



RangeVue™ 15 and RangeVue™ 30

Radar Water Level Sensors



Please read first

About this manual

Please note that this manual was produced by Campbell Scientific Inc. primarily for the North American market. Some spellings, weights and measures may reflect this. 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 from Campbell Scientific it will be suitable for use in your country.*

Reference to some radio transmitters, digital cell phones and aerials (antennas) 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.

Recycling information for countries subject to WEEE regulations 2012/19/EU



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, per [The Waste Electrical and Electronic Equipment \(WEEE\) Regulations 2012/19/EU](#). Campbell Scientific 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 support, please contact Campbell Scientific, or your local agent.

Table of contents

1. Introduction	1
2. Precautions	1
3. Initial inspection	2
4. QuickStart	2
5. Overview	5
6. Specifications	6
7. Installation	9
7.1 Wiring to the data logger	9
7.2 Data logger programming	10
7.2.1 CRBasic programming	10
7.2.2 Field installation	11
7.2.3 Determine and set reference stage	15
8. Operation	16
8.1 Default settings	16
8.2 SDI-12 commands	17
8.3 Status codes	20
8.4 Configuring sensor via extended SDI-12 commands and terminal emulator	21
9. Maintenance, diagnostics, and repair	24
9.1 Testing procedure	25
9.2 Cyclic redundancy check	25
Appendix A. Importing Short Cut code into CRBasic Editor	26
Appendix B. SDI-12 version 1.4 identify measurement commands and responses	27
Appendix C. FCC/IC equipment authorization (USA/Canada only)	29

1. Introduction

The RangeVue™15 and RangeVue™30 radar sensors monitor the water level of rivers, lakes, tidal seas, and reservoirs, and is ideal for areas where submersed sensors can be damaged due to corrosion, contamination, flood-related debris, lightning, or vandalism. The RangeVue 30 can measure distances up to 30 m (98.4 ft) and the RangeVue 15 can measure distances up to 15 m (49.2 ft).

The RangeVue 15 and RangeVue 30 radar sensors output a digital SDI-12 signal to indicate distance and stage. The output is acceptable for recording devices with SDI-12 capability.

2. Precautions

- READ AND UNDERSTAND the [Safety](#) section at the back of this manual.
- Follow country-specific installation standards, prevailing safety regulations, accident prevention rules, and this manual's safety instructions. The sensor is designed for safe operation in accordance with the current technical, safety, and ANSI standards.
- The emitting frequencies of the RangeVue-series is well below the internationally permitted limits. When used correctly, the radar sensor presents no danger to people.
- Do not attempt to install the sensor unless you are qualified to perform the installation.
- Handle the sensor carefully, since it is a precision instrument.
- If installing the sensor from tall structures over water, use appropriate safety equipment such as a safety harness or a life preserver when installing or performing maintenance on the sensor.
- The user is responsible for ensuring that the sensor is maintained and functioning properly.



3. Initial inspection

When unpacking the equipment, do the following:

- Unpack the unit in a clean, dry area.
- Carefully open the shipping package, ensuring that the cable jacket is not damaged or cut. Contact Campbell Scientific if the cable was damaged during unpacking.
- Inspect the equipment for any damage that occurred during shipping. If equipment was damaged during shipping, file a claim with the carrier and report the damage in detail.

4. QuickStart

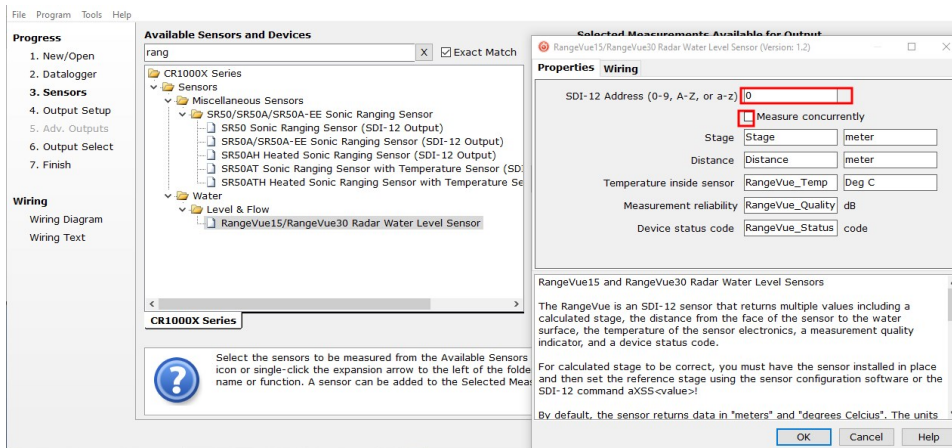
A video that describes data logger programming using *Short Cut* is available at:

www.campbellsci.com/videos/cr1000x-data-logger-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*, and *PC400*.

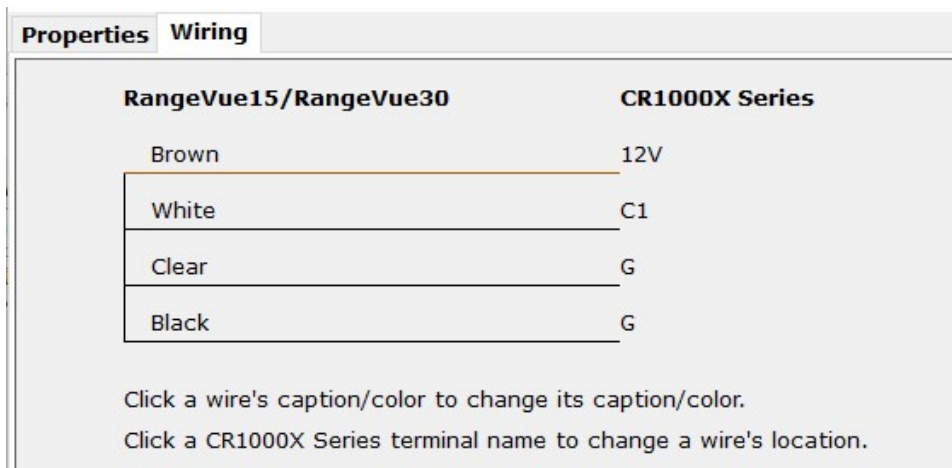
The following procedure also shows using *Short Cut* to program the RangeVue-series.

1. Open *Short Cut* and click **Create New Program**.
2. Double-click the data logger model.

- In the **Available Sensors and Devices** box, type RangeVue or find the sensor in the **Sensors > Water > Level & Flow** folder, and double-click **RangeVue15/RangeVue30 Radar Water Level Sensor**. **SDI-12 Address** defaults to **0**. Enter the correct **SDI-12 Address** if the address has been changed from the factory default value. Check the **Measure concurrently** box if you want to use the **C!** SDI-12 command. By default, the sensor units are meters and degrees Celsius. The units are changed using the extended SDI-12 commands ([Configuring sensor via extended SDI-12 commands and terminal emulator](#) [p. 21]).



- Click the **Wiring** tab. Click **OK** after wiring the sensor.



- Repeat steps three and four for other sensors you want to measure. Click **Next**.

