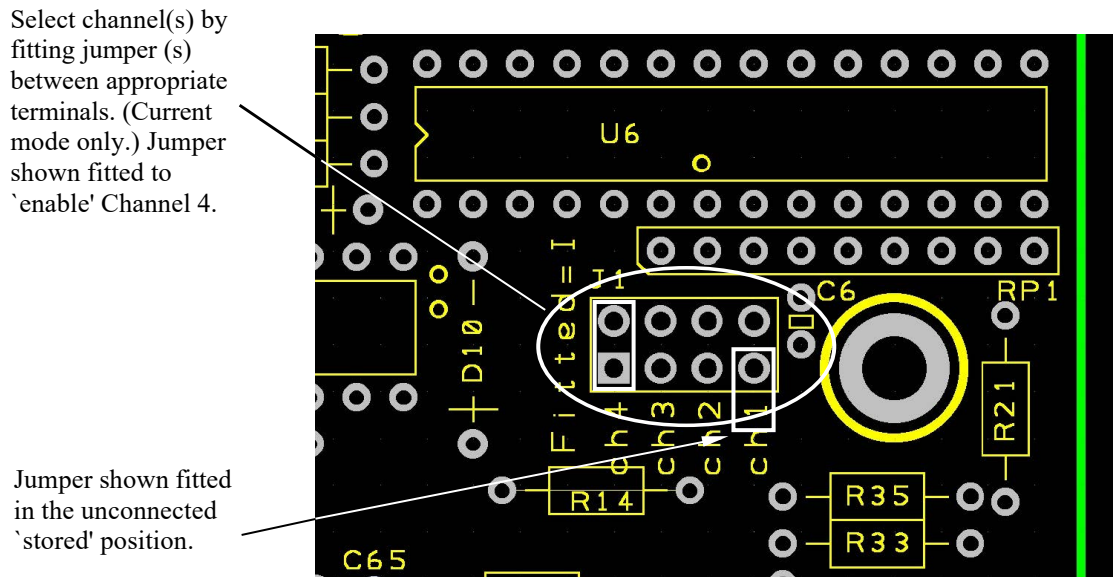

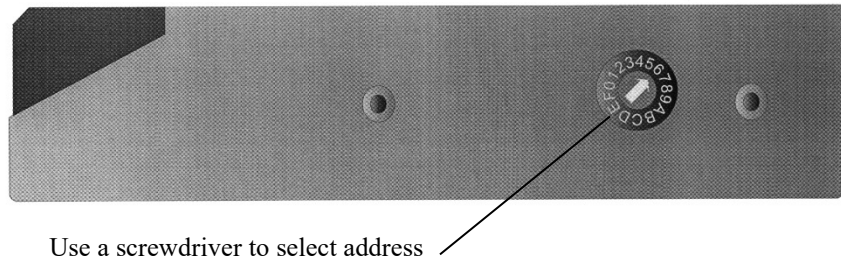*FIGURE 7-4. Location of Jumpers on Circuit Board*

CAUTION Do not store the jumpers between any other pins in the block as this may switch the module into a factory calibration mode, which may result in abnormal operation and change of output accuracy.

The data logger program can override jumper settings (see Section 8.3.1, *CRBasic SDMCVO4() Instruction (p. 16)*).

7.4 SDM Address Setting

The factory-set address is 00. TABLE 7-2 shows switch position and the corresponding address. FIGURE 7-5 shows the position of the switch on the right end of the casing. Remove the right mounting bracket to access the switch.

TABLE 7-2. Switch Position and Addresses	
Switch Setting	**Base 10 Address**
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
A	10
B	11
C	12
D	13
E	14
F	15

Use a screwdriver to select address

FIGURE 7-5. Address Selection Switch

The address switch has a hexadecimal setting position (0 to F). CRBasic data loggers use base 10 when addressing SDM devices. The retired Edlog data loggers used base 4; refer to *www.campbellsci.com/old-manuals* for a table with base 4 addresses.

8. Operation

8.1 Voltage or Current Signaling

The SDM-CVO4 can retransmit sensor measurements to remote displays or measurement systems. In these applications, the data logger program measures the sensors using the same programming as given in the sensor manuals.

