Campbell SCIENTIFIC | QUICK DEPLOY GUIDE

Granite VOLT Series

Analog Measurement Expansion Module

Scan for info:

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IMPORTANT NOTE: This Quick Deploy Guide is meant to be a general reference to give the installer an overview of the steps required to make this system operational. The product manuals are the definitive source for detailed installation instructions and information.

Introduction

The Granite™ VOLT Series modules are 24-bit analog input devices that expand the number of analog channels in a data logger system. The VOLT 108 provides eight differential channels, while the VOLT 116 offers 16.

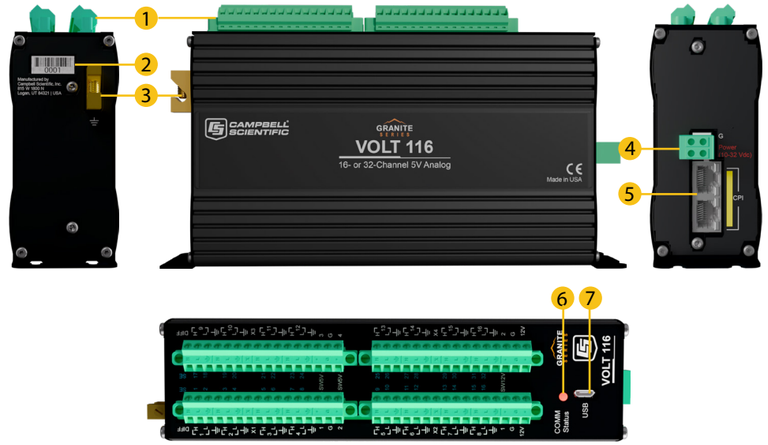
Both modules feature a 24-bit analog-to-digital converter and a low-noise analog front end for high-precision measurements. They support period average measurements and include both current and voltage excitation channels. For more details, refer to the VOLT Series manual.

Downloads

Visit www.campbellsci.com/granite-components and select a specific module to download:

- VOLT Series Manual (includes example programs)
- Updated operating system (OS)
- CPI Calculator. The CPI Calculator is a downloadable Microsoft Excel spreadsheet used to estimate the usage and capacity of a CPI network.
- Device Configuration Utility (DevConfig)

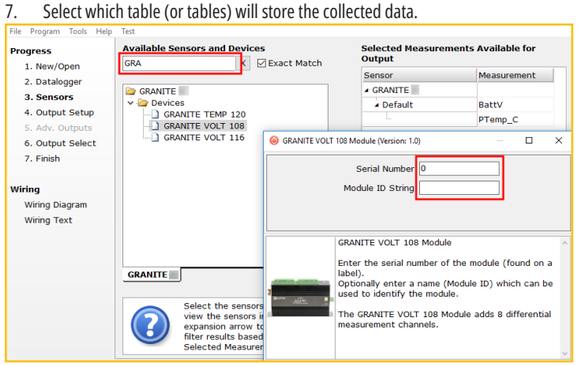
1. Sensor terminals
2. Serial number
3. Ground lug
4. Power connection
5. CPI connection
6. Comm status lights
7. USB connection



Getting Started with Short Cut

Short Cut is a simple way to create a data logger program for the VOLT Series. A program is created by selecting a CPI data logger, adding modules and measurements, and specifying what data should be saved in the output file, see Figure 1 below. If multiple VOLT Series are going to be programmed, use Device Configuration Utility to configure each module with a unique CPI address.

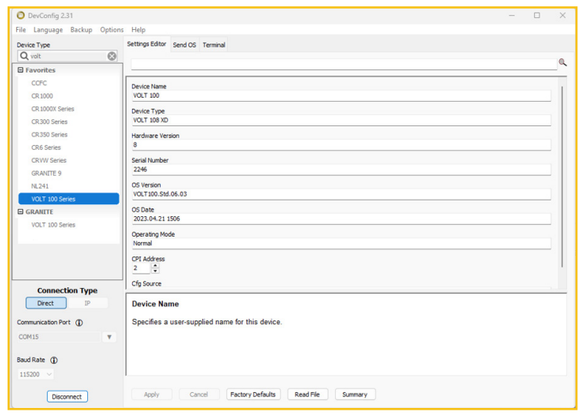
1. Open Short Cut and create a new program.
2. Double-click the appropriate data logger.
3. In the Devices folder under **Available Sensors and Devices**, select the correct VOLT Series module and enter the module serial number and an optional module name.
4. Add sensors and sensor measurements.
5. Create output tables for collected data and enter the sample time period.
6. Create advanced outputs, if required.
7. Select which table (or tables) will store the collected data.