6. In **Output Setup**, type the scan rate, a **Table Name**, and **Data Output Storage Interval**. Click **Next**.

Short Cut (CR1000X Series) C:\Campbell\SCWin\untitled.scw

File Program Tools Help Test

Progress

1. New/Open
2. Datalogger
3. Sensors
4. **Output Setup**
5. Adv. Outputs
6. Output Select
7. Finish

Wiring

Wiring Diagram
Wiring Text

How often should the CR1000X Series measure its sensor(s)? **10** Seconds

Data is processed by the datalogger and then stored in an output table. Two tables are defined by default; up to 10 tables can be added.

Add New Table

1 Hourly **2 Daily**

Table Name: **Hourly** Delete Table

Data Output Storage Interval: **60** Minutes

Makes 360 measurements per output interval based upon the chosen measurement interval of 10 Seconds.

Copy to External Storage

☒ SC115 Flash Memory Drive
☐ Memory Card

☐ Advanced Outputs (all tables)

Specify how often measurements are to be made and how often outputs are to be stored. Note that multiple output intervals can be specified, one for each output table. By default, an output table is set up to send data to memory based on time. Select the Advanced Output option to send data to memory based on one or more of the following conditions: time, the state of a flag, or the value of a measurement.

Previous **Next** Finish Help

NOTE:

Because of the delays using SDI-12, Campbell Scientific recommends measurement scans of 10 seconds or more.

7. Select the output options.

File Program Tools Help

Progress

1. New/Open
2. Datalogger
3. Sensors
4. Output Setup
5. Adv. Outputs
6. **Output Select**
7. Finish

Wiring

Wiring Diagram
Wiring Text

Selected Measurements Available for Output

Sensor	Measurement
CR1000X Series	
Default	BattV
L	PTemp_C
RangeVue15/Rang...	Stage
	Distance
	RangeVue_Temp
	RangeVue_Qu...
	RangeVue_St...

Selected Measurements for Output

Sensor	Measurement	Processing	Output Label	Units
RangeVue15	Stage	Average	Stage_AVG	meter
RangeVue15	Distance	Average	Distance_AV	meter
RangeVue15	RangeVue_T	Average	RangeVue_T	Deg C
RangeVue15	RangeVue_C	Sample	RangeVue_C	dB
RangeVue15	RangeVue_S	Sample	RangeVue_S	code

Sample

Edit Remove

Select which measurements to store in which tables and how each measurement should be processed. For each value to be stored in the table, choose a measurement from "Selected Measurements Available for Output." Next, select one of the processing functions, such as Average, Sample, etc. Note that the output tables must be set up in order for data to be stored in the datalogger memory.

Previous Next Finish Help

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

5. Overview

The radar sensor consists of an integrated microwave transmitter and sensor. A built-in SDI-12 interface provides data processing and SDI-12 communications with the data logger.

The RangeVue-series emits a continuous, frequency-modulated radar signal and measures the elapsed time between the emission and return of the signal. The elapsed time measurement is used to calculate the distance between the sensor face and the target (for example, water, grain, slurry). The distance value is used to determine depth of the medium (Figure 5-1 [p. 5]).

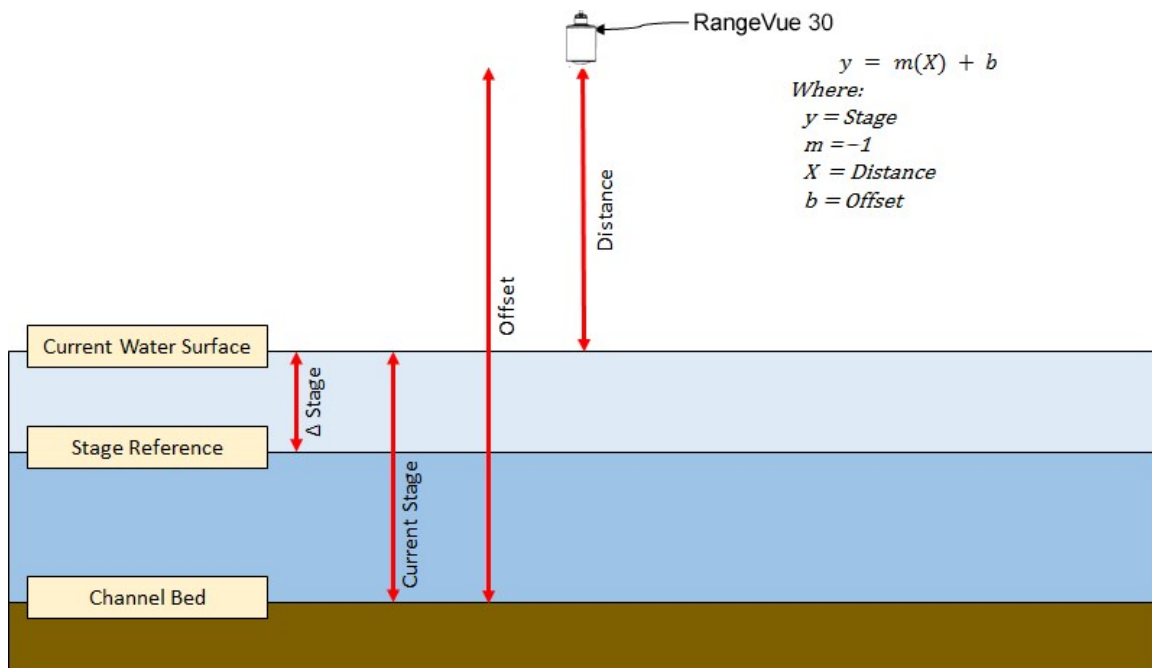


Figure 5-1. RangeVue-series stage, distance, and offset

The RangeVue 30 can measure distances up to 30 m (98.4 ft) and the RangeVue 15 can measure distances up to 15 m (49.2 ft). The RangeVue 15 also has mounting threads to facilitate pipe mounting.

Features:

- Meets USGS Office of Surface Water (OSW) requirements for accuracy
- SDI-12 1.4 functionality including SHEF coded metadata
- Low power mode available
- FCC compliant; individual FCC license not required
- Low maintenance—no moving parts significantly reduces maintenance cost and time
- Rugged enough for harsh environments—IP68 rating
- Compatible with a Campbell Scientific Aspen 10 Edge Device
- Compatible with any SDI-12 data logger/controller including Campbell Scientific GRANITE-series, CR6, CR1000X, CR300-series, CR3000, CR800-series, and CR1000

6. Specifications

Measurement range	(d in Figure 6-1 [p. 6])
RangeVue 30:	up to 30 m (98.43 ft)
RangeVue 15:	up to 15 m (49.21 ft)

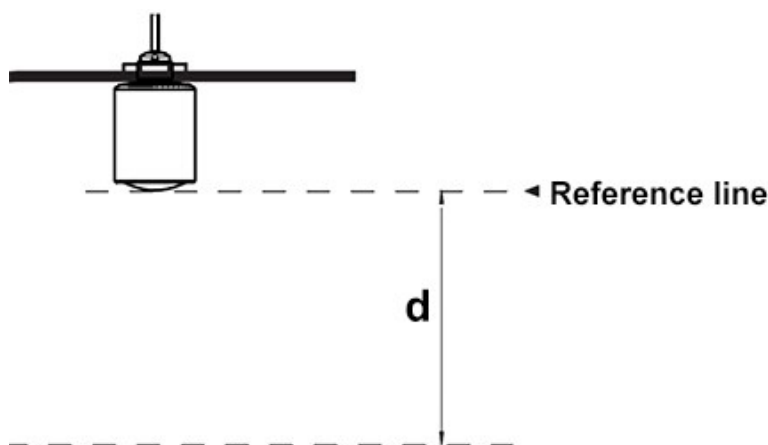


Figure 6-1. Reference line for measurement range

Accuracy:	≤ 2 mm (± 0.0065 ft)
Resolution:	1 mm (0.0033 ft)
Output protocol:	SDI-12 1.4
Frequency:	80 GHz

