



AL200

ALERT2 Encoder, Modulator, and Sensor Interface



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
4.1 Stand-alone mode	2
4.1.1 Physical setup	2
4.1.2 AL200 configuration for stand-alone mode	3
4.2 Data logger peripheral mode	5
4.2.1 Physical setup	6
4.2.2 AL200 configuration for data logger mode	6
5. Overview	6
6. Specifications	7
7. Installation	10
7.1 Configuration	10
7.1.1 Stand-alone device	12
7.1.1.1 Alert2	12
7.1.1.2 Radio settings	15
7.1.1.3 Encryption	16
7.1.1.4 GPS settings	17
7.1.1.5 Sensor Input Settings	18
7.1.1.6 Sensor Data Monitoring	22
7.1.2 Data logger peripheral	22
7.2 Mounting in an enclosure	24
7.3 Grounding	24
7.4 Wiring	24
8. Operation	25
8.1 Terminal interface commands	25
9. Maintenance and troubleshooting	27
9.1 Maintenance	27

9.2 Troubleshooting	28
Appendix A. Glossary	29
Appendix B. Cables and connectors	30
B.1 CS I/O	30
B.2 RS-232	30
B.3 USB	31
B.4 Power	31
B.5 Analog radio interface	32
B.5.1 Connecting a Maxon SD-125 or SD-225-series radio	32
B.6 Sensor I/O interface	33
B.7 GPS input	33
Appendix C. LED indicators	34
Appendix D. AL200 settings	37
Appendix E. AL200 USB-driver installation instructions	46
Appendix F. Updating the AL200 Operating System (OS)	47
Appendix G. Recommended sensor IDs, rain report format, and multi-sensor reports	48
Appendix H. Calculating multipliers and offsets	50
Appendix I. Comparison of OS 6, OS 5, and OS 4	52

1. Introduction

The AL200 is an encoder, modulator, and sensor interface designed for use both as a stand-alone device and as a peripheral to a Campbell Scientific data logger or third-party Data Collection Platform (DCP).

This device uses the Automated Local Evaluation Real Time Protocol version 2 (ALERT2) and can operate as a remote ALERT2 transmitter.

For more information on the ALERT2 protocol, refer to the National Hydrologic Warning Council ALERT2 Technical Working Group website: www.hydrologicwarning.org/content.aspx?page_id=22&club_id=617218&module_id=83216.

2. Precautions

- GPS input gain, antenna gain less conductor losses, should not exceed 25 dB.
- If protecting GPS input with coaxial surge protector, ensure that the protector does NOT block DC voltages.
- Ensure maximum protection against electrical transients/surges. Install coaxial surge protection on all antenna runs. Keep RS-232 and CS I/O connections short.
- The AL200 is NOT powered over CS I/O.
- USB may not be sufficient to reliably power an AL200, even for configuration. If power is supplied over USB, the AL200 will not power up either the radio or attached sensors. Reliable power can be supplied from a 12V battery.
- The device driver for the AL200 must be installed on your computer before you can connect to the AL200 using USB. See [AL200 USB-driver installation instructions](#) (p. 46), for instructions on installing the device driver.
- *Device Configuration Utility* software 2.29 or higher is required to configure the AL200. The latest *Device Configuration Utility* can be downloaded from our website, www.campbellsci.com/downloads.

3. Initial Inspection

Inspect the AL200 for any obvious signs of damage upon receipt. For each AL200, the following items should be accounted for:

Quantity	Part
1	AL200
1	2-pin mating screw terminal connector
2	5-pin mating screw terminal connectors
4	mounting grommets
4	mounting screws
1	Micro-B USB cable

4. QuickStart

There are two basic modes of operation for the AL200. For simplicity, these will be referred to as stand-alone and data logger peripheral modes.

4.1 Stand-alone mode

4.1.1 Physical setup

1. Attach a GPS antenna to the GPS SMA connector located on the side of the AL200.
2. Attach the desired sensors to the appropriate channels on the sensor input connector.
3. If connecting 12 V to the 2-pin connector and a radio is attached to the AL200, connect the radio antenna connection to either an antenna or a 50 ohm dummy load.

4.1.2 AL200 configuration for stand-alone mode

NOTE:

The device driver for the AL200 must be installed on your computer before you can connect to the AL200 using USB. See [AL200 USB-driver installation instructions](#) (p. 46), for instructions on installing the device driver.

1. Connect 12 V power to the 2-pin connector and connect the supplied USB cable between a USB port on your computer and the USB port on the AL200.

CAUTION:

Depending on the version of hardware, the version of the OS, and the USB port on the computer, the AL200 may not receive sufficient power from just the USB port for configuration. Reliable operation for both the *Device Configuration Utility* software and operation requires a 12 V supply.

2. Open *Device Configuration Utility*.
3. Under **Device Type**, select AL200.
4. Click the browse button next to **Communication Port** and select the port associated with the AL200.
5. Click **OK**.
6. The **Baud Rate** must be 57600. If it is other than that, set it to 57600.
7. Click **Connect**.
8. Specify the settings on each tab to the following.

Main

- a. Set **Operation Mode** to **Sensor Input Enabled (CS I/O and RS-232 Disabled)**.
- b. When the *Device Configuration Utility* is connected, the AL200 can be configured to transmit normally either with the **Test Flag** set, without the **Test Flag** set, or muting all transmissions. Setting the **Test Flag** may allow the data collection software to handle maintenance reports appropriately. Select the desired behavior from the drop-down list. The test button will continue to send test transmissions, independent of this setting.

NOTE:

When using the Terminal tab, the *Device Configuration Utility* does not maintain communications without user interaction. Accordingly, the **Test Flag** functionality only operates in the **Settings Editor** tab.

ComPort

- a. Use default values.

ALERT2

- a. Configure settings to match your ALERT2 network.

Radio Settings

- a. For Campbell Scientific RF320 series radios (Ritron DTX-L series), use the default settings. For other radios, check with the manufacturer for the necessary radio settings.

Encryption

- a. Refer to [Encryption](#) (p. 16) for details. For initial configuration, it is recommended to set the **Encrypt Outgoing Messages** to **False**. If determined to be appropriate, enable and check encrypted transmissions before deployment.

GPS Settings

- a. Use default settings. For checking the configuration for use in a TDMA network, it is recommended to leave **Enable TDMA** set to **Yes**. If good GPS reception is not available, temporarily transport the AL200, GPS antenna, and battery to a location that can receive a good GPS signal. After powering, the GPS lock may require up to 14 minutes and the GPS LED will go out. As long as the AL200 is powered its clock will continue to run unless reset by changing the configuration. When checking a transmitter timed transmissions, use a UTC reference like www.time.gov.

Sensor Input Settings

Configure settings to enable or disable the inputs to be used with the AL200.

- a. For SE1 and C1/SDI-12 sensors, it may be necessary to click **Apply** then click **Connect** to display the configuration options for those sensors.

NOTE:

The use of multiple SDI-12 sensors and reading multiple parameters from an SDI-12 sensor is detailed in [Sensor Input Settings](#) (p. 18).

- b. If **Multi-Sensor Report** is enabled, any sensor with an ID of 1 to 8 will be sent in MSR format. If MSR is not selected, all sensors (other than Rain, which is ID 0) will be sent in GSR format.
- c. The P1 input counts the number of tipping bucket pulses and the accumulator value is sent as an integer. For **TDMA Frame Lengths** ≤ 240 s, the accumulator value is sent as a TBRG report with **Time Offsets** for each tip. For **Frame Lengths** > 240 s, the accumulator value is sent as a GSR report. This is necessary since **TBRG Time Offsets** only have a 255 s range.

With the exception of the P1 input, which records tips whenever they occur, sensor readings are taken shortly before the configured **Time Slot** occurs. This allows time for encoding of the message and radio warm time. Only one reading per sensor is taken per frame, so that only one **MANT** message is transmitted (as all reports in a MANT must carry the same time stamp). If a sensor needs to be measured and possibly reported more often than this, the transmitter should be configured for an integer fraction, such as $\frac{1}{2}$ or $\frac{1}{4}$ of the longest frame for the network, and then this gage will be assigned multiple slots in the network design.

- 9. Click the **Apply** at the bottom of the window. It is good practice to save the configuration file for later reference.

CAUTION:

The **Test** button may be pressed for 1 to 4 s to trigger a data transmission. If pressed for longer than 4 s, it will transmit a 5 s tone used for radio and antenna checks and adjustments. These transmissions may interfere with reports from other stations. Do not cause radio transmissions without being connected to either an antenna or a dummy load.

4.2 Data logger peripheral mode

The AL200 can be configured for data logger peripheral mode using **ALERT2 on CS I/O** or **ALERT2 on RS-232**. In these modes, the AL200 receives ALERT2 IND layer packets on the selected data port and retransmits the packets as ALERT2 packets. Campbell Scientific recommends reviewing [Stand-alone mode](#) (p. 2) for general operational details. Only the differences between stand alone and data logger peripheral mode are described in this section.

4.2.1 Physical setup

If the data logger is ready to be used, connect it to either the CS I/O or RS-232 port using an appropriate cable. Attach a GPS antenna to the GPS SMA connector located on the side of the AL200.

4.2.2 AL200 configuration for data logger mode

Specify the settings on each tab as the following describes.

1. **Main**—Set the **Operation Mode** to **ALERT2 on CS I/O** or **ALERT2 on RS-232**.
2. **ComPort**—Ensure the settings match the data logger port that is used.
3. **ALERT2**—If the data logger does not send IND commands to configure these settings, you should configure these settings to match your ALERT2 network.

NOTE:

If the data logger sends the appropriate IND commands, the data logger will overwrite these values.

4. **Radio Settings**—Same as [AL200 configuration for stand-alone mode](#) (p. 3), although the data logger may overwrite these with IND commands.
5. **Encrypt**—Same as [AL200 configuration for stand-alone mode](#) (p. 3), although the data logger may overwrite these with IND commands.
6. **GPS Settings**—Same as [AL200 configuration for stand-alone mode](#) (p. 3), although the data logger may overwrite these with IND commands.
7. **Sensor Input Settings**—Sensor settings are grayed out in **Data logger Peripheral Mode** since all sensors are to be connected to and read by the data logger.

5. Overview

The AL200 ALERT2 Encoder, Modulator, and Sensor Interface is designed for use in radio networks using the ALERT2 protocol. The AL200 can be configured to operate as a stand-alone device or as a data logger peripheral. In stand-alone mode, the AL200 will measure sensors, perform calculations, and, if appropriate, enable the attached radio to transmit the data during a designated time slot. In data logger peripheral mode, the AL200 will receive data from a data

logger, such as the CR6, CR1000X, CR800-series, and CR300-series, or other device and transmit this data during a designated time slot.



The AL200 includes a CS I/O port and an RS-232 port for serial communications. A USB device port is used for configuring the AL200, viewing real time sensor data, and diagnostics. An SMA female connector is provided for connecting a GPS antenna, and a removable screw terminal allows for connecting an analog radio. Removable screw terminals are also used for supplying power to the AL200 and connecting sensors. A copper ground lug is for attaching an earth ground.