Use the point slope equation to scale the measured values. Include the **SDMCV04()** instruction after the mathematical expressions used to scale the sensor measurements.

Use the same scan rate for the sensor measurement instructions and the **SDMCVO4()** instruction. As the required output levels are held in a digital form in the SDM-CVO4, there is little advantage in sending data more frequently – the only benefit being that it would recover more quickly in the event of a loss of power.

8.2   Providing Excitation Supplies to Sensors

One application for this device is to provide excitation to a sensor or sensors. Use the SDM-CVO4 to excite the sensor when a sensor requires a precise voltage or current excitation that cannot be provided by the data logger, or when exciting the sensor from the data logger or its power supply will cause a common-mode measurement error. An example of the latter problem is where the sensor outputs are not within the common-mode voltage that the data logger will accept.

Using the SDM-CVO4 to provide sensor excitation can result in less accurate measurements. Data logger excitation is a ratiometric measurement that compensates for drift in the data logger excitation output. With the SDM-CVO4 as an excitation source, the SDM-CVO4 excitation output drift combines with the data logger measurement errors. When considering whether to use the SDM-CVO4 to supply voltage or current excitation, remember that some sensors may accept a lower excitation voltage or current than their specifications recommend. For example, pressure sensors often recommend 10 V excitation, but may accept a lower excitation voltage that the data logger can provide. If buying new sensors for a project, check for sensor versions that will accept a low voltage excitation.

Some sensors have active components or have large common mode output voltages that require an isolated and/or precise high voltage supply within the current output capability of the SDM-CVO4. In this context, the SDM-CVO4 can provide an isolated supply, a regulated voltage (0 to 10,000 mV), a regulated current (0 to 20 mA), or an unregulated 15 V (nominal) supply (by setting current output mode and using the V_0 terminal).

If all SDM-CVO4 channels are used for exciting sensors, use the standby mode between measurements to save power. To do this, send a command (**SDMCVO4()** with zero reps) to the SDM-CVO4 to shut it down after making the measurements. When using this mode, allow at least 100 ms after turning the SDM-CVO4 on again (by using **SDMCVO4()** with a non-zero number of reps) for the outputs to stabilize, before starting your measurement sequence.

To power more than one sensor from each SDM-CVO4 output, use either a parallel connection in voltage output mode or serial connection in current output mode. Make sure enough current is available in the voltage mode. Also, check that sensor outputs do not have a spread that exceeds the common mode range of the data logger inputs.

8.3 Data Logger Programming

Short Cut can be used for data logger programming code.

If your data acquisition requirements are simple, you can probably create and maintain a data logger program exclusively by using *Short Cut*. If your data acquisition needs are more complex, the files that *Short Cut* creates are a great source for programming code to start a new program or add to an existing custom program.

NOTE	*Short Cut* cannot edit programs after they are imported and edited in *CRBasic Editor*.

A *Short Cut* tutorial is available in Section 4, *Quickstart (p. 3)*. If you wish to import *Short Cut* code into *CRBasic Editor* to create or add to a customized program, follow the procedure in Appendix A, *Importing Short Cut Code Into CRBasic Editor (p. A-1)*. Programming basics for CRBasic data loggers are provided in the following sections. Complete program examples for select CRBasic data loggers can be found in Appendix B, *Example Program (p. B-1)*. Programming basics and programming examples for Edlog data loggers are provided at *www.campbellsci.com/old-manuals*.

The **SDMCVO4()** CRBasic instruction controls the device. Other aspects of the CRBasic program depends on the application. Refer to Section 8, *Operation (p. 14)*, for more information.

8.3.1 CRBasic SDMCVO4() Instruction

This instruction controls the SDM-CVO4, which outputs a voltage or a current. Internal jumpers are used to set the mode for the device, but the jumpers can be overridden with the *Mode* parameter in this instruction.

Syntax
```
SDMCVO4 (CVO4Source, CVO4Reps, SDMAddress, CVO4Mode)
```

CVO4Source   An array with up to four values that holds the voltages (millivolts) or currents (microamps) that will be output by the channels.

CVO4Reps   The number of channels to set to the defined voltage or current. One **SDMCVO4()** instruction can control multiple SDM-CVO4 devices by assigning it consecutive addresses and setting this parameter to the total number of channels of all devices. For example, to set all four channels on two devices, enter 8 for this parameter.