Measuring cycle time:	≤ 250 ms
Step response time:	≤ 3 s
Beam angle	
RangeVue 30:	4°
RangeVue 15:	8°
Emitted HF power (depends on the parameter setting)	
Average spectral transmission power density:	−3 dBm/MHz EIRP
Maximum spectral transmission power density:	+34 dBm/50 MHz EIRP
Maximum power density at a distance of 1 m:	< 3 μW/cm ²
Input voltage:	8 to 32 VDC
Power consumption	
Maximum:	200 mW
Default-power mode:	100 mW at <18 VDC
Low-power mode:	25 mW at <18 VDC; low power mode is set by the <code>αXWPOM+p!</code> SDI-12 command (Table 8-2 [p. 17])
Temperature ranges	
Operating:	−40 to 80 °C
Storage:	−40 to 80 °C
Vibration resistance:	Mechanical vibrations with 5 g and 4 to 100 Hz
Mechanical rating:	IP66/68
Housing material:	PVDF plastic
Antenna material:	PVDF plastic
Weight:	0.7 kg (1.5 lb)
Dimensions:	See Figure 6-2 (p. 8) and Figure 6-3 (p. 8)

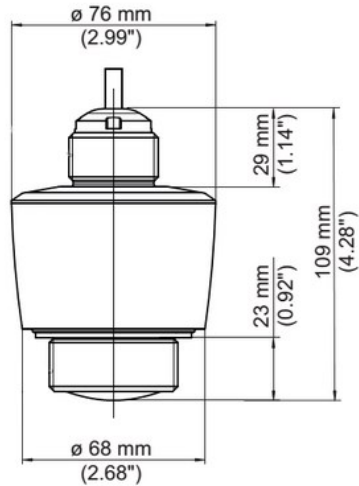


Figure 6-2. RangeVue 15 dimensions

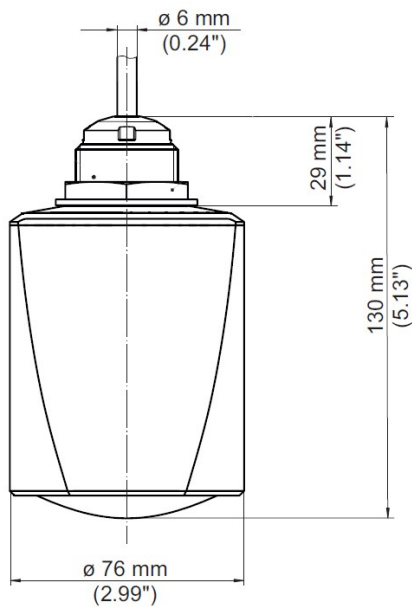



Figure 6-3. RangeVue 30 dimensions

Compliance information: View at:

www.campbellsci.com/rangevue15

www.campbellsci.com/rangevue30

7. Installation

If you are programming your data logger with **Short Cut** or are using the Aspen 10 Edge Device, skip [Wiring to the data logger](#) (p. 9) and [Data logger programming](#) (p. 10). See [QuickStart](#) (p. 2) for a **Short Cut** tutorial. For information about using the Aspen 10 with the RangeVue-series, refer to the Aspen 10 manual, available at www.campbellsci.com/aspen10 .

This section includes the following:

7.1 Wiring to the data logger	9
7.2 Data logger programming	10
7.2.1 CRBasic programming	10
7.2.2 Field installation	11
7.2.3 Determine and set reference stage	15

7.1 Wiring to the data logger

CAUTION:

To avoid shock or damage to the instrument, never apply power while wiring.

CAUTION:

Ensure that the RangeVue-series is properly wired to the data logger before applying power. Applying power when incorrectly wired could damage the RangeVue-series beyond repair.

Connect the RangeVue-series to the data logger in the order shown in [Table 7-1](#) (p. 9).

Table 7-1: Wire color, function, and data logger connection		
Wire color	Wire function	Data logger connection
White	SDI-12 signal	C ¹ or U configured for SDI-12 ¹
Clear	Shield	G
Brown	Power	12V
Black	Power ground	G
¹ C and U terminals are automatically configured by the measurement instruction.		

If multiple SDI-12 sensors are connected to a data logger, Campbell Scientific recommends using separate terminals when possible. However, multiple SDI-12 sensors or multiple RangeVue-series sensors can connect to the same data logger control or **U** terminal. Each must have a unique SDI-12 address. Valid addresses are 0 through 9, a through z, and A through Z. The RangeVue-series ships with a default SDI-12 address of 0.

For the CR6 and CR1000X, triggering conflicts may occur when a companion terminal is used for a triggering instruction such as `TimerInput()`, `PulseCount()`, or `WaitDigTrig()`. For example, if the RangeVue-series is connected to C3 on a CR1000X, C4 cannot be used in the `TimerInput()`, `PulseCount()`, or `WaitDigTrig()` instructions.

NOTE:


After connecting the sensor to power, the sensor performs a BIST (built-in self-test) for approximately 50 seconds (factory default). During this self-check, an internal check of the electronics occurs.

7.2 Data logger programming

Short Cut is the best source for up-to-date programming code for Campbell Scientific data loggers. If your data acquisition requirements are simple, you can probably create and maintain a data logger program exclusively with *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 [QuickStart](#) (p. 2). If you wish to import *Short Cut* code into *CRBasic Editor* to create or add to a customized program, follow the procedure in [Importing Short Cut code into CRBasic Editor](#) (p. 26). Programming basics for CRBasic data loggers are provided in the following sections. Downloadable example programs are available at www.campbellsci.com/downloads/rangevue-example-programs .

7.2.1 CRBasic programming

This instruction sends a request to the sensor to make a measurement and then retrieves the measurement from the sensor. See for more information.

For most data loggers, the `SDI12Recorder()` instruction has the following syntax:

```
SDI12Recorder(Destination, SDIPort, SDIAddress, "SDICommand", Multiplier, Offset, FillNAN, WaitonTimeout)
```

For the **SDIAddress**, alphabetical characters need to be enclosed in quotation marks (for example, "A"). Also enclose the **SDICommand** in quotation marks as shown. The **Destination** parameter must be an array. The required number of values in the array depends on the command (see).

FillNaN and **WaitonTimeout** are optional parameters (refer to the *CRBasic Editor* help for more information).

7.2.2 Field installation

Consider the following while selecting the site:

- **Sensor height:** Mount the sensor high enough to prevent submersion during flooding conditions.

WARNING:

Since the sensor is commonly installed over water from tall structures, use appropriate safety equipment such as a safety harness or a life preserver when installing or performing maintenance on the sensor.

- **Water surface:** Install the sensor above the smoothest part of the water surface.

NOTE:

The smoothest part of the water surface is typically found halfway between bridge piers. However, bridges with long spans between the piers experience more vibration. For these bridges, vibration can be minimized by mounting the sensor a quarter to a third of the distance to the next pier.