6. Specifications

Operating temperature: -40 to $+60$ °C

Power: 9 to 18 VDC (may be reduced by the radio used)
Reverse polarity protected
Removable screw terminal connector, 0.15-inch pitch

Current drain at 12 VDC

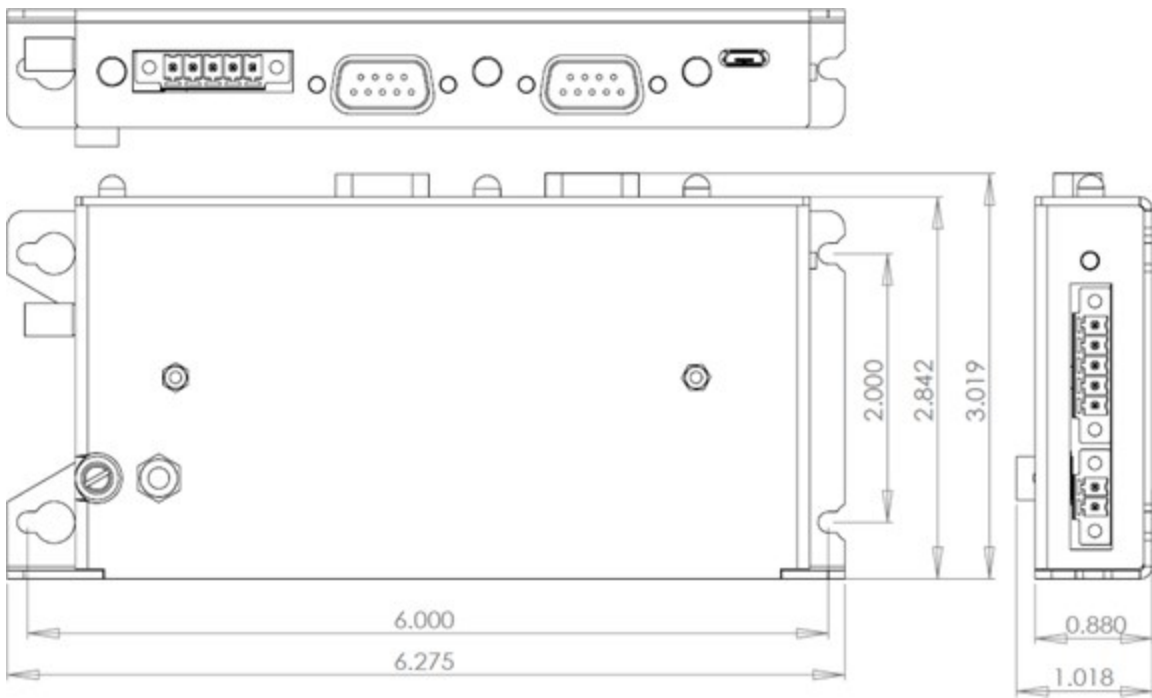
Idle: 1.5 mA

GPS fix: 40 mA

Transmit: 35 mA

Weight: 206 g (7.3 oz)

Dimensions: 159.385 x 76.683 x 25.857 mm
(6.275 x 3.019 x 1.018 in)



Configuration:

This device provides easy configuration through the graphical interface, *Device Configuration Utility*. When used in a stand-alone device, no programming is required.

NOTE:

The device driver for the AL200 must be installed on your computer before you can connect to the AL200 using USB. See [AL200 USB-driver installation instructions](#) (p. 46), for instructions on installing the device driver.

When used as a data logger peripheral, additional steps will be required to program the data logger to interface with the AL200. The data logger program will send IND commands to the AL200, and these may include configuration commands. Configuration commands sent by the data logger will overwrite ones set directly using *Device Configuration Utility*.

USB:

Micro-B receptacle (requires FTDI virtual COM port (VCP) driver installation)


CS I/O port:

SDC 7, 8, 10, 11

NOTE:

ALERT2 AL200 is NOT powered over CS I/O

RS-232 port:	DCE Configurable baud rates, parity, stop bits, and timeout EIA/TIA-232 and V.28/V.24 signaling ± 15kV ESD protection
Test button:	Located in the lower left corner of the AL200. Press for 1 to 4 s to trigger a test transmission containing the latest data available to the AL200. Press for ≥ 4 s to generate a test tone that will be sustained for 5 s. If the AL200 has been configured as a data logger peripheral, only the test tone functionality may be active, depending on the data logger program.
Analog radio interface:	Removable screw terminal connector, 0.15-inch pitch. Transmit only
Transmit audio (Tx):	100 to 1000 mV, peak-to-peak, software adjustable
Switched voltage (SW12V):	Switched supply voltage, 1.8 A at +70 °C
Sensor I/O:	Removable screw terminal connector, 0.15-inch pitch
Switch closure (P1):	Internally pulled up to 5 V through a 100K Ω resistor, switch closure connects to G . 16-bit counter 3.3 ms time constant for debounce 5 ms minimum closed time, 6 ms minimum open time
Single-ended analog (SE1):	16-bit ADC 0 to 5 VDC ±12 mV accuracy 80 μV resolution 50 dB rejection at 60 Hz Software configurable as mV or mA input Precision 100 Ω current sense resistor to G when configured for mA input
Digital I/O (C1):	SDI-12 input Transient voltage surge (TVS) and gas discharge tube (GDT) protected
Switched Voltage (SW12V):	Voltage supply switched on prior to operational sensor scan Thermal fuse hold current = 900 mA @ 20°C, 630 mA @ 50°C, 450 mA @ 70°C

GPS:	<p>SMA female</p> <p>50 Ω input impedance Active antenna design, 3.3 VDC 25 dB maximum gain (including losses)</p> <p>Integrated SAW filtering and jam resistance</p> <p>1 second time-to-fix during normal operation</p> <p>35 second time-to-fix on power up or reboot</p> <p>13 min for leap second, once per day auto</p> <p>PPS $\pm 1 \mu\text{s}$ to full UTC second</p> <p>Receive sensitivity: -161 dBm (-148 dBm for a cold start)</p>
Timekeeping:	<p>GPS disciplined to $\pm 1 \mu\text{s}$</p> <p>Drift $\pm 170 \text{ ms}$ per day with 40°C temperature change (without GPS sync)</p>
Compliance:	<p>RoHS</p> <p>CE</p> <p>IEC61000-4 ESD</p> <p>View compliance documents at: www.campbellsci.com/al200 </p>

7. Installation

7.1 Configuration

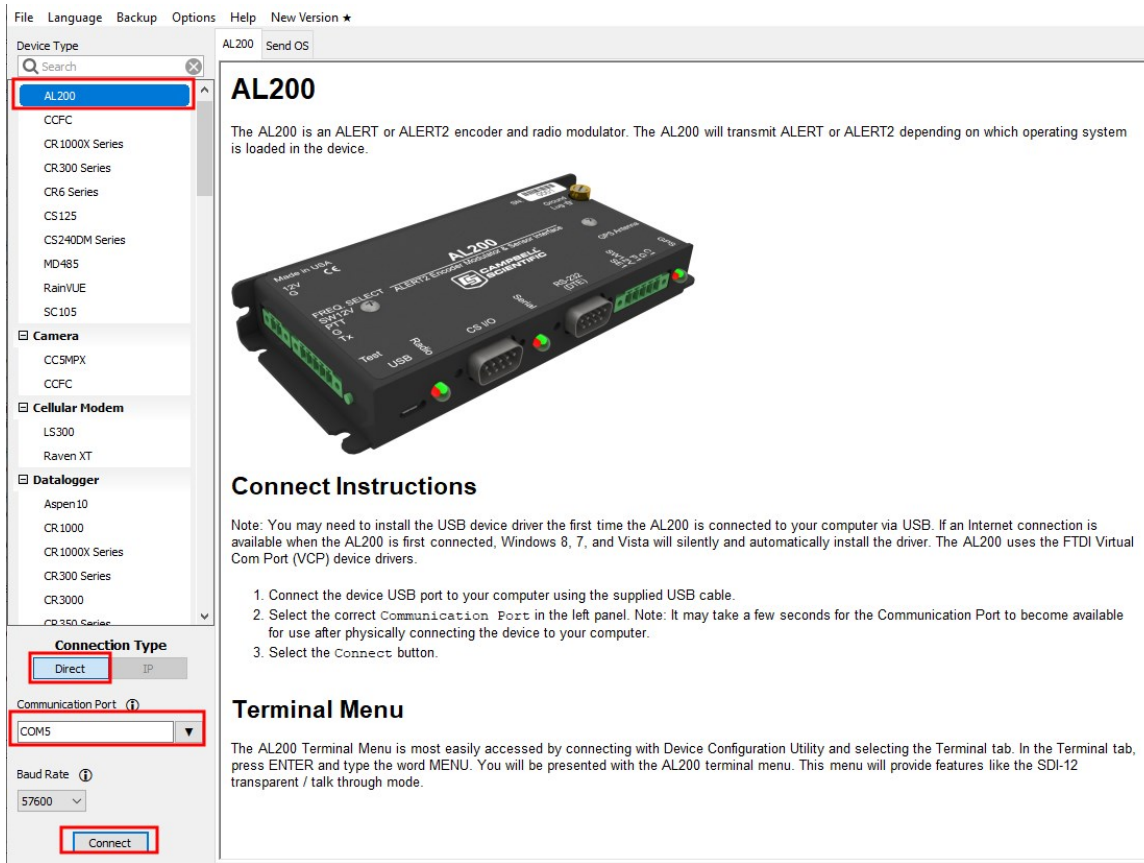
CAUTION:

Users need to understand the network in which the AL200 will be used. The AL200 has many settings that must be configured to determine when and how the AL200 will report data in the time division multiple access (TDMA) scheme. Incorrect settings can cause channel contention and may result in lost data.

NOTE:

The device driver for the AL200 must be installed on your computer before you can connect to the AL200 using USB. See [AL200 USB-driver installation instructions](#) (p. 46), for instructions on installing the device driver.

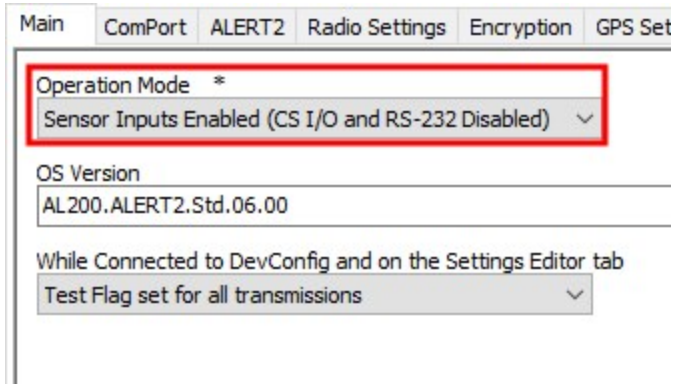
The AL200 is configured via the USB port using the *Device Configuration Utility*.



1. Depending on the version of hardware, the version of the OS, and the USB port on the computer, the AL200 may not receive sufficient power from just the USB port, even for configuration. Reliable operation for both Device Configuration and operation requires a 12V supply. Connect 12V to the 2-pin connector and then connect the supplied USB cable between a USB port on your computer and the USB port on the AL200.
2. Open *Device Configuration Utility*.
3. Under **Device Type**, select AL200.
4. Click the browse button next to **Communication Port** and select the port associated with the AL200.
5. Click **OK**.
6. Ensure that the **Baud Rate** is set to 57600.
7. Click **Connect**.
8. For each tab, specify the settings for the [Stand-alone device](#) (p. 12) or [Data logger peripheral](#) (p. 22) mode.

7.1.1 Stand-alone device

To use the stand alone mode, set **Main > Operation Mode** to **Sensor Input Enabled (CS I/O and RS-232 Disabled)**.



NOTE:

The settings in the **ComPort** tab are not used in the stand-alone mode.

Settings for the other tabs are described in the following sections. These settings are unique to a particular station and others will be common to your network.

7.1.1.1 Alert2

The user needs to set the following parameters since they are unique to a particular station and network. Default values are provided in parentheses.

Main	ComPort	ALERT2	Radio Settings	Encryption	GPS Settings	Sensor Input Settings	Sensor Data Monitoring
Destination Address							
1							
Station Source Address							
1000							
Add Destination Address							
No							
Hop Limit							
1							
Add Path Service Enabled							
Yes							
FEC Mode							
0							
Enable TDMA							
Yes							
TDMA Frame Length							
15000							
TDMA Slot Length							
1000							
TDMA Slot Start Offset							
0							
TDMA Slot Padding							
25							
Center Transmission							
No							

Destination Address (1) – If enabled, this includes the **Destination Address** in MANTPDUs originating from the AL200. The destination address is enabled or disabled in the **Add Destination Address** parameter.

Station Source Address (1000) – This station ID is an integer between 1 and 65,501 that must be unique within the network. Never have the same ID on more than one device in a network, including repeaters and decoders. A database of source addresses can be found at www.alert2.org.

Hop Limit (1) – The maximum number of times a remote transmission can be retransmitted by repeaters. Each repeater decrements the value and when it reaches 0, it will not be repeated. If the value is set to 7 there will be no hop limit applied. This setting should be considered carefully in the network design.

Add Path Service Enabled (Yes) – When enabled, each device that repeats a remote transmission will add its source address to the packet. This traces the path that a packet took from its beginning to its destination.

FEC Mode (0) – **0** sets the highest error correction with lowest throughput. **1** provides a medium error correction and throughput. **2** sets the least error correction with the highest throughput.