Enter 0 for this parameter to turn off power to the device.

SDMAddress   Valid SDM addresses are 0 through 14. Address 15 is reserved for the **SDMTrigger()** instruction.

NOTE	CRBasic data loggers use base 10 when addressing SDM devices.

CVO4Mode   The CVO4Mode determines what type of signal will be output by the device. The options are:

Option	Description
0	Voltage output, use jumper settings (scale only)
1	Current output; use jumper settings (scale only)
10	Voltage output; override jumper setting
11	Current output; override jumper setting

The two override options (10 and 11) affect all of the channels of all of the SDM-CVO4 devices being controlled by this instruction. These two options override the hardware settings in the device. Use of this mode takes approximately 2 milliseconds additional time per device. When either of these options is used you lose the flexibility of setting the output mode for each channel individually. Additionally, subsequent programs sent to the data logger must also use an override mode or the power must be cycled on the device to return it to its default state. Otherwise, if 0 or 1 is entered it will be ignored and the device will remain in its last override state.

NOTE   Current output cannot be controlled if the terminals I_d and V_o are shorted.

8.3.2 SDMSpeed() Instruction

This instruction changes the rate that a data logger uses to clock the SDM data. Slowing down the clock rate may be necessary when long cables lengths are used to connect the data logger and SDM devices.

TABLE 8-1. Description of SDM Speed	
Parameter *& Data Type*	**Enter**
BitPeriod *Constant or variable*	The time per bit, in microseconds. Initial Setting (default): 26.04 µS Resolution: 8.68 µS Min Setting: 8.68 µS Max Setting: 2.2 mS SDMSpeed(30) gives: 26.04 µS SDMSpeed(k) gives: bit_rate = INT((k*72)/625) * Resolution When calculating SDMSpeed(k), the loggers round down to the next higher bit.

Appendix A. Importing Short Cut Code Into CRBasic Editor

Short Cut creates a .DEF file that contains wiring information and a program file that can be imported into the *CRBasic Editor*. By default, these files reside in the C:\campbellsci\SCWin folder.

Import *Short Cut* program file and wiring information into *CRBasic Editor*:

1. Create the *Short Cut* program. After saving the *Short Cut* program, click the **Advanced** tab then the **CRBasic Editor** button. A program file with a generic name will open in CRBasic. Provide a meaningful name and save the CRBasic program. This program can now be edited for additional refinement.

NOTE   Once the file is edited with *CRBasic Editor*, *Short Cut* can no longer be used to edit the program it created.

2. To add the *Short Cut* wiring information into the new CRBasic program, open the .DEF file located in the C:\campbellsci\SCWin folder, and copy the wiring information, which is at the beginning of the .DEF file.

3. Go into the CRBasic program and paste the wiring information into it.

4. In the CRBasic program, highlight the wiring information, right-click, and select **Comment Block**. This adds an apostrophe (') to the beginning of each of the highlighted lines, which instructs the data logger compiler to ignore those lines when compiling. The **Comment Block** feature is demonstrated at about 5:10 in the *CRBasic | Features* video ▶.

Appendix B. Example Program

This program example is for a weather station measuring wind speed, wind direction, temperature, and relative humidity. Each parameter is scaled to 0 to 10000 mVDC, and output to a SCADA system through the SDM-CVO4.

