



# CELL200-Series

## 4G LTE Cellular Module



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# 1. Cellular communications

This manual provides information for interfacing CELL200 Series 4G LTE Cellular Modules to Campbell Scientific data loggers.

Use of the CELL200 series requires a cellular line of service. The products compatible with Verizon, AT&T, T-Mobile, Vodafone, and Telstra are shown in the following table.

Product	Cellular protocol	Market	Verizon	AT&T	T-Mobile	Vodafone	Telstra	Other <sup>1</sup>
CELL205	4G LTE with automatic 3G fallback	North America		✓	✓			✓
CELL210	4G LTE CAT-1	United States	✓					
CELL215	4G LTE with automatic 3G and 2G fallback	EMEA				✓		✓
CELL220	4G LTE with automatic 3G fallback	Australia and New Zealand					✓	✓
CELL225	4G LTE	Japan						✓

<sup>1</sup> More than 600 other providers are available worldwide through Campbell Scientific. See [Establish cellular service](#) (p. 3) for more information.

Before using the CELL200 series, please review:

- [Safety](#)
- [Pre-installation](#) (p. 2)

## 2. Precautions

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- READ AND UNDERSTAND the [Safety](#) section at the back of this manual.
- An authorized technician shall verify that the installation and use of this product is in accordance with the manufacturer's instructions, recommendations and intended use.
- Although the CELL200 series is rugged, it should be handled as a precision instrument.
- Follow local regulations (see Compliance in [Specifications](#) (p. 23)).
- Protect from over-voltage.
- Protect from water.
- Protect from ESD (electrostatic discharge).

## 3. Initial inspection

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- Upon receipt of the CELL200 series, inspect the packaging and contents for damage. File any damage claims with the shipping company.
- Immediately check package contents. Thoroughly check all packaging material for product that may be concealed. Check model numbers, part numbers, and product descriptions against the shipping documents. Model or part numbers are found on each product. Report any discrepancies to Campbell Scientific.

## 4. Pre-installation

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### TIP:

Check [www.campbellsci.com](http://www.campbellsci.com)  to ensure you are using the latest data logger support software and data logger operating system (OS).

Updating the OS during system setup and testing, or onsite is recommended. Sending an OS to a remote data logger will interrupt the data logger program. If you have questions, contact Campbell Scientific for assistance (<https://www.campbellsci.com/support> .

## 4.1 Establish cellular service

For better security, we recommend using Konect PakBus® Router with a private dynamic IP address. This method allows only incoming PakBus communications. No other incoming communications are supported. However, all forms of outbound communications from the data logger are supported, including but not limited to PakBus, email, and FTP.

### NOTE:

When the data logger is connected to both Ethernet and a cellular modem, [IPRoute\(\)](#) may be used to specify which interface to use for the outbound communications, such as email, FTP, and HTTP.

A public static IP address can also be used. This provides more incoming communications functionality, but is less secure and more vulnerable to unsolicited traffic.

### NOTE:

A public static IP account must be used when the module is set up in serial server mode. Private dynamic IP accounts do not support the serial server mode.

### 4.1.1 Campbell Scientific cellular data service

Campbell Scientific can provide subscriptions to cellular service through Verizon, AT&T, T-Mobile, Vodafone, Telstra, and over 600 other providers worldwide. When this cellular service is purchased with the module, the module will come pre-provisioned with the required SIM card and APN. If you have already purchased the CELL200 series, call Campbell Scientific to set up service.

### 4.1.2 Other service providers

While using Campbell Scientific is the simplest way to obtain cellular data service for your module, you can go directly to a provider. For more information on obtaining service directly from Verizon and AT&T, see [Verizon Wireless and AT&T](#) (p. 79).

### TIP:

Prepaid cellular data plans may experience service slow downs when data limits are reached. If file transfer from a cellular-connected data logger works initially, but later has problems, check for data overage on the cellular plan.

This does not apply to Campbell Scientific cellular data services.

## 4.2 Install the SIM card

### NOTE:

If you purchased cellular service from Campbell Scientific with the module, it will come with the SIM (Subscriber Identity Module) card already installed. Proceed to [Konect PakBus Router setup](#) (p. 4).