- **Horizontal structures:** Avoid mounting near horizontal structural surfaces such as beams, brackets, and sidewall joints because these surfaces reflect a strong signal.
- **Obstructions:** Mount the sensor away from obstructions (both above and under water) in the radiation beam path, which spreads as it leaves the sensor. Obstructions to be aware of include excessive waves, splashing, pipes, wires, rocks, bridge piers, and logs. Determine the required clearance for the beam angle using the following formulas and [Figure 7-1](#) (p. 12).

Clearance diameter formulas:

$$RV30CONE_{diameter} = 0.070(CONE_{distance})$$

$$RV15CONE_{diameter} = 0.141(CONE_{distance})$$

Where,

$CONE_{distance}$ = the distance to the reference line ([Figure 6-1](#) [p. 6])

$RV30CONE_{diameter}$ = clearance diameter for the RangeVue 30 in the same measurement units as the $CONE_{distance}$

$RV15CONE_{diameter}$ = clearance diameter for the RangeVue 15 in the same measurement units as the $CONE_{distance}$

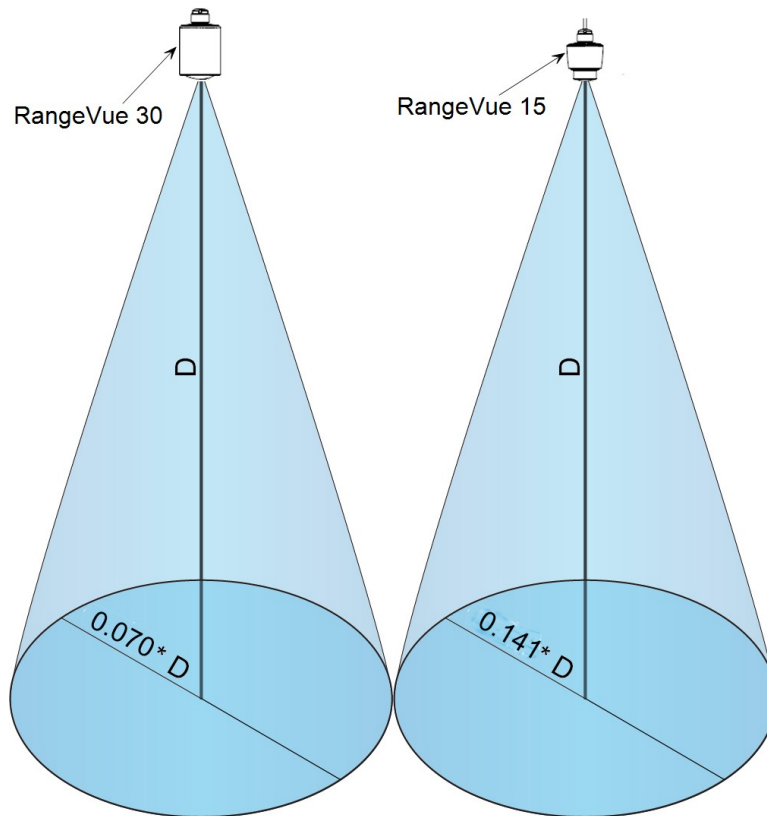


Figure 7-1. Beam path clearances

CAUTION:

Be aware that bridges contract and expand with temperature changes. Traffic loads or trucks can also cause changes to the bridge height.

After choosing an appropriate site, mount and align the sensor using the following procedure:

1. Secure the RangeVue-series bracket to a 1-inch diameter nominal pipe) using the V-clamp, washers, lock washers, and nuts (see [Figure 7-2](#) [p. 13]).

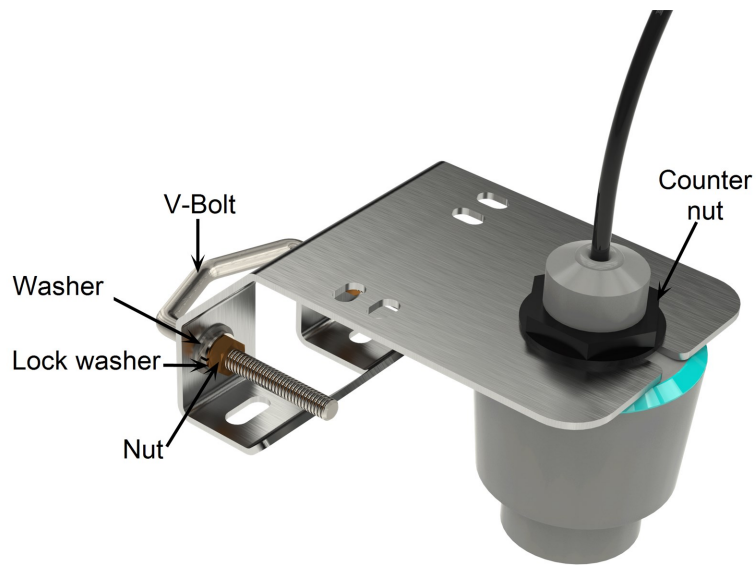


Figure 7-2. RangeVue 15 mounted in the RangeVue-series bracket

2. Place the RangeVue-series in the bracket (see [Figure 7-2](#) [p. 13] and [Figure 7-3](#) [p. 13]).

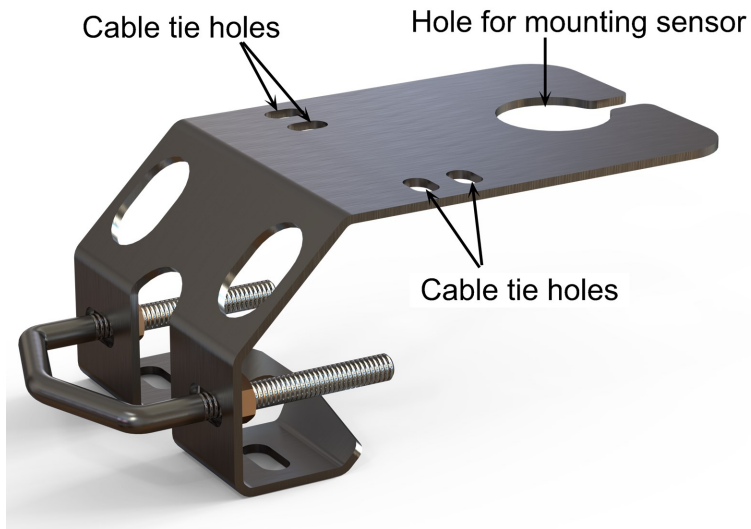


Figure 7-3. RangeVue-series bracket

3. Orient the sensor such that the middle of the sensor label is aligned or parallel with the wall or pier ([Figure 7-4](#) [p. 14] and [Figure 7-5](#) [p. 14]).