Increasing throughput may allow a shorter slot length to be used. The repeater or decoder that receives transmissions directly from this device must be able to decode different FECs if this is set to other than 0 (which is the original ALERT2 level of FEC).

Enable TDMA (Yes) – When enabled and the clock is accurate, the device will transmit in its time slot. If the clock drifts so that this cannot be assured, the device will transmit at random times. If this setting is not enabled, then the device will transmit in ALOHA mode and not time stamp reported readings.

TDMA Frame Length (15000) – Normally, this is the total amount of time that all of the stations in the network are able to report in (if they have reports to send). It is an integer between 5,000 and 3,600,000 with a resolution of 250 ms. The integer must be evenly divisible into 12 hours. In specific network designs, a site or repeater may have its **TDMA Frame Length** configured for an integer fraction (for example 1/3 or 1/2) of the longest system frame length. This allows that site to transmit multiple times in the system-long frame.

TDMA Slot Length (1000) – The maximum amount of time within the frame that the station can report. It is an integer value between 250 ms and 10000 ms. The AL200 allows the slot to overrun (into the next slot) to prevent reports from being disposed during major events. This can be caused by tipping bucket reports, which add bytes for the time offset of each tip. Consider this when designing the network to provide sufficient slot lengths that minimize transmission collisions.

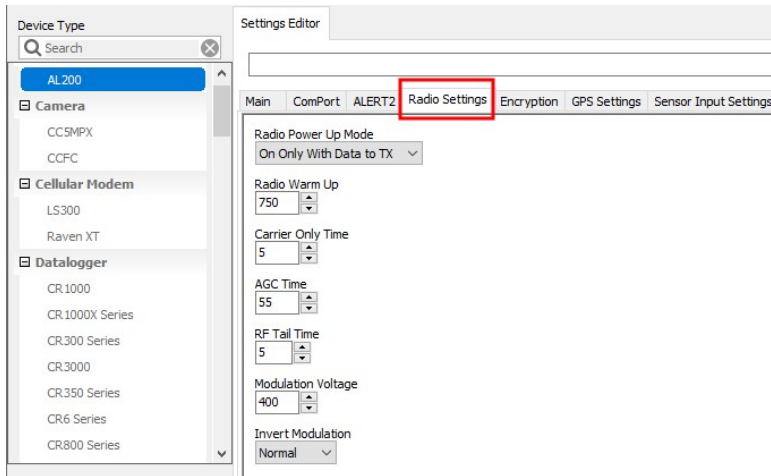
TDMA Slot Start Offset (0) – The amount of time into the frame that the slot will start. For example, if your frame is 120,000 ms (2 minutes) and your slot offset is 61,000 ms, the slot time will begin 1 second into each odd minute.

TDMA Slot Padding (25) – The number of milliseconds added before the beginning of a transmission. Higher values increase the amount of time the device can go between a GPS time sync and still be assured it's within its time slot. However, higher values reduce the amount of time available for transmitting data within the slot length. When the device cannot assure it will remain within its time slot (excepting overrun), it will switch to random transmission times and change its reported clock status.

Center Transmission (No) – When enabled, the total transmission time is calculated and the transmission is started so that the center of the transmission time will occur at the center of the slot, as long as the transmission will start no earlier than the **TDMA Slot Padding** value into the slot. If the transmission is too long to fit in the slot, it will overrun into the next slot. Plan your network design to minimize this possibility. If this setting is not enabled, then the transmission will start (the radio will transmit the carrier) after the **TDMA Slot Padding** delay.

7.1.1.2 Radio settings

The default radio settings are intended for Campbell Scientific RF320 series (Ritron DTX-L series) radios.



If using a different type of radio, consult the manufacturer to determine the settings. The following are descriptions of the radio settings.

Radio Power Up Mode (On Only With Data to TX) – Determines when the radio will be powered.

Radio Warm Up (750) – The amount of time, in milliseconds, that power will be applied to the external radio prior to enabling transmissions.

Carrier Only Time (5) – The amount of time, in milliseconds, that the radio will transmit an unmodulated carrier.

AGC Time (55) – The amount of time, in milliseconds, that the radio will transmit a tone-modulated carrier.

RF Tail Time (5) – The amount of time, in milliseconds, an unmodulated carrier will be transmitted following data transmission.

Modulation Voltage (400) – The peak-to-peak voltage level of the audio modulation that will be fed to the radio. Value is expressed in millivolts.

Modulation Polarity (Normal) – The polarity of the modulation fed to the radio.

NOTE:

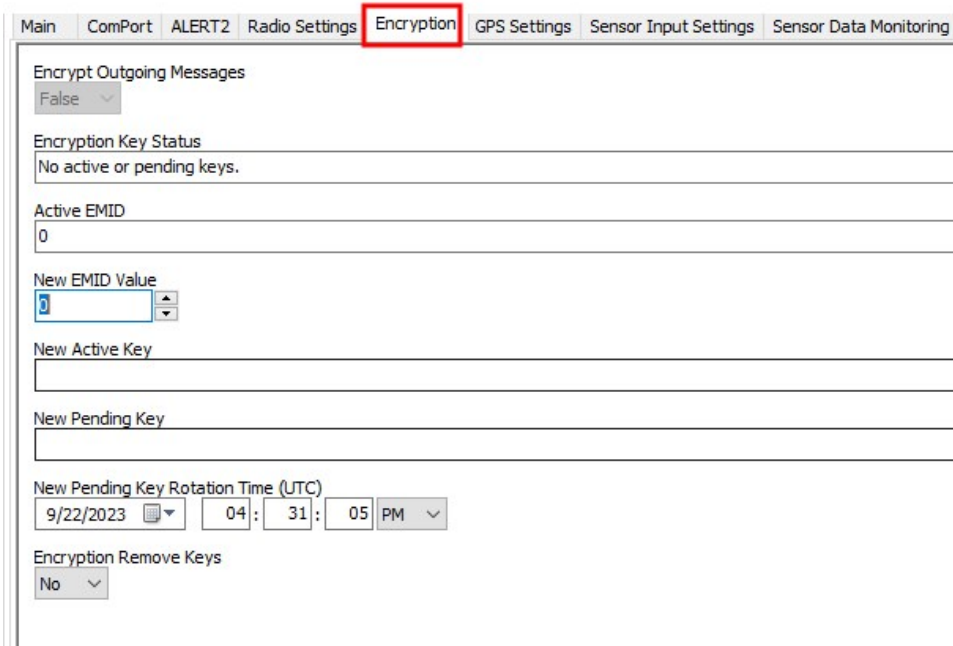
Different brands of radios, and even different models of the same brand may need this setting changed for the transmission to be decoded by older repeaters and base station decoders.

7.1.1.3 Encryption

Encrypt Outgoing Messages – Can only be enabled if a valid key has been entered in the device.

NOTE:

Entering a key does not enable encryption, but allows encryption to be enabled.



The screenshot shows the 'Encryption' settings page. At the top, a navigation bar includes 'Main', 'ComPort', 'ALERT2', 'Radio Settings', 'Encryption' (highlighted with a red box), 'GPS Settings', 'Sensor Input Settings', and 'Sensor Data Monitoring'. The main content area contains the following settings:

- Encrypt Outgoing Messages:** A dropdown menu set to 'False'.
- Encryption Key Status:** A text field displaying 'No active or pending keys.'
- Active EMID:** A text field displaying '0'.
- New EMID Value:** A numeric input field with a spinner, currently set to '0'.
- New Active Key:** An empty text input field.
- New Pending Key:** An empty text input field.
- New Pending Key Rotation Time (UTC):** A date and time picker showing '9/22/2023', '04', '31', '05', and 'PM'.
- Encryption Remove Keys:** A dropdown menu set to 'No'.

Keys, Active and Pending:

Encryption requires at least a valid **Active Key**. This key is 32 hex characters, and pairs can be separated by colons. The key is used once encryption is enabled. A **Pending Key** and **Rotation Time** can also be set. Once the rotation time elapses, the pending key will replace the active key. The **Encryption Key Status** shows whether keys are set. For security reasons once a key is entered, it cannot be viewed.

TIP:

When setting a **Pending Key Rotation Time**, enter the date, hour, or minutes first, and then the seconds will quit advancing.

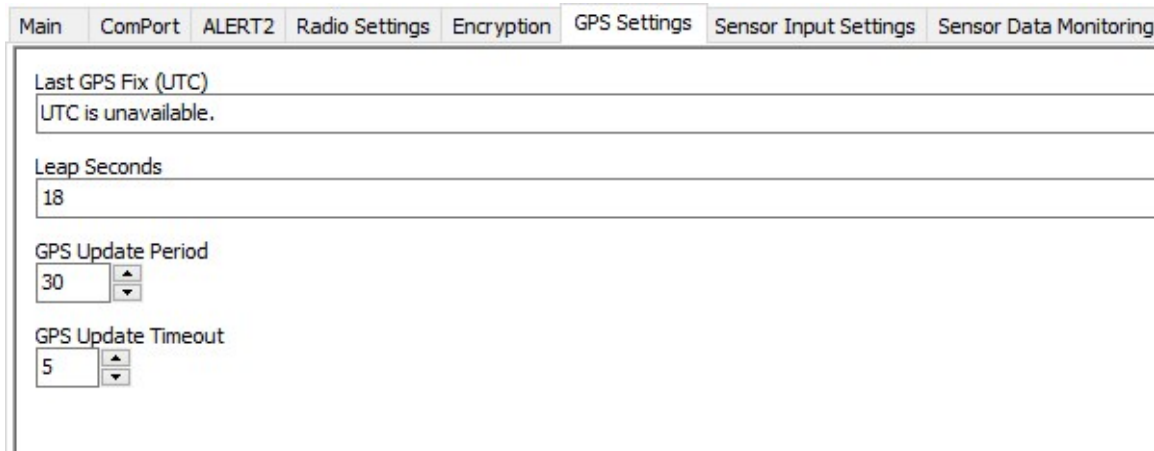
EMID, Active and New

Encrypted messages include an **Encrypted Message ID (EMID)** that increments each transmission. This prevents a "Replay Attack" where a message is captured and then resent at a later time. Each decoder keeps a table of the highest EMID received from each **Source Address** it has received encrypted messages from, so that it verifies that any new message can not be a replay of a previous one. The impact this has on maintenance of a network is that if a transmitter is replaced

in the field, the replacement transmitter must have not only the correct key set, but also the **EMID** must be set to a higher number than the previous transmitter had already used. If the EMID of the transmitter being replaced cannot be read to determine that value, each of the decoders can be checked and their UI will normally display the highest **EMID** received for each **Source Address**. When a new key is applied, including a **Pending Key**, the **EMID** will by default be set to 0.

Encryption Remove Keys—Setting this to **Yes** then **Applying** it will remove any active and pending keys. This also sets **Encrypt Outgoing Messages** to **False**, since a valid key must be entered before enabling encryption.

7.1.1.4 GPS settings



The screenshot shows a software interface with a tabbed menu at the top. The tabs are: Main, ComPort, ALERT2, Radio Settings, Encryption, GPS Settings (selected), Sensor Input Settings, and Sensor Data Monitoring. The GPS Settings tab contains the following fields:

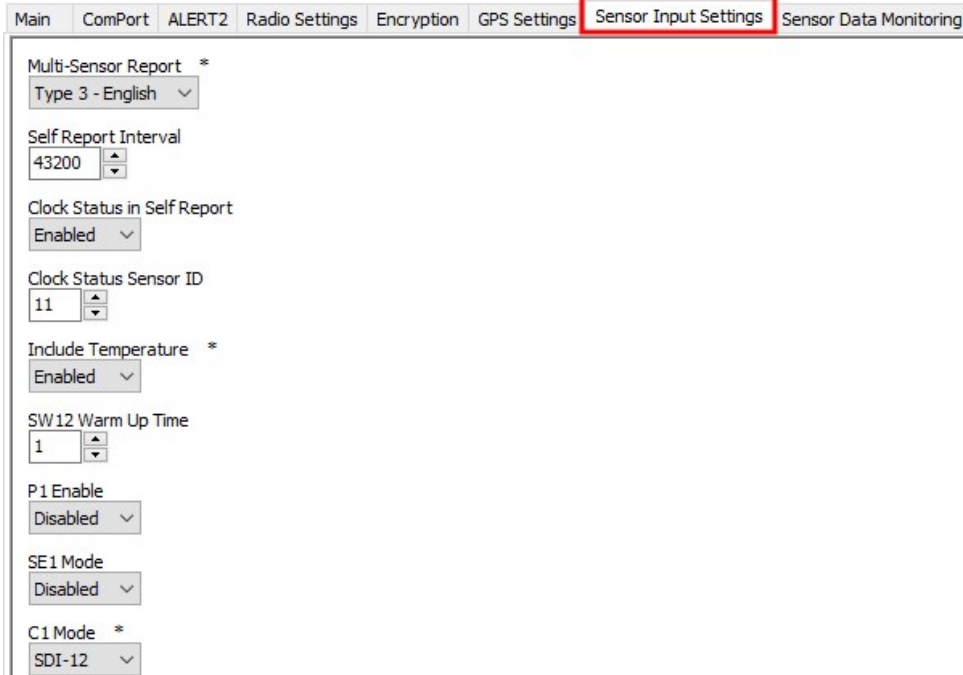
- Last GPS Fix (UTC): A text box containing "UTC is unavailable."
- Leap Seconds: A text box containing "18".
- GPS Update Period: A spin box containing "30".
- GPS Update Timeout: A spin box containing "5".