The CELL200 series requires a Micro-SIM (3FF) (6 position / contacts); a smartcard that securely stores the key identifying a mobile subscriber. You should only need to install the SIM card once in the life of the module.

To install the SIM card:

1. Remove the SIM card cover.
2. Note the location of the notched corner for correct alignment. The gold contact points of the SIM face down when inserting the SIM card as shown in the following figure. **Gently** slide the card into the slot until it stops and locks into place. To eject the SIM card, press it in slightly and release.
3. Replace the SIM card cover.



FIGURE 4-1. SIM card installation

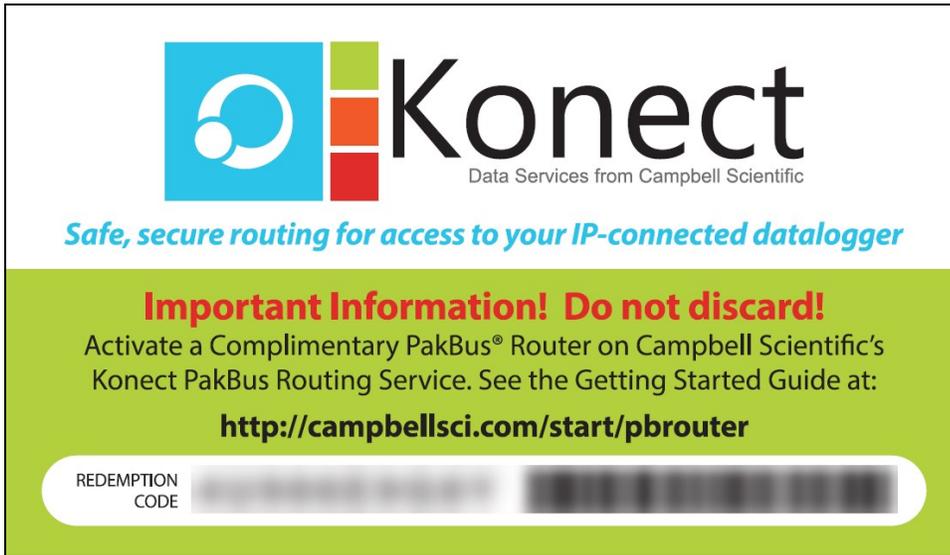
## 4.3 Konect PakBus Router setup

For better security, we recommend using Konect PakBus® Router with a private dynamic IP address. This method allows only incoming PakBus communications. No other incoming

communications are supported. However, all forms of outbound communications from the data logger are supported, including but not limited to PakBus, email, and FTP.

### 4.3.1 Get started

You will need the Konect PakBus Router redemption code that came on a card with the CELL200 series.



The image shows a redemption card for Konect Data Services. At the top, the Konect logo is displayed, consisting of a blue square with a white circle and a green square, followed by the word "Konect" in a large, bold, black font. Below the logo, it says "Data Services from Campbell Scientific". Underneath, a blue italicized tagline reads "Safe, secure routing for access to your IP-connected datalogger". A green banner contains the text "Important Information! Do not discard!" in red, followed by "Activate a Complimentary PakBus® Router on Campbell Scientific's Konect PakBus Routing Service. See the Getting Started Guide at: <http://campbellsci.com/start/pbrouter>". At the bottom, there is a white rounded rectangle labeled "REDEMPTION CODE" with a blurred code.

Open a web browser and go to [www.konectgds.com](http://www.konectgds.com) .