CRBasic Example B-1. CR1000X Program Using an SDM-CV04 to Output to a SCADA System

```
Public WS_ms
Public WD_0_360
Public Temp_C
Public RH
Public WD_0_540
Public CVO4Output(4)
Alias CVO4Output(1) = WSOut
Alias CVO4Output(2) = WDOut
Alias CVO4Output(3) = TempOut
Alias CVO4Output(4) = RHOut

'Code for DataTable OneMin
DataTable(OneMin,1,-1)
  DataInterval(0,1,Min,0)
  WindVector (1,WS_ms,WD_0_360,IEEE4,0,0,0,0)
  Average(1,Temp_C,IEEE4,0)
  Sample(1,RH, IEEE4)
EndTable

BeginProg
  Scan(1,Sec,1,0)
    'Code for 03002 wind measurements, WS_ms & WD_0_360:

    PulseCount(WS_ms,1,P1,5,1,0.75,0.2)
    BrHalf(WD_0_360,1,mV1000,1,Vx1,1,1000,True,2000,60,355,0)
    'Code for HMP60 measurement, AirTC and RH:
    VoltSe(Temp_C,1,mV1000,3,0,0,60,0.1,-40.0)
    VoltSe(RH,1,mV1000,2,0,0,60,0.1,0)
    ' Call Data Table
    CallTable(OneMin)
    'Convert 0-360 WD to 0-540:
    If WD_0_540 >= 270 AND WD_0_360 <180 Then
      WD_0_540 = WD_0_360 + 360
    Else
      WD_0_540 = WD_0_360

    EndIf
    'Scale the measurements for the SDM-CVO4 to output 0-10000 mV
    WSOut = WS_ms*200  'WS: 0-50 m/s = 0-10000 mV
    WDOut = WD_0_540 *18.59  'WD: 0-540 deg = 0-10000mV
    TempOut= 100*(Temp_C+40)  'Temp: -40-60 deg C = 0-10000 mV
    RHOut = RH *100  'RH: 0-100 % RH = 0-10000 mV
    'Send mV outputs to SDM-CVO4 using the option to override the switch settings
    SDMCVO4 (CVO4Output(),4,0,10)
  NextScan
EndProg
```

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Use tripods, towers, and attachments to tripods and towers only for purposes for which they are designed. Do not exceed design limits. Be familiar and comply with all instructions provided in product manuals. Manuals are available at www.campbellsci.com. You are responsible for conformance with governing codes and regulations, including safety regulations, and the integrity and location of structures or land to which towers, tripods, and any attachments are attached. Installation sites should be evaluated and approved by a qualified engineer. If questions or concerns arise regarding installation, use, or maintenance of tripods, towers, attachments, or electrical connections, consult with a licensed and qualified engineer or electrician.

General
- Protect from over-voltage.
- Protect electrical equipment from water.
- Protect from electrostatic discharge (ESD).
- Protect from lightning.
- Prior to performing site or installation work, obtain required approvals and permits. Comply with all governing structure-height regulations.
- Use only qualified personnel for installation, use, and maintenance of tripods and towers, and any attachments to tripods and towers. The use of licensed and qualified contractors is highly recommended.
- Read all applicable instructions carefully and understand procedures thoroughly before beginning work.
- Wear a **hardhat** and **eye protection**, and take **other appropriate safety precautions** while working on or around tripods and towers.
- **Do not climb** tripods or towers at any time, and prohibit climbing by other persons. Take reasonable precautions to secure tripod and tower sites from trespassers.
- Use only manufacturer recommended parts, materials, and tools.

Utility and Electrical
- **You can be killed** or sustain serious bodily injury if the tripod, tower, or attachments you are installing, constructing, using, or maintaining, or a tool, stake, or anchor, come in **contact with overhead or underground utility lines**.
- Maintain a distance of at least one-and-one-half times structure height, 6 meters (20 feet), or the distance required by applicable law, **whichever is greater**, between overhead utility lines and the structure (tripod, tower, attachments, or tools).
- Prior to performing site or installation work, inform all utility companies and have all underground utilities marked.
- Comply with all electrical codes. Electrical equipment and related grounding devices should be installed by a licensed and qualified electrician.
- Only use power sources approved for use in the country of installation to power Campbell Scientific devices.

Elevated Work and Weather
- Exercise extreme caution when performing elevated work.
- Use appropriate equipment and safety practices.
- During installation and maintenance, keep tower and tripod sites clear of un-trained or non-essential personnel. Take precautions to prevent elevated tools and objects from dropping.
- Do not perform any work in inclement weather, including wind, rain, snow, lightning, etc.

Maintenance
- Periodically (at least yearly) check for wear and damage, including corrosion, stress cracks, frayed cables, loose cable clamps, cable tightness, etc. and take necessary corrective actions.
- Periodically (at least yearly) check electrical ground connections.

Internal Battery
- Be aware of fire, explosion, and severe-burn hazards.
- Misuse or improper installation of the internal lithium battery can cause severe injury.
- Do not recharge, disassemble, heat above 100 °C (212 °F), solder directly to the cell, incinerate, or expose contents to water. Dispose of spent batteries properly.

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