Last GPS Fix – The data and time of the last successful GPS fix obtained by the AL200

GPS Update Period (30) –Determines how often the GPS receiver will attempt to get a GPS fix. Value is expressed in minutes.

GPS Update Timeout (5) – The maximum amount of time, in minutes, that the GPS receiver will normally be enabled if a GPS fix is unable to be obtained. If the AL200 needs to update or confirm the number of **Leap Seconds**, this may require the GPS to remain on for up to 13 minutes.

7.1.1.5 Sensor Input Settings



Main ComPort ALERT2 Radio Settings Encryption GPS Settings **Sensor Input Settings** Sensor Data Monitoring

Multi-Sensor Report *
Type 3 - English ▾

Self Report Interval
43200 ▲ ▾

Clock Status in Self Report
Enabled ▾

Clock Status Sensor ID
11 ▲ ▾

Include Temperature *
Enabled ▾

SW12 Warm Up Time
1 ▲ ▾

P1 Enable
Disabled ▾

SE1 Mode
Disabled ▾

C1 Mode *
SDI-12 ▾

Multi-Sensor Report (Disabled) – If enabled, sensors with IDs of 1 through 8 will be sent in a compact pre-defined format. See [Recommended sensor IDs, rain report format, and multi-sensor reports](#) (p. 48).

Self Report Interval (43,200 [12 hours]) – Set the frequency that the AL200 transmits non-event-triggered current readings from all enabled sensors. Value is expressed in seconds.

Clock Status in Self Report (Enabled) and **Clock Status Sensor ID (11)**- Always sent as an **Event** report, the AL200 transmits the new **Clock Status** when it changes. It is important that ALERT2 sites stay synchronized with GPS. Enabling this also transmits it in each timed Self Report. It is recommended that it is monitored and if GPS status degrades, that a notification is sent to maintenance personnel by a Data Collection Platform.

SW12 Warm Up Time (1) – Set the amount of time, in seconds, that the AL200 waits after powering the sensors before making a measurement.

P1 Mode – Enable or disable the pulse count terminal depending on whether or not it is used. This is reported as ID 0.

SE1 Mode – Set to **Millivolt** if using a sensor that has a single ended voltage output. Set to **Milliamp** if the sensor has a single-ended current output or 4 to 20 mA loop output.

SE1 ALERT2 Sensor ID – The sensor ID of the sensor connected to the SE1 terminal. Refer to [Recommended sensor IDs, rain report format, and multi-sensor reports](#) (p. 48) for a list of recommended sensor ID values.

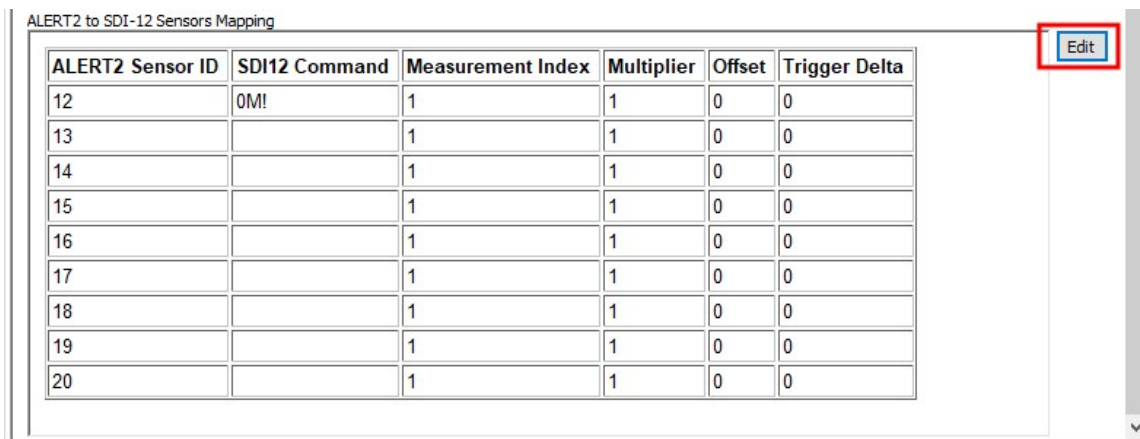
SE1 Multiplier – Set this sensor-specific value that along with the **SE1 Offset** is used to convert the sensor analog output to an engineering unit. See [Calculating multipliers and offsets](#) (p. 50) for more information.

SE1 Offset – Set this sensor-specific value that along with the **SE1 Multiplier** is used to convert the sensor analog output to an engineering unit. See [Calculating multipliers and offsets](#) (p. 50) for more information.

SE1 Tx Change – Set the threshold that a calculated value for the SE1 measurement must reach (in either direction) from the last reported value in order to trigger a data transmission.

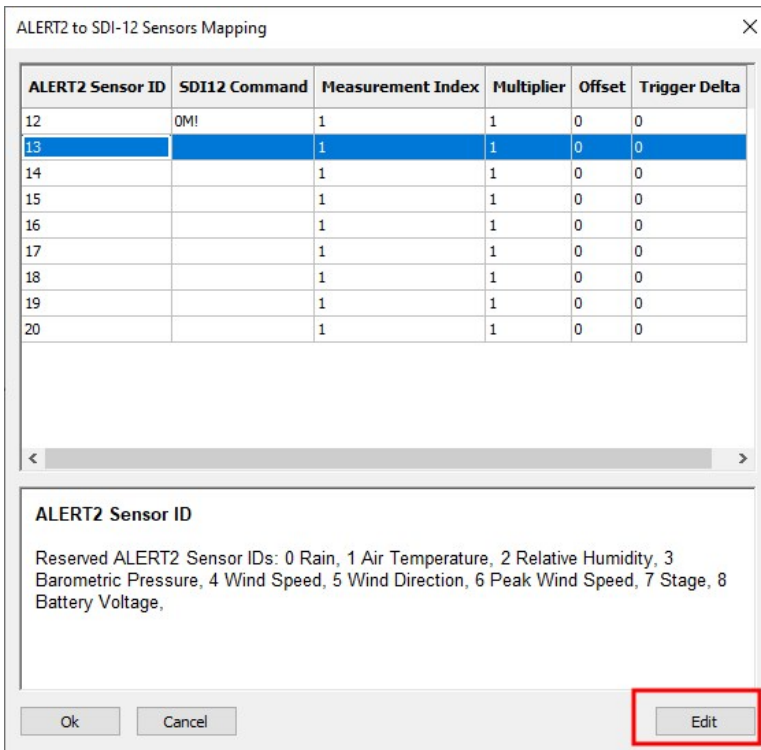
C1 Mode (Disabled) –Set to **SDI-12** if using SDI-12 sensors. Do the following to enter the SDI-12 settings:

1. **Alert2 to SDI-12 Sensor Mapping** table shows the SDI-12 settings for each of the SDI-12 sensors. To enter or edit the settings, click **Edit** next to the table.

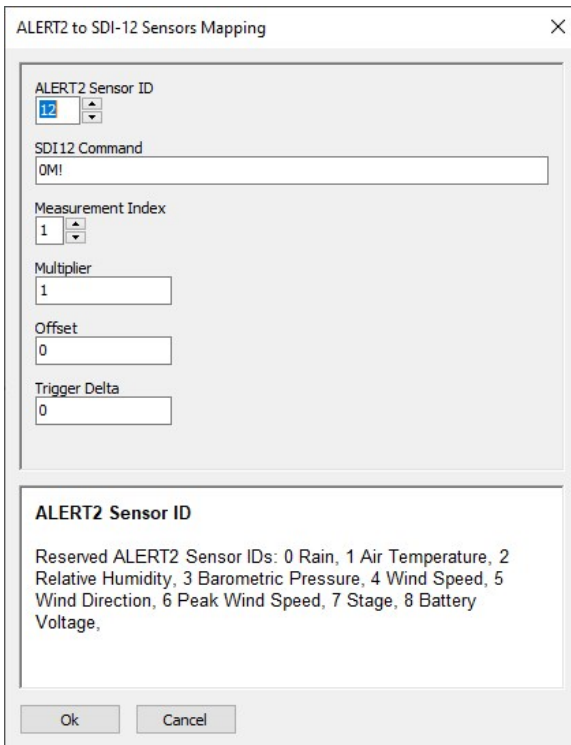


ALERT2 Sensor ID	SDI12 Command	Measurement Index	Multiplier	Offset	Trigger Delta
12	OM!	1	1	0	0
13		1	1	0	0
14		1	1	0	0
15		1	1	0	0
16		1	1	0	0
17		1	1	0	0
18		1	1	0	0
19		1	1	0	0
20		1	1	0	0

2. After the dialog box appears, select the sensor to edit and click **Edit**.

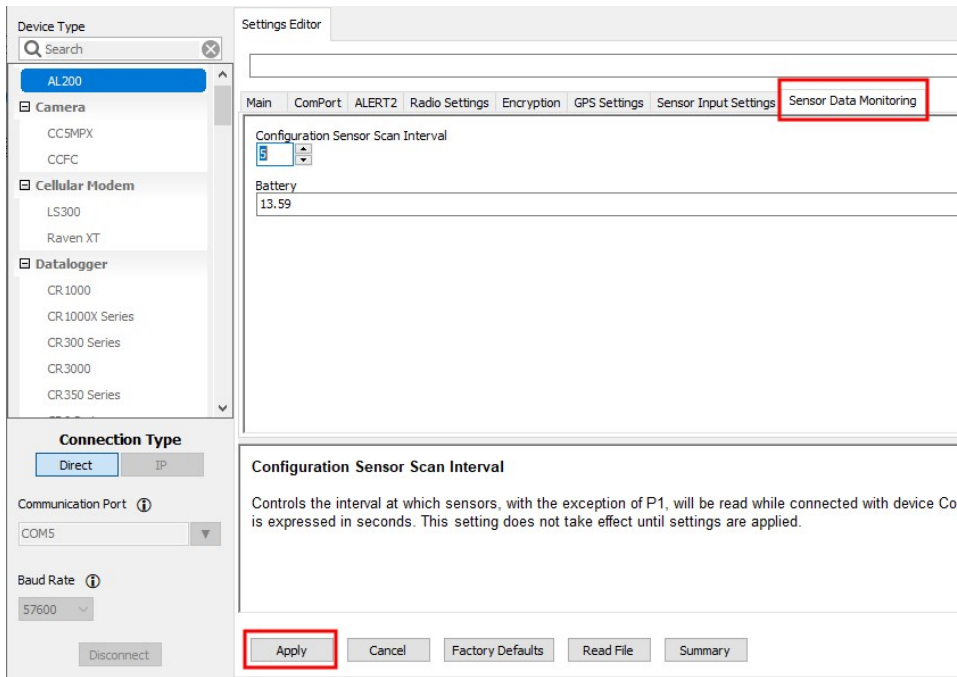


3. The following dialog box will appear for entering the settings.



- a. **ALERT2 Sensor ID** – Set the sensor ID of the sensor connected to the C1 terminal. See [Recommended sensor IDs, rain report format, and multi-sensor reports](#) (p. 48) for more information.
- b. **SDI-12 Command** – The measurement command that will be sent to the attached SDI-12 sensor. The format is $aM!$, where a is the SDI-12 address. Multiple SDI-12 sensors can be queried. If the same command is immediately above in the table, then it is sent once. Additional measurement indexes for that sensor can be sent as additional **ALERT2 Sensor IDs**.
- c. **Measurement Index** – If the attached SDI-12 sensor returns more than one value, select which value to use.
- d. **Multiplier (1)** – This sensor-specific value, along with the **SDI-12 Offset**, is used to convert the sensor output to other units. See [Calculating multipliers and offsets](#) (p. 50) for more information. Most SDI-12 sensors do not require a multiplier or offset except for unit conversion.
- e. **Offset (0)** – This sensor-specific value, along with the **SE1 Multiplier**, is used to convert the sensor output to other units. See [Calculating multipliers and offsets](#) (p. 50) for more information. Most SDI-12 sensors do not require a multiplier or offset except for unit conversion.
- f. **Trigger Delta** – The threshold that a calculated difference in value for the SDI-12 measurement must exceed from the last transmitted value in order to trigger a data transmission.