Device Configuration Utility Configuration

Install the module driver before connecting the VOLT Series module to a computer. This is optional for Windows 10, or later, operating systems.

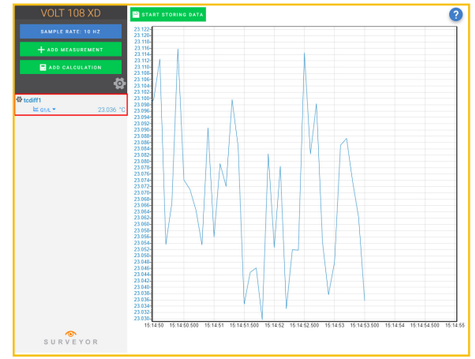
1. Open Device Configuration Utility.
2. Under **Device Type**, select Granite > VOLT 100 series.
3. Review the Connecting with USB Instructions on the right.
4. Apply 9 to 32 VDC power.
5. Connect a USB cable between the computer and the VOLT module.
6. Select **Direct** under **Connection Type**.
7. Under **Communication Port,** select the port labeled **VOLT 100 series**.
8. Click **OK**.
9. Click **Connect** then **OK** to avoid conflicts.
10. Set the **Device Name** (optional) and the **CPI Address**.
    - Device Name is a user-editable field to set a unique name to the VOLT series module.
    - CPI Address – Each VOLT Module connected to the same data logger must have a unique address. Allowable addresses are 1 through 120.
11. Click **APPLY** to save changes.



Getting Started with SURVEYOR

Campbell Scientific SURVEYOR software is an easy way to quickly see measurement results and store data from the VOLT Series. The device configuration can be saved on the computer or exported as a CRBasic data logger program. SURVEYOR is available as a download from www.campbellsci.com/cs-surveyor.

1. Open SURVEYOR.
2. Connect a USB cable between the computer and the VOLT module.
3. Power the VOLT module (9 to 32 VDC).
4. Select **Connect Now**.
5. Select the **VOLT module** from the Communication Port.
6. Make selections for **Speed** or **Noise Rejection** and **CAN enabled**.
7. Click **APPLY**.
8. Select a **SAMPLE RATE.**
9. **ADD MEASUREMENT(s)**.



Data Logger Program Export
A CRBasic program can be created based on how a VOLT Series module is configured in Surveyor. Select File to Export a data logger program.
Download Surveyor:
www.campbellsci.com/cs-surveyor

Connections and Lights

Power
- 9 to 32 VDC input
- Follow wiring labels

CPI & CPI Cable
- 2 CPI connections per module
- 1 data logger CPI connection per CPI network
- CPI Cable: Cat5e or Cat6 cable with RJ45 connectors

Ground
- Use 14 gauge (AWG) or larger to earth ground

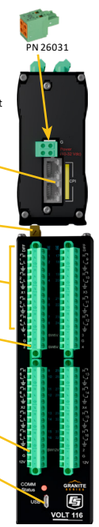
Sensor Terminal Connections
- Analog measurement and excitation channels
- Switched 5 V channels
- Switched 12 V channels
- 12 V (continuous)

USB
- USB cable
- PC connection

Mounting
- Compatible with Campbell Scientific back plates
- DIN rail mounting optional

Typical Current Drain	
Sleep/Standby	< 1 mA
Active 1 Hz Scan[1]	2 mA
Active 20 Hz Scan[1]	20 mA
Maximum	75 mA

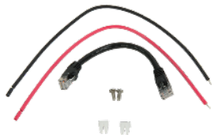
[1]Assumes one single-ended measurement with f_{NL} = 30,000



Comm Light Status

Light State	Channel Status
Green flash	VOLT is configured and receiving sync signals from the data logger
Orange flash	VOLT has not been configured by the data logger
Red single-flash	VOLT is configured, but is not receiving sync signal from the data logger
Red double-flash	VOLT has encountered a scan timeout
Red solid	Error

Parts Kit and Accessories



Parts kit for VOLT Series peripherals includes:
- 6 inch network cable
- USB cable
- Power cables mounting screws
- Mounting screws
- Mounting grommets