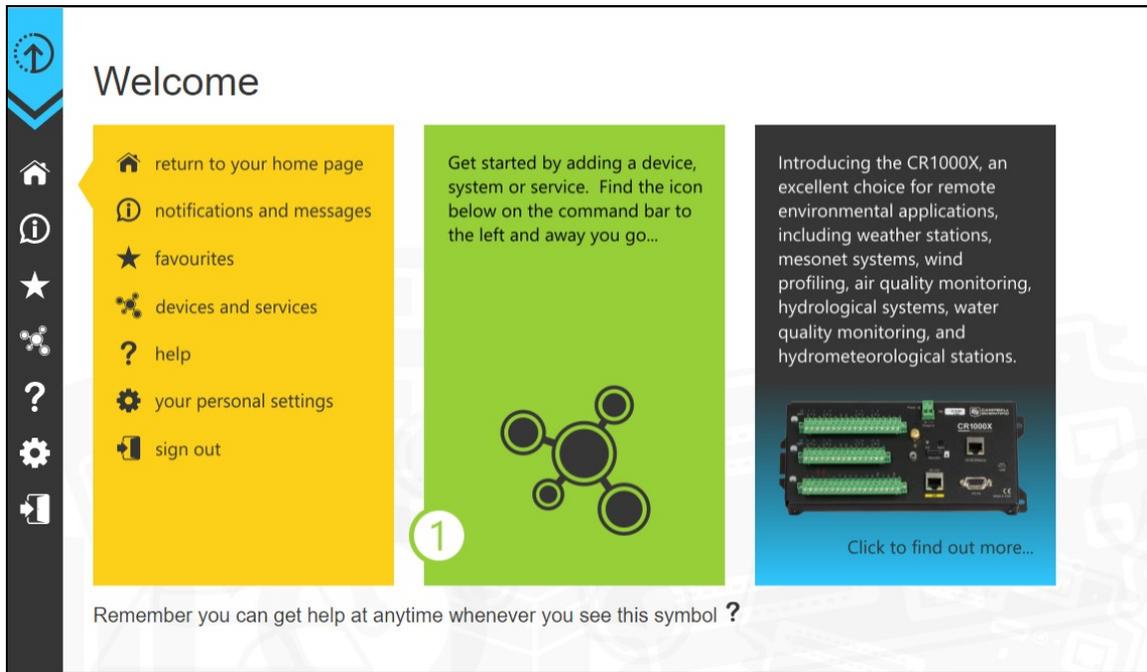
First-time users need to create a **free account**. After you submit your information, you will receive two emails up to five minutes apart. One email will contain a Passport ID and the other your Password. If emails are not received, check your email junk folder.



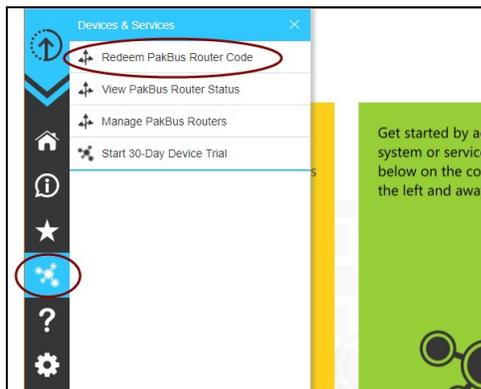
The image is a screenshot of the Konect Data Collection website. The top features the Konect logo and the text "Data Services from Campbell Scientific". Below this, the words "DATA COLLECTION" are prominently displayed in white. A progress indicator with six dots is visible, with the first dot filled. Three buttons are arranged horizontally: "LEARN MORE" with a downward arrow, "FREE ACCOUNT" with a document icon, and "SIGN IN" with a rightward arrow. At the bottom center, the Campbell Scientific logo is shown, which includes a stylized 'S' and the text "CAMPBELL SCIENTIFIC WHEN MEASUREMENTS MATTER". The background is dark with faint icons of various scientific and industrial equipment.

## 4.3.2 Set up Konect PakBus Router

1. Sign in to [www.konectgds.com](http://www.konectgds.com) using your Passport ID and Password found in the two received emails. Once logged in, you will be at the Welcome page.