7.1.1.6 Sensor Data Monitoring



Configuration Sensor Scan Interval – Set the interval on which sensors will be read only while connected to the AL200 with the *Device Configuration Utility* software and in the **Settings Editor** tab.

TBR – Accumulator can be read and changed with this setting.

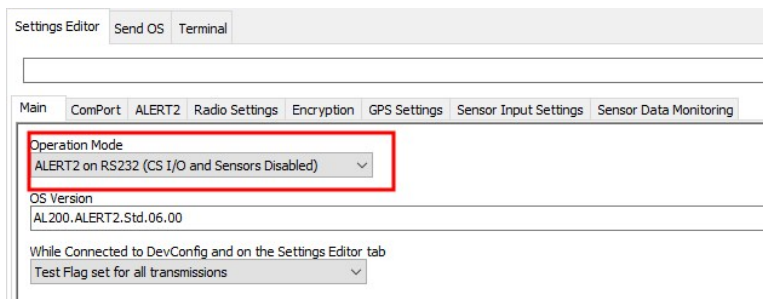
Battery – ensure that the battery voltage is an acceptable range.

NOTE:

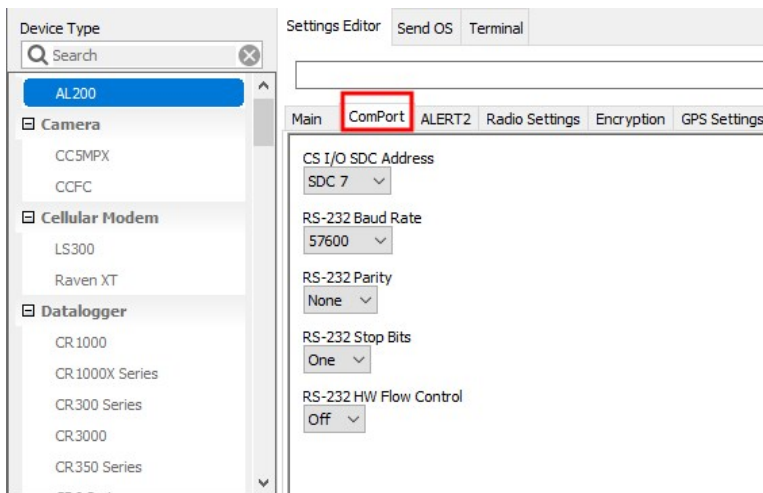
After configuring the AL200 settings, click **Apply** at the bottom of the screen to send the changes to the device. Campbell Scientific recommends saving the configuration file for later reference.

7.1.2 Data logger peripheral

1. To use the data logger peripheral mode, set **Main > Operation Mode** to either **ALERT2 on CS I/O (Sensors and RS-232 Disabled)** or **ALERT2 on RS-232 (CS I/O and Sensors Disabled)** depending on whether the AL200 is connected to the CS I/O or RS-232 port.



2. Click ComPort.



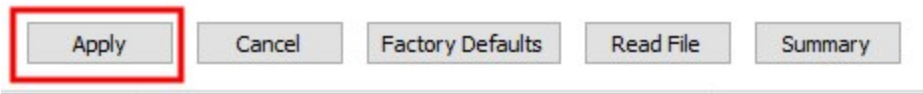
- a. If the AL200 is connected to the data logger CS I/O port, select the appropriate **CS I/O SDC Address**; SDC 7 is the default value. The CS I/O port is not necessary when using the RS-232 port.
 - b. If the AL200 is connected to an RS-232 device, configure the **RS-232 Baud Rate**, **RS-232 Parity**, and **RS-232 Stop Bits** to match the device.
3. Many of the **ALERT2**, **Radio**, **Encryption**, and **GPS Settings** are unique to a particular station and others will be common to your network. The settings are described in [Alert2](#) (p. 12), [Radio settings](#) (p. 15), [Encryption](#) (p. 16), and [GPS settings](#) (p. 17). The settings may be set by the data logger program using IND-API commands. If they are not set by the data logger, they can be set using the *Device Configuration Utility* software.

CAUTION:

Do not use an IND-API command and the *Device Configuration Utility* utility simultaneously because the setting will be overwritten, causing confusion.

4. The **Sensor Input Settings** and **Sensor Data Monitoring** are not used for the data logger peripheral mode and so are disabled.

5. After configuring the AL200 settings, click **Apply** at the bottom of the screen to send the changes to the device. It is a good idea to save the configuration file for later reference.



7.2 Mounting in an enclosure

When used in outdoor applications, the AL200 should be installed in a desiccated, weatherproof enclosure. The AL200 can either be flat- or edge- mounted to a panel using the supplied plastic grommets and 6-32 screws.

7.3 Grounding

The ground lug should be connected to a good earth ground using 12 AWG stranded wire. This will help protect the AL200 from electrical surges. The ground reference for analog measurements should be connected to the **G** terminal on the sensor connector block.

7.4 Wiring


Connect 12 V battery wires to the AL200 12V and G terminal. The 12 V battery should have sufficient capacity to handle the transmit current required by the radio without significant voltage drop.

Connect the transmit audio, Push to Talk, power, and ground lines from your analog radio to the **SW12V**, **Tx (audio)**, **PTT**, and **G** terminals of the radio connector. The AL200 should be mounted as close as possible to the radio to avoid long cable runs between the two devices.

If using the AL200 in the stand-alone mode, connect the sensor wires to the appropriate sensor inputs. Depending on site conditions, additional surge protection for the sensor cables may be required.

If using the AL200 as a data logger peripheral, connect either the **CS I/O** (using an SC12 cable) or **RS-232** port to the data logger.

8. Operation

The AL200 uses the ALERT2 protocol as developed by the ALERT2 Technical Working Group (TWG) and is designed for use as an ALERT2 transmitter. For more information on the ALERT2 protocol, visit the National Hydrologic Warning Council website: www.hydrologicwarning.org .

Under normal operation, the AL200 will obtain a GPS fix and measure sensors based on its configuration. When the sensors are measured and an event threshold has been exceeded, the AL200 will wait until its designated time slot and then power up the radio and transmit the data to a repeater or base receiver.

- Event-driven rainfall data is transmitted as a TBRG (tipping bucket rain gauge) report for **TDMA Frame Lengths** less than or equal to 240 sec with a sensor ID of zero (0). For **Frame Lengths** greater than 240 sec, the accumulator value is sent as a **GSR** report. This is necessary since **TBRG Time Offsets** only have a 255 sec range.
- Other event-driven sensor data is transmitted as a GSR (general sensor report), or MSR (multi-sensor report) if MSRs are enabled and the sensor IDs are in the range of 1 to 8. If events for multiple sensors are detected in the same frame, then multiple general sensors reports will be transmitted in a single MANT message.

If a GPS fix cannot be obtained and the AL200 internal clock may have drifted sufficiently that it cannot be assured that it will transmit in its time slot, the **Clock Status** will change from 0 and the device will transmit data at random times throughout the frame interval in an attempt to not continuously interfere with adjacent time slots.

When connected to the AL200 with the *Device Configuration Utility*, the AL200 will power up and measure the attached sensors on the **Configuration Sensor Scan Interval** located on the **Sensor Data Monitoring** tab.

8.1 Terminal interface commands

OS 6 adds many commands available through the **Terminal** tab of the *Device Configuration Utility*. Keep in mind the following:

- The **Test Flag** and behavior of the transmissions only applies to the **Settings Editor** tab. On that tab, the AL200 is being periodically queried for **Sensor Data Monitoring**. In the **Terminal** tab, these queries are not occurring, so the selected **Test Flag** and transmission

behavior does not apply.

- The **Terminal** prompt should always respond with “**a1200:**”. If it does not, press the [Esc] key.
- There is an extensive list of terminal commands; many are for advanced troubleshooting. You may be asked to execute some of them during troubleshooting when working with Campbell Scientific support. Only a few of the common commands are detailed here.
- A complete list of commands and basic help is returned by the command “**HELP**”. Since the list is several pages long, it may be helpful to export the terminal to a file if you want a list you can refer back to. Additionally, entering **HELP** and then another word will filter the list. For example, type “**HELP HELP**” to get a list of hints about whether arguments should precede or follow the command. “**HELP GPS**” will list only commands that include “**GPS**” in the command or the help text.

A few terminal commands follows:

- The following are examples of using terminal commands to check GPS function:

Turning the GPS off and then back on may be helpful if it has locked up for any reason:

```
a1200: GPSON  
a1200: GPSOFF
```

Enable debug output for the GPS.

NOTE:

The help for the **GPSDEBUG** command shows the argument within parentheses, as explained in **HELP HELP**, so the debug level precedes the command:

```
a1200: 2 GPSDEBUG
```

The **SYNC** command will enable nmea output and start the GPS acquire process:

```
a1200: SYNC
```

Depending on the state of the GPS and the reception of satellites, the output may show or go back to no time or position as shown by all commas:

```
nmea> $GPRMC,,V,,,,,,,,,N*53
```

This will start to fill in with the GPS time seconds, and initially the wrong date:

```
nmea> $GPRMC,191028.600,V,,,,,,,,151111,,,N*4C
```

As satellite signals are received, the time, location, and date will start to update. In the following example, **4123.1519,N,10567.2273,W** is the latitude and longitude, and **071123** shows the date as 7 Nov, 2023:

```
nmea> $GPRMC,191051.602,A,4123.1519,N,10567.2273,W,0.15,54.32,071123,,,A*4A
```

Once the GPS has acquired and is stable, the fractional part of the seconds will drop to 0, and the PulsePerSecond will be reported.

```
nmea> $GPRMC,191058.000,A,4123.1518,N,10567.2268,W,0.00,54.32,071123,,A*48  
PPS
```

- **WHOAMI** shows many aspects of the state of the AL200.
- **SENSORS** shows the configuration of the sensors.
- **SMAP** lists the sensors, if they are active, the sensors reporting criteria, and the latest values
- **Z** will allow sending an SDI-12 command to a sensor. If the sensor is powered from SW12, it may be necessary to power the sensor with the **12VON** command. The AL200 is not able to query sensors for their address. If the address is unknown (for example to change it), it may be necessary to try different addresses until the sensor responds.
- **RESTART** is used to reset the system.

9. Maintenance and troubleshooting

NOTE:

The AL200 is designed to provide years of trouble-free service with reasonable care. However, if factory repair is needed, first contact a Campbell Scientific application engineer to obtain an RMA (Return Materials Authorization) number. An RMA number and product-safety documents are required prior to any repair shipments being accepted at Campbell Scientific. See the [Assistance](#) (p. 1) for more information.

9.1 Maintenance

Periodically check the sensor inputs against known values to ensure that the device is still within the specified accuracy ranges. Connecting to the AL200 with a USB cable will force the AL200 to measure the attached sensors on the **Configuration Sensor Scan Interval**. This will allow the user to quickly see how sensors respond to changes. Upon disconnecting from the device, the AL200 will resume scanning each frame.

Pressing the **Test Button** for one to four seconds will trigger a test transmission containing the latest data available to the AL200. Pressing the button for longer than four seconds will cause the

AL200 to generate a test tone and sustain it for five seconds. This test tone can be used to check the forward and reflected power of the radio.

Consult your sensor and radio manufacturer manuals for recommended maintenance of these devices.