Common Accessories
- HUB-CPI- 8-Channel RJ45 Hub for CPI Peripherals
- CPI Network Kit
- CAT5UCBL- CAT5e unshielded cable with RJ45 connectors in customer-defined lengths
- CAT5e unshielded cable with RJ45 connectors, 50 feet
- CAT5e unshielded cable with RJ45 connectors, 10 feet
- Granite Series DIN Rail Kit for 2-inch Modules

Troubleshooting Tips

- Confirm voltage at the power connector is between 9.6 and 32 VDC
- Verify each VOLT Series module in the network has a unique CPI address
- Verify that Cat5e or Cat6e cable is used and check for the following:
  - » Loose connection points
  - » Faulty connectors
  - » Cut wires
  - » Damaged insulation, which allows water to migrate into the cable
- Add a CPI terminator to the last module in a daisy-chain network
- Verify enough data logger memory has been allocated in the CRBasic program
  - » Typically, a Scan() BufferOption of 300 to 500 will suffice
- Check if the program scan rate is long enough for the measurement time
- Ensure the CPI network bit rate is fast enough for the data generated and can accommodate the cable lengths used
- Check the operating systems of both the data logger and VOLT Series module and update as needed

CRBasic Tip: When using a CPI module, improve data logger performance by adjusting the CRBasic SCAN instruction buffer. Set it to around 400 for small networks and 1500 for larger networks. This allocates extra memory for the data logger to process incoming data while handling other tasks.

Measurement Speeds

The following table shows the maximum[1] measurement speeds of the VOLT Series modules based on input parameters and the number of channels.

	Voltage Measurement						Voltage with Excitation Measurement								
f_{NI}[2]	**30,000 Hz** (non-geographic)		**60 Hz** (North America)		**50 Hz** (Europe)		**30,000 Hz** (non-geographic)			**60 Hz** (North America)			**50 Hz** (Europe)		
Reverse Measurement[3]	False	True	False	True	False	True	False	True	True	False	True	True	False	True	True
Reverse Excitation[3]	–	–	–	–	–	–	False	False	False	False	False	False	False	False	False
Settling Time (µs)[4]	100	400	500	500	500	500	500	500	500	500	500	500	500	500	500
Channels[5]	Maximum Measurement Rate (Hz)[6] per channel														
1	500	250	50	25	25	20	500	500	250	50	25	10	25	20	10
2	500	250	25	10	20	10	500	250	125	25	10	5	20	10	5
3	500	200	10	5	10	5	500	250	100	10	5	2	10	5	2
4	250	125	10	5	10	5	250	200	50	10	5	2	10	5	2
5	250	125	10	5	5	2	250	125	50	10	5	2	5	2	2
6	250	100	5	2	5	2	250	125	50	5	2	2	5	2	2
7	250	100	5	2	5	2	250	125	50	5	2	2	5	2	1
8	250	50	5	2	5	2	250	100	25	5	2	1	5	2	1
9	250	50	5	2	5	2	250	100	25	5	2	1	5	2	1
10	250	50	5	2	2	2	250	50	25	5	2	1	2	2	1
11	250	50	5	2	2	2	200	50	25	5	2	1	2	2	1
12	250	50	2	2	2	2	200	50	25	2	2	1	2	2	1
13	250	50	2	2	2	1	125	50	25	2	2	1	2	1	0
14	125	50	2	2	2	1	125	50	25	2	2	1	2	1	0
15	125	50	2	1	2	1	125	50	25	2	1	0	2	1	0
16	125	25	2	1	2	1	125	50	20	2	1	0	2	1	0