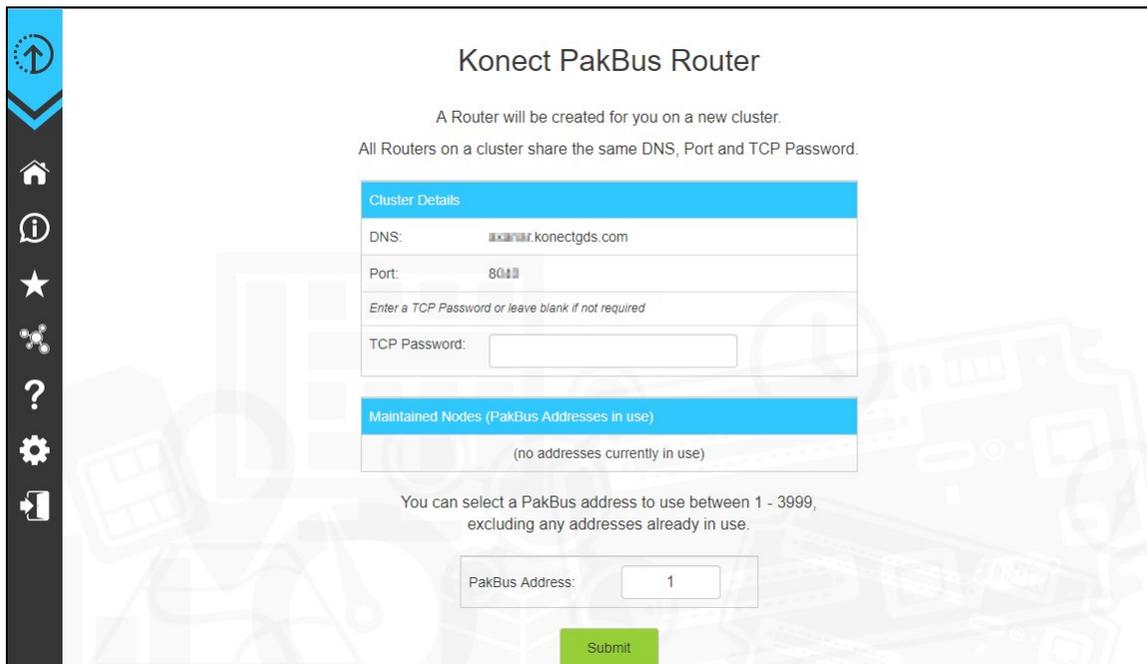
2. Click **Devices and services** on the command bar to the left and select **Redeem PakBus Router Code**. Enter your complimentary Router Code found on the included card with your cellular-enabled device and click **Submit**.



- The next screen shows the assigned **DNS** address and **Port** for the router. Enter a **TCP Password** and select a unique **PakBus Address** for your data logger.

**TIP:**

**Make note of this information;** it will be required for data logger configuration as well as LoggerNet setup. Please note your **DNS, Port, TCP Password** and **PakBus address;** you will need them later.



The screenshot shows the 'Konect PakBus Router' configuration page. At the top, it states 'A Router will be created for you on a new cluster.' and 'All Routers on a cluster share the same DNS, Port and TCP Password.' Below this is a 'Cluster Details' section with the following fields: 'DNS: konectgds.com', 'Port: 80', and 'TCP Password:'. A note below the password field says 'Enter a TCP Password or leave blank if not required'. Below the cluster details is a 'Maintained Nodes (PakBus Addresses in use)' section, which currently shows '(no addresses currently in use)'. A note below this section says 'You can select a PakBus address to use between 1 - 3999, excluding any addresses already in use.' At the bottom, there is a 'PakBus Address:' field with the value '1' and a green 'Submit' button.

- Click **Submit**.
- To edit settings at a later date, click **devices and services**  on the command bar and select **Manage PakBus Routers**.



**NOTE:**

The **DNS** address and **Port** number, assigned when your account was setup, cannot be edited.

## 5. Overview

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The CELL200-series modules may be configured in one of five ways, depending on the data logger, communications type, and needs of the user.

- **Integrated:** The module mimics the behavior of our integrated cell modems. No settings are configured directly in the module. All settings are configured in the attached data logger.
- **Non-integrated:** The module mimics the behavior of our older cellular modems. Settings must be configured in both the module and the data logger.
- **Serial Server:** In this mode, the module receives IP communications over the cellular network and converts those to serial communications to pass on to the data logger. From the perspective of the data logger, this is no different than a serial cable connecting it to a computer.

**NOTE:**

A public static IP account must be used when the module is set up in serial server mode. Private dynamic IP accounts do not support the serial server mode.