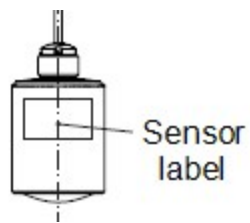


Figure 7-4. Polarization markings

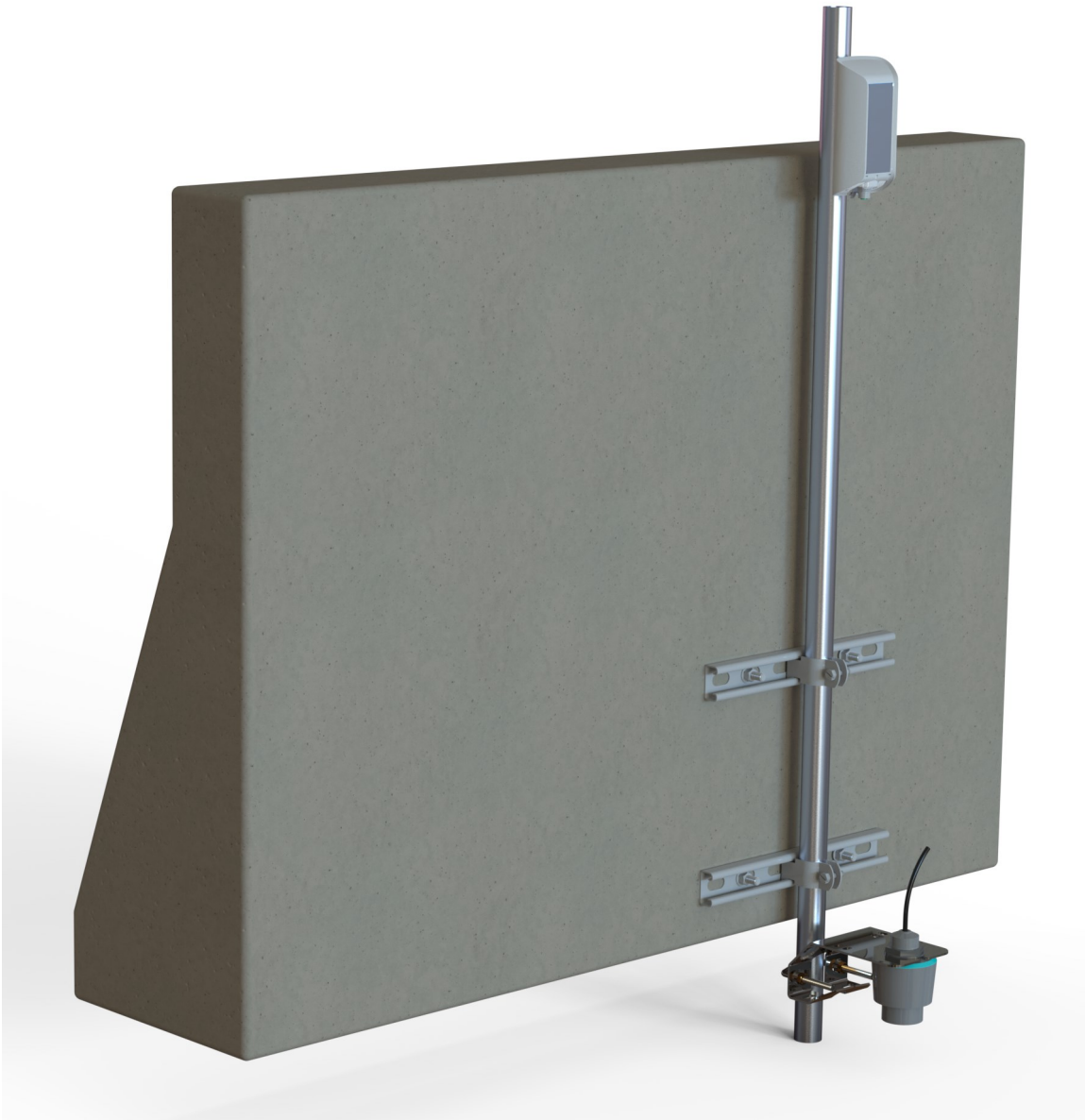


Figure 7-5. RangeVue 15 mounted near wall (cable not connected).

4. Use a bubble level to make certain the antenna horn is aligned within 1° of vertical. A measurement error will be introduced if the antenna is not perpendicular to the water surface. The maximum range is reduced because of the off-axis return signal.
5. Secure the RangeVue-series to the bracket by tightening the counter nut (see [Figure 7-2](#) [p. 13] and [Figure 7-6](#) [p. 15]).



Figure 7-6. Counter nut on the RangeVue 30.

6. Connect the cable, route it to the data logger, then secure it to the bracket and mounting pipe using cable ties.

7.2.3 Determine and set reference stage

Change the reference stage setting at deployment. This setting allows the sensor to complete an offset calculation. Every future measurement will use the offset and the current distance measurement to calculate water stage or depth.

Using a staff plate or other physical datum, measure water level at the measurement site. Record the measurement. Ensure that the measurement is in the same units as the sensor unit setting. Default value is feet.

Enter reference stage using a terminal emulator ([Configuring sensor via extended SDI-12 commands and terminal emulator](#) [p. 21]).

8. Operation

This section discusses the following.

8.1 Default settings	16
8.2 SDI-12 commands	17
8.3 Status codes	20
8.4 Configuring sensor via extended SDI-12 commands and terminal emulator	21

8.1 Default settings

Table 8-1 (p. 16) shows the default settings. The default settings are changed using SDI-12 commands (Table 8-2 [p. 17]) and a terminal emulator ([Configuring sensor via extended SDI-12 commands and terminal emulator](#) [p. 21]). The reference stage settings must be changed. The other default settings can be used in most circumstances.

Table 8-1: Default settings		
Setting	Default	Read or write
SDI-12 address	0 (change only if two sensors are connected to the same terminal) valid addresses are 0 through 9, A through Z, and a through z.	Read/write
Power mode	1 = normal	Read/write
Stage/distance units	0 = meter	Read/write
Temperature units	degree Celsius	Read/write
Stage reference	0	Must be set using a terminal emulator. Refer to Configuring sensor via extended SDI-12 commands and terminal emulator (p. 21)

8.2 SDI-12 commands

8.2 (p. 17) shows the measurement and extended SDI-12 commands for the RangeVue-series. The RangeVue-series responds to the **M!**, **C!**, **CC!**, **RO!**, and **ROC!** SDI-12 measurement commands. When using an **M!** command, the data logger waits for the time specified by the sensor, sends the **D!** command, pauses its operation, and waits until either it receives the data from the sensor or the sensor timeout expires. If the data logger receives no response, it will send the command a total of three times, with three retries for each attempt, or until a response is received.

The **C!** command follows the same pattern as the **M!** command with the exception that it does not require the data logger to pause its operation until the values are ready. Rather, the data logger retrieves the data with the **D!** command on the next pass through the program. Another measurement request is then sent so that data are ready on the next scan.

The **RO!** command directly reads the sensor measurements and outputs all of its values.

The **MC!**, **CC!**, and **ROC!** commands are the same as the previous commands, but where the **C** at the end of the command forces a validation for the data received from the sensor using a checksum. If the checksum is invalid, the data logger will re-request the data up to three times. The checksum validation increases the measurement time by about 40 milliseconds if there are no errors. Retries will increase the measurement time in proportion to the number of retries. The checksum option is necessary only for long cable lengths or when electronic noise may impact measurement transmission to the data logger.

Information about using the extended commands are provided in [Configuring sensor via extended SDI-12 commands and terminal emulator](#) (p. 21).

NOTE:


Additional SDI-12 information is available at www.sdi-12.org .