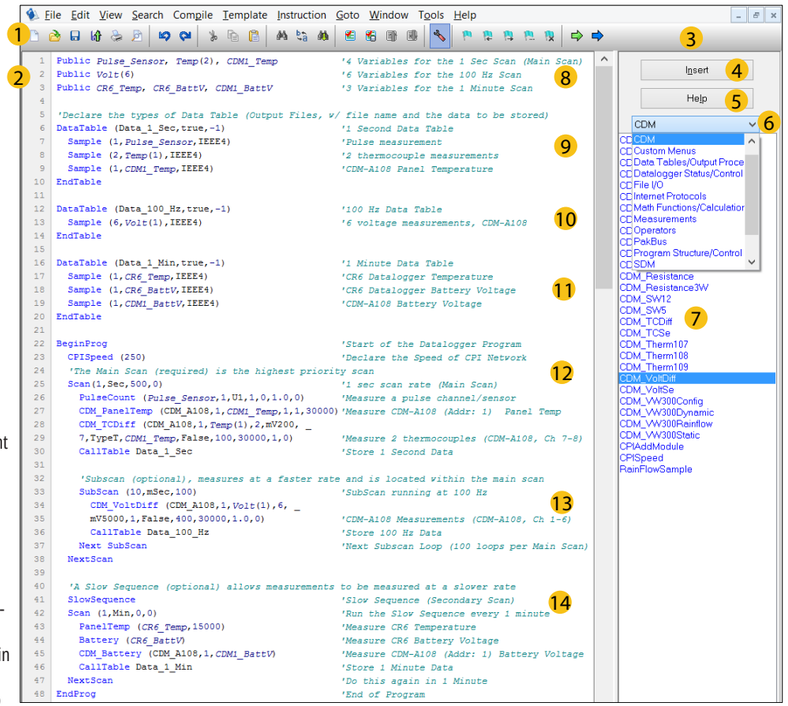
[1] The maximum speed refers to the speed on a single channel. For example, 3 channels at 150 Hz indicates 150 Hz on each channel.
[2] f_{NI} is the speed of the analog to digital convertor (ADC), 30,000 Hz is typically used for fast measurements, 60 and 50 Hz are typically used filter out the noise influence from the AC power grid.
[3] Reverse Measurement and Reverse Excitation are parameters that allow the measurement to be taken again by reversing the polarity and excitation (if present).
[4] Settling Time is the amount of time after setting up the measurement before the measurement is made, the default is 500 µs, minimum time is 100 µs.
[5] Measurement speeds are stated assuming a single instruction is used with repetitions, individual instructions for each channel decreases the speed.
[6] Measurement speeds reflect the specified input parameters, generally speaking, input parameters that slow the measurement speed increase the resolution.

CRBasic Programming

A VOLT Series module should be considered an extension of the data logger. In a CRBasic program, the VOLT Series module is called with CRBasic instructions and returns data over the CPI network. The following example shows a program that calls the CDM-A108 using various commands and with Different Scan Intervals. Your program may look very different and should be developed based on your system needs.

CRBasic Editor

1. Toolbar
2. Line number
3. Instruction panel
4. Insert selected instruction
5. Help file for selected instruction
6. Instruction panel filter
7. Available instructions



VOLT Series Program Structure[1]

8. Lines 1–3: Measurement variables
9. Lines 6–10: One second datatable
10. Lines 12–14: 100 Hz datatable
11. Lines 16–20: One minute datatable
12. Lines 22–38 and line 48: Main program[2]
13. Lines 33–37: SubScan within the main program[2]
14. Lines 41–47: Slow Sequence scan[2]

[1] This program is an example. Your program may look very different
[2] See Different Scan Intervals

Different Scan Intervals

A data logger can have multiple scan intervals. Most data logger programs are fine with only the Main Scan.

Main Scan: Tasks within the Main Scan have the highest priority. Some instructions must be executed in the Main Scan (ex. CDM-VW300 instructions, pulse, and controls).

Sub Scan: A Sub Scan is used when measurements within the Main Scan need to be performed at a faster rate.

Slow Sequence: The Slow Sequence contains instructions that do not need to happen at the rate of the Main Scan. This is often used for slower measurements or communications.

CRBasic Tips and Tricks

- Right-click on an instruction to view a pop-up window (e.g., right-click on CDM_TCDiff). This opens the instruction parameters and Help.
- When looking for a specific instruction, try using the instruction filter.
- An underscore "_" can be used to break a very long line of code into two lines that still evaluates like a single line of code, see line 28–29 and 34–35.

PipeLineMode vs SequentialMode Programming

PipeLineMode allows a data logger to prioritize and execute the tasks in a program in the most efficient way possible. SequentialMode forces the data logger to perform the program tasks in the order they appear. PipeLineMode is the recommended method to accomplish the higher measurements speed capability of a CPI network. Some Granite modules (CDM-VW300) require a PipeLineMode program. See PipeLineMode or SequentialMode help file for more information.

Buffers

Because of the quantity of CPI data streaming to the data logger, a scan buffer (line 25, 3rd variable) should be used. A buffer allows a data logger to accept CPI data while it is working on a local data logger task or measurement, without losing CPI data. For most systems, a Scan Buffer of 300 to 500 is generally sufficient.