9.2 Troubleshooting

Table 9-1: Problems and possible causes	
Problems	Possible causes
The AL200 is not transmitting event- triggered data.	<ul style="list-style-type: none"> • The AL200 is currently connected to the <i>Device Configuration Utility</i> and is set to Mute all transmissions. • The event threshold is not properly set. • The current measurement does not exceed the event threshold.
The Test button is not initiating a data transmission.	The AL200 is configured as a data logger peripheral and the test button functionality has been disabled.
The AL200 is reporting incorrect values.	<ul style="list-style-type: none"> • The applied multipliers and offsets are not correct. • The attached sensor isn't working properly. Ensure the sensor is wired correctly and that the sensor cable is in good shape. • The sensor may require a warm-up time, and the configured time SW12 may not be sufficient.
The radio LED is always red.	The AL200 has been configured to keep the radio always on.
The GPS LED is on longer than the maximum allowed on time.	The GPS module is attempting to obtain leap second information and may be on for up to 13 minutes.

Appendix A. Glossary

A

ALERT

Automated Local Evaluation in Real Time. A communication protocol developed in the early 1970's for the efficient reporting of real-time rainfall data over radio telemetry networks.

ALERT2

Successor of the ALERT communication protocol. A layered protocol suite designed for the primary purpose of real-time and coordinated communication of data over a radio telemetry network.

I

IND

Intelligent Network Device. A device that implements the AirLink and MANT protocols for the transmission, repeating, or receipt of ALERT2 data.

P

PDU

Protocol Data Unit. Data payload with control header used for exchange between protocol layers. Sometimes generalized as "packet".

S

SDC

Synchronous Device Communications. A Campbell Scientific addressable, synchronous communications protocol. The protocol allows multiple peripherals to be connected to the same communication bus as long as each peripheral has a unique SDC address.

Appendix B. Cables and connectors

B.1 CS I/O

CS I/O is an interface unique to Campbell Scientific products. CS I/O uses TTL signaling. CS I/O devices are connected using a 9-pin, straight-through, male-to-female cable with all 9 pins connected. The supplied SC12 cable is recommended.

Pin	Data logger function, DB9 female	AL200 function, DB9 male
1	5 VDC	N/C
2	Signal ground	Signal ground
3	Ring	Ring
4	RXD	TXD
5	ME	ME
6	SDE	SDE
7	CLK/HS	CLK/HS
8	12 VDC	N/C
9	TXD	RXD

B.2 RS-232

RS-232 is used for asynchronous serial communication. It is a standard EIA/TIA-232 DB9 socket female DCE interface. A DB9 male to male null modem cable is used to connect the AL200 to a Campbell Scientific data logger RS-232 port.

Pin	AL200 function, DCE, DB9 female
1	N/C
2	TXD
3	RXD
4	N/C
5	Signal ground
6	N/C
7	CTS
8	RTS
9	N/C

B.3 USB

The USB interface is a standard Micro-B configuration. A USB A to Micro-B cable is supplied. Connection to a computer requires installation of the FTDI Virtual COM Port (VCP) device driver.

Pin	Function
1	VBUS, 5 VDC
2	Data –
3	Data +
4	Not used, grounded internally
5	Ground

B.4 Power

Input power is supplied using a 2-pin screw terminal. A mating connector is supplied.

G 12V



Table B-4: Power input pin description

Pin	Function
G	Supply ground
12V	Supply voltage

B.5 Analog radio interface

The analog radio interface is a 5-pin screw terminal. A mating connector is supplied.

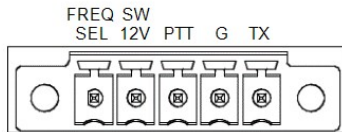


Table B-5: Radio interface pin description

Pin	Function
Freq. Select	Unused
SW12V	Switchable radio power supply
PTT	Push-to-talk. Grounded during transmission.
G	Ground
TX	Transmit audio output

B.5.1 Connecting a Maxon SD-125 or SD-225-series radio

A Maxon SD-125 or SD-225 Series Radio can be connected to the AL200 using a radio data cable (Campbell Scientific pn 31924).

Table B-6: Maxon SD-125/225 radio connections

Wire color	AL200 terminal	DB9 pin number
Black	G	4
Red	SW12V	5

Table B-6: Maxon SD-125/225 radio connections

Wire color	AI200 terminal	DB9 pin number
White	PTT	3
Green	TX	1

B.6 Sensor I/O interface

The sensor I/O interface is a 5-pin screw terminal. A mating connector is supplied.

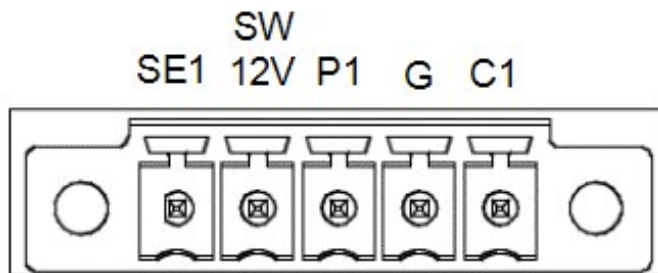


Table B-7: Sensor I/O pin description

Pin	Function
SE1	Analog voltage / current input
SW12V	Switchable sensor power supply
P1	Switch closure input. Internally pulled high to 5V through a 100 k Ω resistor.
G	Ground
C1	Digital I/O for SDI-12

B.7 GPS input

The GPS input is a SMA female connector.

Table B-8: GPS Input Pin Description

Pin	Function
Center conductor socket	RF Input, biased by 3.3 V for use with active antennas
Shield	RF ground

Appendix C. LED indicators

The GPS LED is next to the GPS antenna connection. It is used for monitoring GPS power up and acquisition of a good satellite lock/fix.

State	Description
Green	Half second flash when a good GPS sync is achieved. During calibration it will flash every 5 seconds
Red	GPS module on; no GPS lock (or downloading almanac/leap second information). It can stay on longer than timeout if calibrating leap seconds.

State	Description
Off	GPS module in hibernate state.
Green	GPS lock acquired (will only flash momentarily before turning off)
Red	GPS module on; no GPS lock (or downloading almanac/leap second information). It can stay on longer than timeout if calibrating leap seconds.

The **Serial** LED is located between the RS-232 and CS I/O interfaces. With OS 6, it can be used for monitoring the operational conditions.

State	Description
Green	Double blink every second is a heartbeat indicating normal operations.
Red	Blinks when traffic is on the RS-232, CS-IO, USB, or SDI-12 terminals; it will also blink the error number, in blinks, if a system error occurs.

On OS 4, it can be used for monitoring communication events on those ports.

Table C-4: Serial LED state descriptions (OS 4)	
State	Description
Off	Neither interface is currently transferring data.
Green	RS-232 activity, Internal U0 activity.
Red	CS I/O activity, Internal U1 activity.

The **Radio** LED is located between the CS I/O and USB interfaces. It can be used for monitoring the power and communication state of the radio interface.

Table C-5: Radio LED state descriptions (OS 6)	
State	Description
Green	Flash indicates transmission of AirLink frame.
Red	Power applied to radio, SW12V high.
¹ When the radio is both powered on and transmitting, the red and green LEDs will appear orange.	

Table C-6: Radio LED state descriptions (OS 4)	
State	Description
Off	Radio interface not currently in use.
Green	PTT applied, transmitting.
Red	Power applied to radio, SW12V high
¹ When the radio is both powered on and transmitting, the red and green LEDs will appear orange.	

Under normal operation, the LED sequence should be as follows from powering up the device through a data transmission:

1. **GPS** LED is red immediately (OS 4- within 2 minutes) after power, then flashes green indicating that the AL200 has a GPS fix.
2. **GPS** LED remains red for up 13 minutes as the AL200 downloads leap second information from the satellite.
3. OS 6: **Serial** LED double flashes green every second.
OS 4: **Serial** LED flashes green or red indicating that the AL200 has been sent data from a data logger, or data is being internally transferred from the sensor inputs to memory.

4. **Radio** LED is red briefly while the radio is powered up and allowed to warm up. If the radio is set to always on, this LED will constantly be red.
5. **Radio** LED flashes orange (actually green and red lights, but is orange in appearance) indicating that the AL200 is transmitting data.

Appendix D. AL200 settings

NOTE:

Settings apply to both OS 4 and OS 6 unless noted.

Table D-1: AL200 setting descriptions

Setting	Description
Operation Mode (OS 6)	<p>The AL200 supports ALERT2 sensor measurements and IND-API encoding. Each process can service one physical connection on the AL200 at a time. Those connections are the CS I/O, RS-232, and direct-sensor inputs. The CS I/O port and sensor inputs are multiplexed, so their use is mutually exclusive.</p> <ul style="list-style-type: none"> • ALERT2 on RS-232 (CS I/O and Sensors Disabled): The AL200 accepts ALERT2 IND-API commands on the RS-232 port. • ALERT2 on CS I/O (RS232 and Sensors Disabled) The AL200 accepts ALERT2 IND-API commands on the CS I/O port. • Sensor Input Enabled (CS I/O and RS232 Disabled) The AL200 measures the attached sensors.
Operation Mode (OS 4)	<p>The AL200 supports ALERT2 and ALERT-concentration processing. Each process can service one physical connection on the AL200 at a time. Those connections are the CS I/O, RS-232, and direct-sensor inputs. The CS I/O port and sensor inputs are multiplexed, so their use is mutually exclusive.</p> <ul style="list-style-type: none"> • ALERT2 on CS I/O, ALERT Concentration on RS-232: The AL200 accepts ALERT2 on the CS I/O port and ALERT packets on the RS-232 port. • Sensor Input Enabled (CS I/O Disabled), ALERT Concentration on RS-232: The AL200 measures the attached sensors and receive serial ALERT packets on the RS-232 port. • ALERT Concentration on CS I/O, ALERT2 on RS-232 The AL200 accepts ALERT on the CS I/O port and ALERT2 on the RS-232 port.


Table D-1: AL200 setting descriptions	
Setting	Description
OS Version	The operating system (OS) version currently running on this device. OS updates are available at: www.campbellsci.com/downloads  .
Test flag (when connected to the <i>Device Configuration Utility</i> ; OS 6 only)	<p>When connected to the <i>Device Configuration Utility</i> using a USB cable and clicking Connect, the AL200 can be configured to transmit normally either with the Test Flag set, without the Test Flag set, or muting all transmissions. Setting the Test Flag may allow the <i>Data Collection Software</i> to handle maintenance reports appropriately. Select the desired behavior from the drop-down list. The test button will continue to send test transmissions, independent of this setting.</p> <p>NOTE: When using the Terminal tab, the <i>Device Configuration Utility</i> does not maintain communications without user interaction. Accordingly, the Test Flag functionality will only operate as selected when in the Settings Editor tab.</p>
CS I/O SDC Address	Synchronous Device for Communication (SDC) address that this device should use while communicating over CS I/O. Communication speed (bit rate) is controlled by the data logger.
RS-232 Baud Rate	The baud rate used for communication over RS-232.
RS-232 Parity	Parity bit usage during communication over RS-232.
RS-232 Stop Bits	The number of stop bits sent after each character during communication over RS- 232.
RS-232 HW Flow Control (OS 6 Only)	Use RTS/CTS hardware flow control over RS-232.
Time To Next Slot (OS 4 Only)	Time (seconds) until the next transmission slot.
Station Source Address	ALERT2 station source address. Each station in an ALERT2 network must have a unique source address (range is 1 to 65534).
Destination Address	If enabled, the source address of the device in which packets are directed.