Table 8-2: SDI-12 measurement and extended commands

SDI-12 command	Values returned or function
<i>aM!</i> , <i>aC!</i> , <i>aCC!</i> , <i>aRO!</i> , <i>aRCO!</i>	<ol style="list-style-type: none">1. Stage2. Distance3. Electronics temperature4. Signal-to-noise (SNR) ratio²5. Device status (Table 8-3 [p. 20])
<i>aXRPOM!</i>	Read power operation mode

Table 8-2: SDI-12 measurement and extended commands

SDI-12 command	Values returned or function
<p>$aXWPOM+p!$</p> <p>Where,</p> <p>p =power operation mode code</p>	<p>Write power operation mode. It returns:</p> <p>$aXWPOM+p+nnn!$</p> <p>Where,</p> <p>p is the power operation mode code:</p> <p>0=low power mode 1=normal power mode</p> <p>nnn is the operational-status code (Table 8-4 [p. 21])</p>
<p>$aXRDU!$</p>	<p>Read distance units</p> <p>Where:</p> <p>0=m 1=ft 2=mm 3=inch</p>
<p>$aXWDU+d!$</p> <p>Where,</p> <p>d =distance unit code</p>	<p>Write distance unit code. It returns:</p> <p>$aXWDU+d+nnn!$</p> <p>Where,</p> <p>d is the distance unit code</p> <p>0=m 1=ft 2=mm 3=inch</p> <p>nnn is the operational-status code (Table 8-4 [p. 21])</p>

Table 8-2: SDI-12 measurement and extended commands	
SDI-12 command	Values returned or function
<p><i>aXWTU+t!</i></p> <p>Where,</p> <p><i>t</i> = temperature unit code</p>	<p>Write temperature units. It returns:</p> <p><i>aXWTU+t+nnn!</i></p> <p>Where,</p> <p><i>t</i> is the temperature unit code</p> <p>0=°C</p> <p>1=°F</p> <p>2=K</p> <p><i>nnn</i> = operational-status code (Table 8-4 [p. 21])</p>
<i>aXRS!</i>	Read stage reference
<p><i>aXSS+ssssssss!</i></p> <p>Where,</p> <p><i>ssssssss</i> =stage reference</p>	<p>Set stage reference. It returns:</p> <p><i>aXSS+ssssssss+nnn!</i></p> <p>Where,</p> <p><i>ssssssss</i> is the stage reference. The format depends on units:</p> <p>ssss.sss for meter</p> <p>ssss.ss for feet</p> <p>sssssss for millimeter</p> <p>sssssss for inch</p> <p><i>nnn</i> is the operational-status code (Table 8-4 [p. 21])</p>
<i>aV!</i>	<ol style="list-style-type: none"> 1. Operating system (OS) version 2. Device status (Table 8-3 [p. 20])
<i>?!</i>	SDI-12 address
<p>¹a is the sensor address. In the SDI12Recorder() CRBasic instruction, the command parameter does not include the SDI-12 address because the address is a separate parameter.</p> <p>²A higher signal-to-noise ratio (SNR) signifies a stronger and clearer radar signal relative to the noise. A good SNR can vary based on several factors including the specific sensor design, operating environment, and application requirements. As a general guideline, above 10 dB is the minimum threshold to reliably distinguish the signal from noise and interference. A SNR above 20 dB is a very good SNR, indicating a strong and clear signal with minimal interference, which can lead to highly accurate measurements.</p>	

8.3 Status codes

The M!, C!, CC!, R0!, RC0!, and V! SDI-12 commands report device-status codes ([Table 8-3](#) [p. 20]), and several of the extended SDI-12 commands report operational-status codes ([Table 8-4](#) [p. 21]).

Table 8-3: Device-status codes	
Code	Description
013	No measured value available
017	Adjusted span too small
025	Error in the linearization table
036	No executable software
040	Error in the electronics
080	General software error
040	Error in the electronics
080	General software error
105	Measured value is determined
260	Error in the calibration
261	Error in the device setting
264	Installation/setup error
265	Measurement function
500	Error in the delivery status
501	Error in the non-active linearization table
504	Error on an device interface
505	No measured value available
507	Error in the device setting
508	Non executable Bluetooth software
509	Software update running
510	No communication with the main controller
511	Inconsistent software configuration

Table 8-3: Device-status codes	
Code	Description
600	Impermissible electronics temperature
601	Overfilling
603	Impermissible power supply

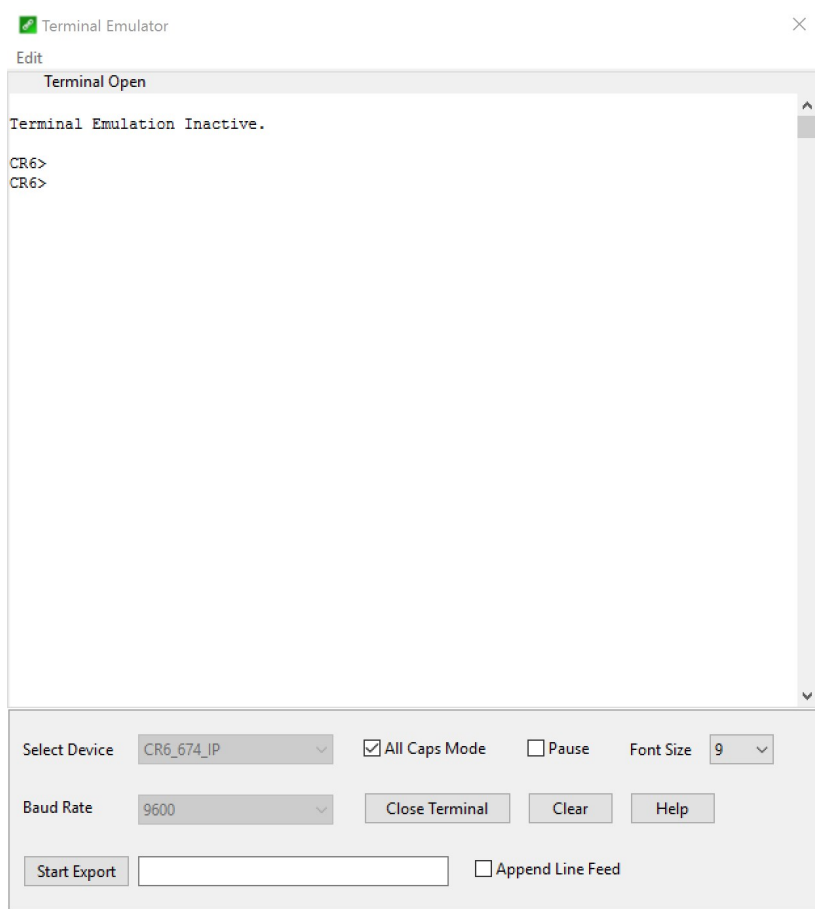
Table 8-4: Operational-status codes	
Code	Description
0	NO_ERROR
128	EXECUTION_ERROR
129	ACTION_NOT_IMPLEMENTED
132	INVALID_SELECTION
133	INVALID_DATA_LENGTH
134	VALUE_TOO_LARGE
134	VALUE_TOO_SMALL
136	INVALID_DATA
138	TELEGRAM_TOO_LARGE
142	DATA_NOT_AVAILABLE
143	DEVICE_BUSY
144	WRITE_PROTECTED
149	READ_ONLY
150	NOT_AUTHENTICATED

8.4 Configuring sensor via extended SDI-12 commands and terminal emulator

The RangeVue-series is fully configurable using SDI-12 extended commands through a terminal emulator program. The following instructions step you through the initial setup process. [8.2](#) (p. 17) lists all the extended SDI-12 commands and the values that are returned. It is possible to