CRBasic instruction	Instruction overview
CDM_Battery	Returns the CDM battery voltage
CDM_BrFull (6W)	Performs a full bridge measurement
CDM_BrHalf (3W, and 4W)	Performs a half bridge measurement
CDM_ExciteI	Used to enable a current excitation to an excitation channel
CDM_ExciteV	Used to apply a voltage excitation to an excitation channel
CDM_MuxSelect	Select a specified channel on the AM16/32B multiplexer with the VOLT Series Module
CDM_PanelTemp	Measure the temperature (°C) of the VOLT Series wiring panel
CDM_PeriodAvg	Measure the period (microseconds) or the frequency (Hz) of a single-ended channel
CDM_PulsePort	Toggle the state of a digital channel on a VOLT Series Module
CDM_Resistance (3W)	Measure the resistance with a current excitation on a channel
CDM_SW12 (5)	Set the switched 12 volt channel high or low on the VOLT Series Module
CDM_TCDiff	Measure a thermocouple and convert to temperature (°C)
CDM_Therm107 (108 and 109)	Used to measure the Campbell Scientific 107, 108, and 109 thermistors
CDM_VoltDiff	Measure an analog voltage using 2 channels (high and low) (mV)
CDM_VoltSe	Measure an analog voltage using 1 channel in reference to ground (mV)
CPIAddModule	Configure the CPI Address programmatically based on a CDM serial number
CPISpeed	Set the CPI network speed the data logger uses to communicate with CDMs (50, 125, 250, 500, or 1000 Kbps)

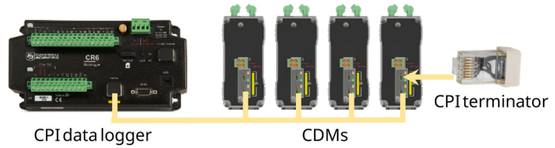
CPI Networks

CPI Overview

CPI is a communication protocol developed to communicate data from Granite modules to a data logger. CPI networks can be installed in either a Daisy-Chain Topology or Star Topology and can include different types of Granite modules. CPI networks require Cat5e or Cat6 cable. Any CPI network designed near the upper limits (CPI usage or cable length) should be tested; site conditions vary and affect performance.

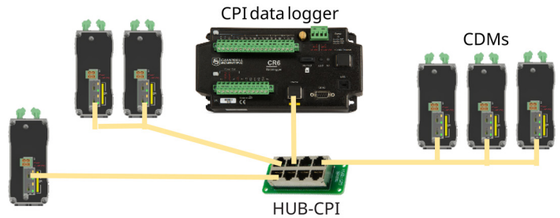
Daisy-Chain Topology

A Daisy-Chain network consists of a data logger on one end and Granite modules connected in sequence. It is recommended to install a CPI Terminator on the last module to increase performance and minimize errors in the CPI network.



Star Topology

A Star network consists of Granite modules going multiple directions from a single point (often at the data logger). A HUB-CPI is used to route the CPI cables. A CPI Terminator can't be used in a star network.



CPI Network Speed

A CPI network is capable of operating at 1000, 500, 250, 125, or 50 kilobits per second (Kbps). The CPI speed is declared by the CRBasic data logger program using the CPISpeed() instruction. If the CPI speed is not declared, the default speed is 250 Kbps. Determining the CPI network speed and maximum cable lengths is a two step process:

1. CPI Usage

The VOLT Series CPI usage is based on the number of measurements and speed from the following equation:

CPI Usage (Kbps) = (Measurements) x (speed) x (0.064)

Example: A VOLT Series module measuring 8 sensors at 200 Hz would have a CPI usage of approximately 102 Kbps because 8 x 200Hz x 0.064 = 102 Kbps

2. CPI Network

The maximum CPI cable length is based on the network topology and the CPI speed.

Maximum Total[5] CPI Cable Length

Network Topology	CPI Speed (Kbps)				
	1000	500	250	125	50
Daisy-Chain with Termination	50 ft (15 m)	200 ft (61 m)	500 ft (152 m)	1200 ft (366 m)	2800 ft (853 m)
Daisy-Chain w/o Termination	1 ft (0.3 m)	200 ft (61 m)	400 ft (122 m)	1000ft (305 m)	2400ft (732 m)
Star Topology	n/a	100 ft (30 m)	400 ft (122 m)	1000 ft (305 m)	2400 ft (732 m)

[5] The maximum total cable length of the CPI network is the sum of all CPI cable.
Example: A Star Topology network with two VOLT Series modules described in step 1 requires 204 Kbps. The CPI Speed should be set at 250 Kbps and the sum of all CPI cables shouldn't exceed 400 ft.