Table D-1: AL200 setting descriptions	
Setting	Description
Add Destination Address	Determines whether the Destination Address is added to the packet header. A setting of No disables the Destination Address settings control.
FEC Mode (OS 6 Only)	<p>Forward Error Correction modes trade throughput for redundancy:</p> <p>0 = Highest error correction with lowest throughput. . This is the original ALERT2 level of correction and must be used with older repeaters or decoders. Levels 1 and 2 can only be used if the device that directly receives transmissions from this site is capable of decoding different FEC levels.</p> <p>1 = Medium error correction and throughput.</p> <p>2 = Least error correction with highest throughput.</p>
Enable TDMA (OS 6 Only)	When enabled and the clock is accurate, the device transmits in its time slot. If the clock drifts, the device transmits at random times. If this setting is not enabled, the device transmits in ALOHA mode and does not report the time stamp with the readings.
TDMA Frame Length	The total amount of time (in milliseconds) that all of the stations in the network will report. It is an integer between 5000 and 3600000 (1 hour). The value must be evenly divisible into 12 hours, for example $(43200000 / \mathbf{Frame Length} = \text{Whole Number})$ or $(43200000 \text{ MOD } \mathbf{Frame Length} = 0)$. ALOHA mode would be a network design decision and is not assured to be random. Collisions would be expected to occur.
TDMA Slot Length	The maximum amount of time (in milliseconds) that this device can transmit within a single frame. The value has a resolution of 250 ms. It is an integer value in the range of 250 to 10000 ms.
TDMA Slot Offset	The offset, from the beginning of the frame, for the transmission slot. The value is expressed in milliseconds with a resolution of 250 ms. The value cannot exceed $(\mathbf{Frame Length} - 250 \text{ ms})$.
TDMA Slot Padding (OS 6 Only)	This is the number of ms that will be added before the beginning of a transmission. The higher this value, the longer the device can go between GPS time sync and still be assured of being within its time slot.

Table D-1: AL200 setting descriptions	
Setting	Description
Center Transmission (OS 6 Only)	When enabled, the total transmission time is calculated and the transmission is started so that the center of the transmission time will occur at the center of the slot, as long as the transmission will start no earlier than the Slot Padding value into the slot.
Hop Limit	The maximum number of times a packet, originating from this device, will be repeated (hop) before being discarded. None (7) disables the limiting of hops. Example: if this station requires 1 repeater hop to reach the base station receiver, the hop limit should be set to a minimum of 1.
Add Path Service Enabled	Request that each device that forwards data originating from this station add its source address to the packet header. Enabling this option allows a receiver to know the path that the packet took through the network, which is important for determining network performance and troubleshooting. This is enabled by default so that it is compatible with older repeaters and behaves similarly to previous OSs. If the repeaters implement the Add Path Override, it will be possible to disable it at gauge sites for normal operation and enable the override at the repeaters when required.
Radio Power Up Mode	The setting controls when the attached radio is powered up. The radio can be powered up every frame, or continuously. For maximum power savings, set to On Only With Data to Tx . The radio will only power up if the AL200 has data to be transmitted. For maximum responsiveness, set to On Continuously . For OS 4 only, if set to On Every Frame , for every frame, the radio is turned on for at least the number of milliseconds set for the Radio Warm Up , whether there is data to be sent or not.
Radio Warm Up	The amount of time power should be applied to the radio prior to the start of the transmission slot. Power will be applied according to the Radio Power Up Mode. The value is expressed in milliseconds with a resolution of 10 ms
Carrier Only Time	Amount of unmodulated carrier used in Airlink preamble. The value is expressed in milliseconds.
AGC Time	Amount of tone-modulated carrier used in Airlink preamble. The value is expressed in milliseconds
RF Tail Time	Amount of unmodulated carrier to follow transmitted frame. The value is expressed in milliseconds.

Table D-1: AL200 setting descriptions

Setting	Description
Modulation Voltage	This setting controls the modulation voltage. The value is expressed in millivolts, peak-to-peak. Settings do not take effect until applied.
Invert Modulation Polarity	Depending on the radio used the audio, the Airlink modulation signal may need to be inverted. For Ritron radios, this is typically set to Normal . Different radio models from the same manufacturer may need to be set differently, especially if using older decoders and repeaters in the network. Newer decoders such as the AL205R/B will work with transmitters using either polarity.
Encrypt Outgoing Messages (OS 6 Only)	This can only be enabled if a valid key has been entered in the device. NOTE: Entering a key does not enable encryption but allows encryption to be enabled.
Encryption Key Status (OS 6 Only)	Shows whether the active and pending keys are set.
Active EMID (OS 6 Only)	Lists the current EMID being used by the encryption. If a transmitter is replaced in the field, the replacement transmitter must have not only the correct key set, but also the EMID must be set to a higher number than the previous transmitter had already used.
New EMID Value (OS 6 Only)	Used for replacing a transmitter in the field without changing the key on this transmitter and at the decoders. If a new key is set, the EMID will automatically be set to 0
New Active and Pending Keys (OS 6 Only)	Encryption requires at least a valid Active Key . This key must be 32 hex characters. Pairs can be separated by colons. The Active Key is used after encryption is enabled. A Pending Key and Rotation Time must also be set. For security reasons, once a key is entered, it cannot be viewed.
New Pending Key Rotation Time (OS 6 Only)	Once the Pending Key Rotation Time lapses, the Pending Key will become the active key. The EMID will also be set to 0.
Encryption Remove Keys (OS 6 Only)	Remove active and pending keys and sets the Encrypt Outgoing Messages to False, since it is necessary to enter a valid key before enabling encryption.

Table D-1: AL200 setting descriptions

Setting	Description
Last GPS Fix	The last time that the device successfully acquired a GPS fix. The time is shown in UTC. Remember that the time needs to be corrected for your time zone offset when trying to understand this value in context of the local time.
Leap Seconds (OS 6 Only)	Both OS 4 and OS 6 computed Leap Seconds from the GPS Almanac transmission (may require up to 13 minutes to be received). This value is required to compute UTC time from GPS time. This read-only value is displayed to the user in OS 6.
GPS Update (Power On) Interval	Time between GPS fix attempts. The value is expressed in minutes.
GPS Update Timeout (On Max)	The maximum time the GPS will normally remain on while trying to obtain a fix. The value is expressed in minutes. If the device is checking or updating its Leap Second value, the GPS may remain on for up to 13 minutes.
Multi-Sensor Report	If enabled, sensors with IDs 1 through 8 will be sent in a compact pre-defined format. See Recommended sensor IDs, rain report format, and multi-sensor reports (p. 48).
Self Report Interval	Controls the frequency at which sensor data should be reported, without being triggered by an event. Value is expressed in seconds.
Clock Status in Self Report	Clock Status (CS) is used to make sure the unit stays in its TDMA time slot. When the CS changes, it will be shown as an event triggered report. Campbell Scientific recommends keeping the CS enabled in Self Reports (timed reports) unless data transmission must be minimized, and reliable alarming of CS is assured.
Include Temperature (OS 6 Only)	The IND Temperature is reported in degrees C as a Type 5 MSR as defined in the ALERT2 Application Layer Protocol Specification, Ver 1.3. The specification recommends a Sensor ID 202.
SW12 Warm Up Time	Controls the amount of time SW12V should be on before reading sensor inputs, except for P1. A setting of -1 means SW12V will be left on continuously. A setting of 0 means SW12V will not be enabled before measurement. Value is expressed in seconds.

Table D-1: AL200 setting descriptions	
Setting	Description
P1 Mode	Enables the P1 terminal input. The P1 input is typically used for measuring switch closure, such as output produced by a tipping bucket rain gage. An ALERT2 sensor ID of 0 will be used for tipping bucket and TBRG sensor reports for this input.
SE1 Mode	Sets the operation mode for the SE1 terminal input. SE1 is used for measuring millivolt or milliamp input signals, such as the signals produced by pressure transducers.
SE1 ALERT2 Sensor ID	The ALERT2 sensor ID that will be used to identify a SE1 general sensor report. The ID cannot be set to 0 or 8. 0 is reserved for reporting P1 input. 8 is reserved for reporting battery.
SE1 Multiplier	Multiplier to apply to SE1 measurement before evaluation and transmission. Example: Water Level = SE1 measurement • SE1 Multiplier + SE1 Offset.
SE1 Offset	Offset to apply to SE1 measurement before evaluation and transmission. Example: Water Level = SE1 measurement • SE1 Multiplier + SE1 Offset.
SE1 Tx Change	Amount of change in reading required to trigger Tx of reading. Reading = SE1 measurement x SE1 Multiplier + SE1 Offset.
C1 Mode (OS 6 Only)	Enables SDI-12 sensor readings on C1
C1 Mode (OS 4 Only)	Sets the operation mode for the C1 terminal input. C1 is used for measuring status (high/low) or SDI-12 inputs, like those produced by a float switch or pressure transducing level sensor, respectively.
C1 ALERT2 Sensor ID (OS 4 Only)	The ALERT2 sensor ID that will be used to identify a C1 general sensor report. The ID cannot be set to 0 or 8. 0 is reserved for reporting P1 input. 8 is reserved for reporting battery.
SDI-12 Command	SDI-12 command to be sent to the attached sensor.
SDI-12 Value to Send	Selects which value returned by the SDI-12 sensor to use for evaluation and transmission. For example, if the sensor returned 4 values, and the 3rd value needs to be used, this setting should be 3.
SDI-12 Multiplier	Multiplier to apply to the SDI-12 measurement before evaluation. Example: Water Level = SDI-12 measurement • SDI-12 Multiplier + SDI-12 Offset.

Table D-1: AL200 setting descriptions	
Setting	Description
SDI-12 Offset	Offset to apply to the SDI-12 measurement before evaluation. Example: Water Level = SDI-12 measurement • SDI-12 Multiplier + SDI-12 Offset.
SDI-12 Tx Change	Amount of change in the reading required to trigger Tx of reading. Reading = SDI-12 measurement • SDI-12 Multiplier + SDI-12 Offset.
Configuration Sensor Scan Interval	Controls the interval at which sensors (except sensor connected to P1) will be read while connected with <i>Device Configuration Utility</i> . Value is expressed in seconds. This setting does not take effect until settings are applied.
Battery	Battery / supply voltage (volts). While connected to the <i>Device Configuration Utility</i> , the battery voltage will be measured every Configuration Sensor Scan Interval . The measured value will be queried and displayed here at a regular refresh interval.
P1 Total	If the P1 input is enabled, the total number of counts since the device was last powered up or reset will be displayed here. The measured value will be queried and displayed here at a regular refresh interval.
SE1 Raw Reading	If SE1 is enabled, this reading is the value without the SE1 Multiplier and SE1 Offset applied. While connected to the <i>Device Configuration Utility</i> , SE1 will be measured every Configuration Sensor Scan Interval . The measured value will be queried and displayed here at a regular refresh interval.
SE1 Scaled Reading	If SE1 is enabled, this reading is the value with the SE1 Multiplier and SE1 Offset applied. While connected to the <i>Device Configuration Utility</i> , SE1 will be measured every Configuration Sensor Scan Interval . The measured value will be queried and displayed here at a regular refresh interval.
SE1 Transmitted	Last three transmitted readings for SE1 (T0, T1, T2). The list will be queried and displayed here at a regular refresh interval. With OS 4, while connected to the <i>Device Configuration Utility</i> , automated reporting/transmission is disabled. Press and hold the test button for 3 to 5 seconds to force a transmission while connected.
C1 Raw Reading	If C1 input is enabled, the reading is either the control port state or the SDI-12 value without the SDI-12 Multiplier and SDI-12 Offset applied. With OS 4, while connected to the <i>Device Configuration Utility</i> , C1 will be measured every Configuration Sensor Scan Interval . The measured value will be queried and displayed at a regular refresh interval.

Table D-1: AL200 setting descriptions

Setting	Description
C1 Scaled Reading	If C1 input is enabled, the reading is either the control port state or the SDI-12 value with the SDI-12 Multiplier and SDI-12 Offset applied. While connected to the <i>Device Configuration Utility</i> , C1 will be measured every Configuration Sensor Scan Interval . The measured value will be queried and displayed at a regular refresh interval.
C1 Transmitted	If C1 input is enabled, the reading is either the control port state or the SDI-12 value for the last three transmitted readings of C1 (T0, T1, T2). The list will be queried and displayed here at a regular refresh interval. With OS 4, while connected to the <i>Device Configuration Utility</i> , automated reporting/transmission is disabled. Press and hold the test button for 3 to 5 seconds to force a transmission while connected.

Appendix E. AL200 USB-driver installation instructions

When plugging the AL200 into your Windows XP or Vista PC for the first time, it may be necessary to install the FTDI Virtual COM Port (VCP) driver. This is not required when using Windows 7 or 8.

Visit www.ftdichip.com/Drivers/VCP and select the appropriate file based on your computer operating system. Download the zip file to your computer and extract the files to a directory of your choosing. Select and open the executable file and proceed through the install wizard. After the drivers finish installing, you should see a confirmation screen indicating that the drivers were installed or updated successfully. You will then need to restart your computer to apply the changes.