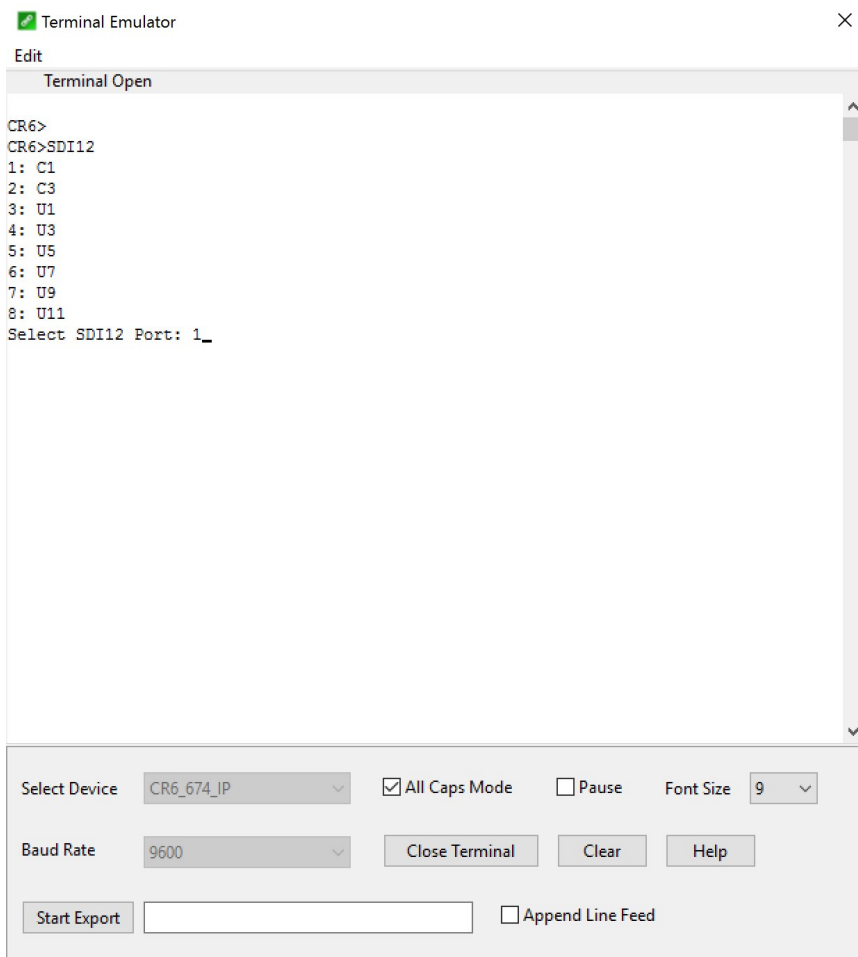
completely reset the sensor to factory defaults settings as well. Most of the extended SDI-12 commands require 2 seconds to complete the change when the sensor is in normal power mode.

1. Connect the RangeVue-series to your data logger ([Wiring to the data logger](#) [p. 9]).
2. Connect to the data logger using **LoggerNet** and open the terminal emulator. In **LoggerNet**, the terminal emulator is located at: **LoggerNet > Main > Connect > data logger > Terminal Emulator**.
3. Click **Open Terminal**.
4. Press **Enter** until a prompt appears.



5. If using a Campbell Scientific data logger, type **SDI12** <Enter> once the prompt is present.

6. Enter the number corresponding to the terminal your sensor is wired into.



7. Set the **Current or Reference Stage**. This should be set at deployment. Using a staff plate or other physical datum at the study site, measure and enter the current stage. This allows the sensor to complete an offset calculation based on the entered stage and the measured distance to water surface. Every future measurement will use the offset and measured distance to water surface to calculate water stage or depth.

Command: 0XSS+50! (where 50 is the reference stage)

Response: 0+50.000+000

The sensor response includes the sensor address (0) + reference stage (50.000) + status code (000).

8. The default SDI-12 address for the sensor is **0**. Change the sensor address if you will have more than one SDI-12 sensor on the same terminal with the **aAb!** command, where **a** is the current sensor address and **b** is the desired address. The sensor will respond with the new address if it was successfully changed.

Command: 0A1!

Response: 1

9. The default stage/distance units are meters. To change the units, use the **aXWdU+d!** command, where **d** is 0 (meters), 1 [feet], 2 (millimeters), or 3 (inches). Refer to [SDI-12 commands](#) (p. 17) for more information.
10. The default temperature units are degree Celsius. To change the units, use the **aXWTU+t!**, where **t** is 0 (°C), 1 (°F), or 2 (K). Refer to [SDI-12 commands](#) (p. 17) for more information.
11. Set the **Power Mode** of the sensor. The default power mode is normal and has a numeric code of 1. Low power mode turns off the processor of the sensor in between measurements consuming significantly less power. However, it will take longer to respond to each measurement command since it will power down after a measurement is complete. Measurement time will be a function of boot time and the integration time. To run in low power mode, use the following command.

Command: 0XWPOM+0!

Response: 0+0+000

The sensor response includes the sensor address (0) + power mode (0) + error code (000).

9. Maintenance, diagnostics, and repair

NOTE:

All factory repairs and recalibrations require a returned material authorization (RMA) and completion of the "Statement of Product Cleanliness and Decontamination" form. Refer to the [Assistance](#) page for more information.

The RangeVue-series is maintenance free under normal operation.

9.1 Testing procedure

1. Double-check all wiring connections.

CAUTION:

The data logger cannot issue SDI-12 commands when a USB cable is connected to the sensor.

2. Connect the sensor to your data logger and apply +12 V power.
3. Send the Acknowledge Active command (**a!**). This command is used to check the presence of the sensor on the bus. Only the address is sent back in response.
4. Send the Identification command (**aI!**).
5. Compare the output stage versus the actual stage using the Start Measurement command (**aM!**) followed by the Send Data command (**aD!**).

9.2 Cyclic redundancy check

The cyclic redundancy check (CRC) is used to produce and send a small, fixed-size checksum of a larger block of data to the data logger. This checksum detects errors after transmission or storage. The CRC is computed and added before any transmission or storage. The CRC is also authenticated by the recipient, after the transmission, to confirm that no alterations occurred. CRCs are good at identifying errors caused by noise in transmission channels.

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 *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, then save it. Click the **Advanced** tab then the **CRBasic Editor** button. Your program file will open in CRBasic with a generic name. 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.

2. To add the *Short Cut* wiring information into the new CRBasic program, open the .DEF file located in the C:\campbellsci\SCWin folder. Copy the wiring information found at the beginning of the .DEF file.
3. Go into the CRBasic program and paste the wiring information at the beginning of the program.
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. SDI-12 version 1.4 identify measurement commands and responses

Version 1.4 compliant sensors must respond to identify commands for each type of measurement command and each parameter with a command. The broad identify commands return how many variables will be returned with a given measurement command and the time it will take the sensor to respond. The specific identify parameter commands will return a SHEF code, the measurement units, and the type of measurement (sample, count, or average). For more information see the SDI-12 version 1.4 specification.

(http://sdi-12.org/current_specification/SDI-12_version-1_4-Jan-10-2019.pdf)

Table B-1: Identify commands for the RangeVue-series			
Type of command	Command	Sensor response	Comment
Identify Measurement for 'M' Commands	aIM!, aIMC!	atttn	ttn: response time n: # of values returned
Identify Measurement for 'C' Commands	aIC!, aICC!	atttnn	ttn: response time nn: # of values returned
Identify Measurement for the 'V' Command	aIV!	atttn	ttn: response time n: # of values returned

Table B-2: Identify measurement parameters for M! and C! commands			
Parameter	Commands		Sensor response
	M!	C!	
Stage	aIM_001!	aIC_001!	a,hg,m;
Distance	aIM_002!	aIC_002!	a,ha,m;
Electronics temperature	aIM_003!	aIC_003!	a,TempElectronic,degrees C;
Level reliability	aIM_004!	aIC_004!	a,LevelReliability,dB;
Device status	aIM_005!	aIC_005!	a,DeviceStatus;

Appendix C. FCC/IC equipment authorization (USA/Canada only)

The RangeVue-series is FCC compliant (FCC IC # M01PULS616263). Modifications to the sensor must have express agreement from Campbell Scientific. Any modifications not approved by Campbell Scientific will cause the expiration of the operating license issued by the FCC/IC. The radar sensor is in conformity with Part 15 of the FCC directives and fulfills the RSS-210 regulations.

Regulations for operation include:

- These devices must not cause any interfering emissions.
- These devices must accept any interfering emissions received, including interference that may cause unwanted operating conditions.


Limited warranty

Covered equipment is warranted/guaranteed against defects in materials and workmanship under normal use and service for the period listed on your sales invoice or the product order information web page. The covered period begins on the date of shipment unless otherwise specified. For a repair to be covered under warranty, the following criteria must be met:

1. There must be a defect in materials or workmanship that affects form, fit, or function of the device.
2. The defect cannot be the result of misuse.
3. The defect must have occurred within a specified period of time; and
4. The determination must be made by a qualified technician at a Campbell Scientific Service Center/ repair facility.

The following is not covered:

1. Equipment which has been modified or altered in any way without the written permission of Campbell Scientific.
2. Batteries; and
3. Any equipment which has been subjected to misuse, neglect, acts of God or damage in transit.


Campbell Scientific regional offices handle repairs for customers within their territories. Please see the back page of the manual for a list of [regional offices](#) or visit www.campbellsci.com/contact  to determine which Campbell Scientific office serves your country. For directions on how to return equipment, see [Assistance](#).

Other manufacturer's products, that are resold by Campbell Scientific, are warranted only to the limits extended by the original manufacturer.

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Campbell Scientific will, as a default, return warranted equipment by surface carrier prepaid. However, the method of return shipment is at Campbell Scientific's sole discretion. Campbell Scientific will not reimburse the claimant for costs incurred in removing and/or reinstalling equipment. This warranty and the Company's obligation thereunder is in lieu of all other

warranties, expressed or implied, including those of suitability and fitness for a particular purpose. Campbell Scientific is not liable for consequential damage.

In the event of any conflict or inconsistency between the provisions of this Warranty and the provisions of Campbell Scientific's Terms, the provisions of Campbell Scientific's Terms shall prevail. Furthermore, Campbell Scientific's Terms are hereby incorporated by reference into this Warranty. To view Terms and conditions that apply to Campbell Scientific, Logan, UT, USA, see [Terms and Conditions](#) . To view terms and conditions that apply to Campbell Scientific offices outside of the United States, contact the [regional office](#) that serves your country.

Assistance

Products may not be returned without prior authorization. Please inform us before returning equipment and obtain a **return material authorization (RMA) number** whether the repair is under warranty/guarantee or not. See [Limited warranty](#) for information on covered equipment.

Campbell Scientific regional offices handle repairs for customers within their territories. Please see the back page of the manual for a list of [regional offices](#) or visit www.campbellsci.com/contact  to determine which Campbell Scientific office serves your country.

When returning equipment, a RMA number must be clearly marked on the outside of the package. Please state the faults as clearly as possible. Quotations for repairs can be given on request.

It is the policy of Campbell Scientific to protect the health of its employees and provide a safe working environment. In support of this policy, when equipment is returned to Campbell Scientific, Logan, UT, USA, it is mandatory that a "[Declaration of Hazardous Material and Decontamination](#)" form be received before the return can be processed. If the form is not received within 5 working days of product receipt or is incomplete, the product will be returned to the customer at the customer's expense. For details on decontamination standards specific to your country, please reach out to your [regional Campbell Scientific](#) office.

NOTE:

All goods that cross trade boundaries may be subject to some form of fee (customs clearance, duties or import tax). Also, some regional offices require a purchase order upfront if a product is out of the warranty period. Please contact your [regional Campbell Scientific](#) office for details.

Safety

DANGER — MANY HAZARDS ARE ASSOCIATED WITH INSTALLING, USING, MAINTAINING, AND WORKING ON OR AROUND TRIPODS, TOWERS, AND ANY ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC. FAILURE TO PROPERLY AND COMPLETELY ASSEMBLE, INSTALL, OPERATE, USE, AND MAINTAIN TRIPODS, TOWERS, AND ATTACHMENTS, AND FAILURE TO HEED WARNINGS, INCREASES THE RISK OF DEATH, ACCIDENT, SERIOUS INJURY, PROPERTY DAMAGE, AND PRODUCT FAILURE. TAKE ALL REASONABLE PRECAUTIONS TO AVOID THESE HAZARDS. CHECK WITH YOUR ORGANIZATION'S SAFETY COORDINATOR (OR POLICY) FOR PROCEDURES AND REQUIRED PROTECTIVE EQUIPMENT PRIOR TO PERFORMING ANY WORK.

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, such as those of the FAA in the USA.
- 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.

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.

Use and disposal of batteries

- Where batteries need to be transported to the installation site, ensure they are packed to prevent the battery terminals shorting which could cause a fire or explosion. Especially in the case of lithium batteries, ensure they are packed and transported in a way that complies with local shipping regulations and the safety requirements of the carriers involved.
- When installing the batteries follow the installation instructions very carefully. This is to avoid risk of damage to the equipment caused by installing the wrong type of battery or reverse connections.
- When disposing of used batteries, it is still important to avoid the risk of shorting. Do not dispose of the batteries in a fire as there is risk of explosion and leakage of harmful chemicals into the environment. Batteries should be disposed of at registered recycling facilities.

Avoiding unnecessary exposure to radio transmitter radiation

- Where the equipment includes a radio transmitter, precautions should be taken to avoid unnecessary exposure to radiation from the antenna. The degree of caution required varies with the power of the transmitter, but as a rule it is best to avoid getting closer to the antenna than 20 cm (8 inches) when the antenna is active. In particular keep your head away from the antenna. For higher power radios (in excess of 1 W ERP) turn the radio off when servicing the system, unless the antenna is installed away from the station, e.g. it is mounted above the system on an arm or pole.

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.

WHILE EVERY ATTEMPT IS MADE TO EMBODY THE HIGHEST DEGREE OF SAFETY IN ALL CAMPBELL SCIENTIFIC PRODUCTS, THE CUSTOMER ASSUMES ALL RISK FROM ANY INJURY RESULTING FROM IMPROPER INSTALLATION, USE, OR MAINTENANCE OF TRIPODS, TOWERS, OR ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC.

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