Appendix F. Updating the AL200 Operating System (OS)

Whenever a new operating system (OS) is released for the AL200, it will be available from our website, www.campbellsci.com/downloads.

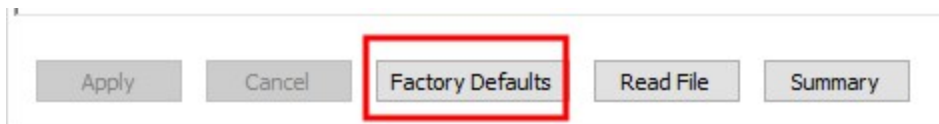
Follow these steps to send the new OS to the AL200:

1. Connect a USB cable between one of your computer USB ports and the USB port on the AL200.
2. Open the *Device Configuration Utility*.
3. Select the **AL200** under **Device Type**.
4. Select the appropriate **Communication Port**.
5. Click the **Send OS** tab.
6. Press **Start**.
7. In the resulting dialog box, select the file that should be sent to the device as an operating system (this file should have a .hex extension) then press **OK**. The operating system will be sent to the AL200.

CAUTION:

Do not remove power while an OS download is in process.

8. After the OS has been successfully updated, **Apply Factory Defaults** first then make appropriate changes to configure the station.



Appendix G. Recommended sensor IDs, rain report format, and multi-sensor reports

The following are the recommendations provided in the ALERT2 Application Layer Protocol Specification document, Version 1.3.

ID	Sensor type
0	Rain
1	Air temperature
2	Relative humidity
3	Barometric pressure
4	Wind speed
5	Wind direction
6	Peak wind speed
7	Stage
8	Battery voltage

ID 0 is assigned to Rain as measured with a tipping bucket. P1 input counts the number of pulses, and the accumulator value is sent as an integer. For TDMA Frame Lengths ≤ 240 sec, this is sent as a TBRG (Type 2) report with Time Offsets for each tip. For Frame Lengths > 240 sec, the accumulator value is sent as a GSR (Type 1) report. This is necessary since TBRG Time Offsets only have a 255 sec range.

Multi-Sensor Reports are an efficient way of transmitting reports for typical weather station sensors in both English (type 3) and Metric (type 4) units with a fixed resolution. Sensors must use IDs 1 to 8, and then any sensor with an ID in that range will be sent in the MSR. Sensors that are not enabled are not transmitted.

Table G-2: Type 3 (English units) sensor, bytes, format, resolution, and units					
ID	Sensor	Bytes	Format	Resolution	Units
1	Air temperature	2	Signed integer	0.1	°F
2	Relative humidity	1	Unsigned integer	1	%
3	Barometric pressure	2	Unsigned integer	0.1	hPa
4	Wind speed	1	Unsigned integer	1	mph
5	Wind direction	2	Unsigned integer	1	deg
6	Peak wind speed	1	Unsigned integer	1	mph
7	Stage	2	Signed integer	0.01	ft
8	Battery voltage	1	Unsigned integer	0.1	V

Table G-3: Type 4 (Metric units) sensor, bytes, format, resolution, and units					
ID	Sensor	Bytes	Format	Resolution	Units
1	Air temperature	2	Signed integer	0.1	°C
2	Relative humidity	1	Unsigned integer	1	%
3	Barometric pressure	2	Unsigned integer	0.1	hPa
4	Wind speed	2	Unsigned integer	1	km/hr
5	Wind direction	2	Unsigned integer	1	deg
6	Peak wind speed	2	Unsigned integer	1	km/hr
7	Stage	3	Signed integer	0.001	m
8	Battery voltage	1	Unsigned integer	0.1	V

Appendix H. Calculating multipliers and offsets

Unlike ALERT which could only represent measurement values between 0 and 2047, ALERT2 has the ability to represent a much larger range of floating point numbers. The reading does not need to be scaled to a unitless number that is less than 2047. Instead, with ALERT2, you can transmit values in engineering units with a high degree of resolution. The simplified example below demonstrates how to calculate the multiplier and offset that are needed to convert a pressure transducer output, 0 to 5 volts, to feet of water.

For this example, we will use a pressure transducer that has a 0 to 30 psi range and a 0 to 5 volts output. From the manufacturer supplied calibration report it is known that the sensor outputs 0.0123 volts at 0 psi and 4.987 volts at 30 psi (12.3 and 4987 millivolts respectively).

The relationship between the sensor's output in millivolts and pressure is defined by the equation of a line (assuming linearity), $Y = mX + b$, where Y is pressure, m is the calculated multiplier, X is the sensor's output in millivolts, and b is the calculated offset.

$$Y = mX + b$$

OR

$$\text{Pressure} = \text{Multiplier} \times \text{Sensor Output} + \text{Offset}$$

The multiplier is determined by dividing the sensor's measurement ranges by the sensor's range of output. For this example the multiplier will be:

Multiplier

$$\mathbf{Multiplier} = \frac{Y_2 - Y_1}{X_2 - X_1}$$

OR

$$\mathbf{Multiplier} \frac{30 - 0}{(4987 - 12.3)} = \frac{30}{(4974.7)} = \mathbf{0.0060 \text{ psi per mV}}$$

The offset is determined by entering the multiplier into the pressure equation and solving for the offset using a known pressure and sensor output.

$$\text{Offset} = \text{Pressure} - (\text{Multiplier} \cdot \text{Sensor Output})$$

OR

$$\text{Offset} = 0 - (0.0060 \times 12.3) = -0.074 \text{ psi per mV}$$

Now, we can calculate pressure based on the reading we get from the sensor. For example, you measure the sensor's output as 2543.210 mV. Pressure would be determined by:

$$\text{Pressure} = (0.0060 \cdot 2543.210) + (-0.074) = 15.263 \text{ psi}$$

To determine water depth, simply multiply the pressure value by the appropriate conversion factor.

For fresh water this is:

$$1 \text{ psi} = 2.308 \text{ ft.}$$

For salt water this is:

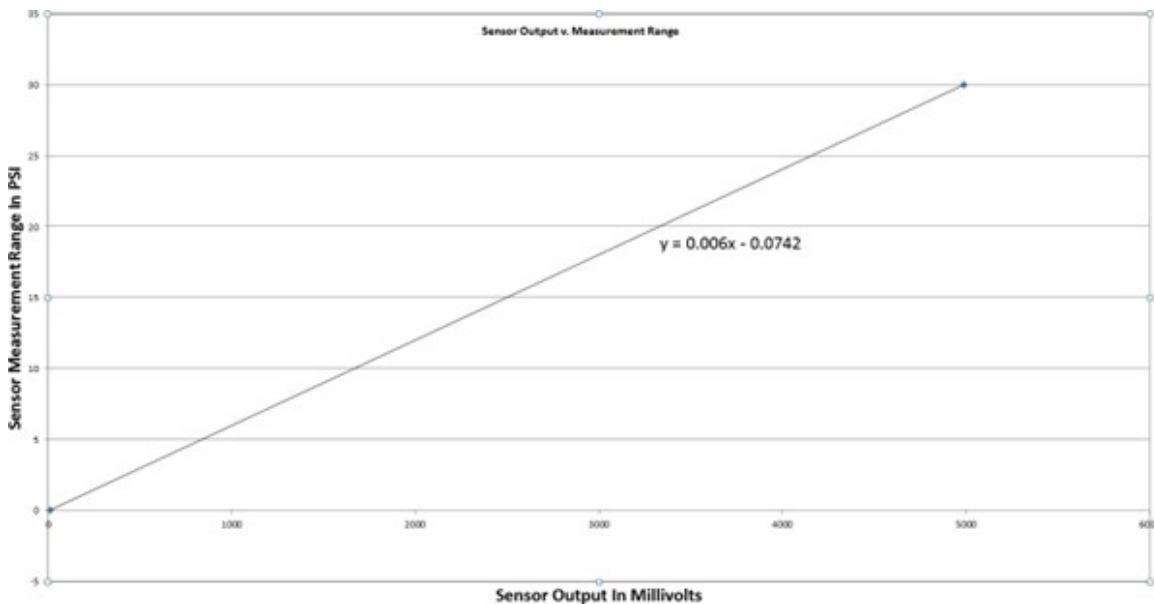
$$1 \text{ psi} = 2.250 \text{ ft.}$$

For the above example (assuming fresh water):

$$\text{Depth of Water} = \text{Pressure} \times 2.308$$

$$\text{Depth of Water} = 15.263 \times 2.308 = 35.226 \text{ ft.}$$

These calculations can easily be performed using many spreadsheet programs by plotting the sensor's measurement range versus the sensor's output range. The equation of the trendline contains the multiplier and offset.



Appendix I. Comparison of OS 6, OS 5, and OS 4

OS 5 was not intended for stand-alone applications, but for a limited number of data logger driven applications. The NHWC TWG had not formally adopted version 2.0 IND API commands, so the data logger code used with an AL200 running either OS 4 or OS 5 will require modification to function with OS 6.

CAUTION:

Do not update an AL200 from either OS 4 or OS 5 to OS 6 until the data logger code has been modified and tested to comply with IND API spec version 2.0.

Most ALERT2 OS 4 and OS 5 users will want to update to OS 6. However, some OS 4 features are not included in OS 6. The operating system differences are documented in this appendix.

Major features added to OS 6 include configurable FEC and 0.25 sec slots, Encryption, expanded SDI-12 capabilities, GPS improvements, and IND API 2.0 support.

Due to limitations, OS 6 did not implement ALERT Concentration or the Status (high/low) sensor.

In OS 4, the AL200 suppresses event-triggered transmissions while connected to the *Device Configuration Utility*. During this time, the **Test Button** is used to trigger a data transmission.

In OS 4, when the configuration is changed or the AL200 is power cycled, the GPS will require approximately 13 minutes to obtain the correct leap second correction. Until that is successful, it will transmit in random TDMA slots.

OS 4 implements Digital I/O (C1):

- Software configurable as status (high/low) or SDI-12 input

- Status Low 0 to 1.4 VDC, High 3.5 to 5.0 VDC

- SDI-12 limited to 1 address, 1 value.


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.

CAMPBELL SCIENTIFIC EXPRESSLY DISCLAIMS AND EXCLUDES ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Campbell Scientific hereby disclaims, to the fullest extent allowed by applicable law, any and all warranties and conditions with respect to the products, whether express, implied, or statutory, other than those expressly provided herein.


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.

Global Sales and Support Network

A worldwide network to help meet your needs



Campbell Scientific Regional Offices

Australia

Location: Garbutt, QLD Australia
Phone: 61.7.4401.7700
Email: info@campbellsci.com.au
Website: www.campbellsci.com.au

Brazil

Location: São Paulo, SP Brazil
Phone: 11.3732.3399
Email: vendas@campbellsci.com.br
Website: www.campbellsci.com.br

Canada

Location: Edmonton, AB Canada
Phone: 780.454.2505
Email: dataloggers@campbellsci.ca
Website: www.campbellsci.ca

China

Location: Beijing, P. R. China
Phone: 86.10.6561.0080
Email: info@campbellsci.com.cn
Website: www.campbellsci.com.cn

Costa Rica

Location: San Pedro, Costa Rica
Phone: 506.2280.1564
Email: info@campbellsci.cc
Website: www.campbellsci.cc

France

Location: Montrouge, France
Phone: 0033.0.1.56.45.15.20
Email: info@campbellsci.fr
Website: www.campbellsci.fr

Germany

Location: Bremen, Germany
Phone: 49.0.421.460974.0
Email: info@campbellsci.de
Website: www.campbellsci.de

India

Location: New Delhi, DL India
Phone: 91.11.46500481.482
Email: info@campbellsci.in
Website: www.campbellsci.in

South Africa

Location: Stellenbosch, South Africa
Phone: 27.21.8809960
Email: sales@campbellsci.co.za
Website: www.campbellsci.co.za

Spain

Location: Barcelona, Spain
Phone: 34.93.2323938
Email: info@campbellsci.es
Website: www.campbellsci.es

Thailand

Location: Bangkok, Thailand
Phone: 66.2.719.3399
Email: info@campbellsci.asia
Website: www.campbellsci.asia

UK

Location: Shephed, Loughborough, UK
Phone: 44.0.1509.601141
Email: sales@campbellsci.co.uk
Website: www.campbellsci.co.uk

USA

Location: Logan, UT USA
Phone: 435.227.9120
Email: info@campbellsci.com
Website: www.campbellsci.com