- **Serial Client:** Use this mode when the module is behind a cellular provider firewall and it has a private dynamic IP address. In serial client mode the module will connect to the cellular network and initiate a TCP client socket connection.
- **Serial Server/Client:** In serial server/client mode the module connects to the cellular network and opens a listening port. When a client connects to the listening port, the CELL200 series will be in "**Serial Server**" mode, as described earlier. When no client is connected to the listening port, the CELL200 series will be in "**Serial Client**" mode, as described earlier, and all data on the active port will be sent and received through the initiated TCP client socket connection.

Data loggers compatible with each mode are shown in the following table.

	Integrated PPP	Non-integrated PPP	Serial server <sup>2</sup>	Serial client <sup>3</sup>	Serial server/client <sup>3</sup>
GRANITE series/CR6 series/CR1000X/CR300 series <sup>1</sup>	✓		✓	✓	✓
CR1000/CR3000/CR800 series		✓	✓	✓	✓
CR200(X) series			✓	✓	✓
Array-based (Edlog) data loggers			✓	✓	✓

<sup>1</sup> Integrated PPP mode requires operating system 03.00 or later for the CR1000X, 09.00 or greater for the CR6 series, and 08.00 or later for the CR300 series.

<sup>2</sup> Serial server mode requires a public static IP account.

<sup>3</sup> Requires CELL200 series OS 2.00 or later.

**NOTE:**

PakBus data loggers include the following models: GRANITE-series, CR6, CR3000, CR1000X, CR800-series, CR300-series, CR1000, and CR200(X)-series.

## 6. QuickStart (integrated mode)

**NOTE:**

This QuickStart describes configuring the CELL200 series in integrated mode (mimicking our internal cell modems) with its default settings. It can also be configured in non integrated or serial server mode.

This QuickStart section does not apply to CR3000, CR1000 and CR800-series users. See [Overview](#) (p. 8) for more information on the different modes. See [CELL200 series and data logger configuration](#) (p. 34) for more information on configuring the module in the different modes.

The Provisioning Report received with your Cellular Data Service shows whether the module was configured with a private dynamic or public static IP address. See [FIGURE 6-1](#) (p. 10) for an example of a Campbell Scientific Provisioning Report. Other cellular providers should provide similar information.



2. Connect your data logger RS-232 or CS I/O port to the CELL200-series module RS-232 or CS I/O port. Ensure the same port is used for each device, for example RS-232 to RS-232. See [Wiring and connections](#) (p. 28).
3. If not connecting through CS I/O, provide power to the CELL200 series. The data logger provides power through the CS I/O port. USB power is not sufficient to power the CELL200 series; 12 V is required.

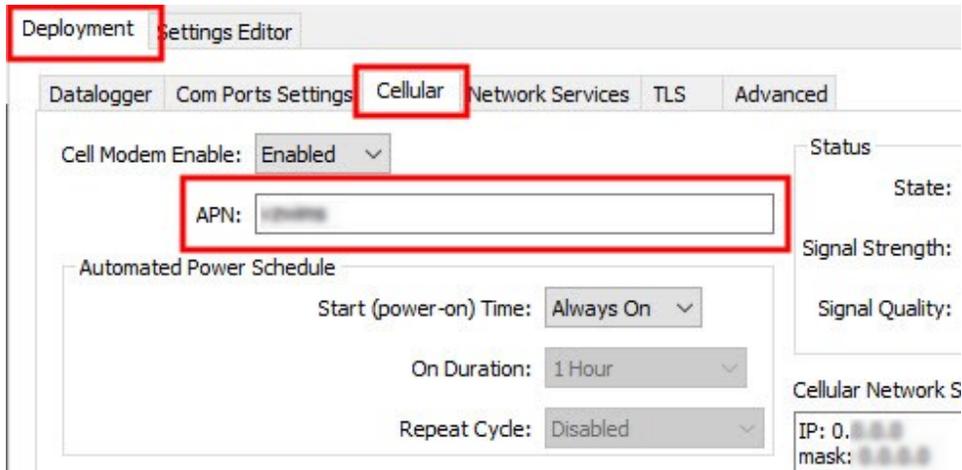
## 6.1.2 Configure data logger

1. Connect to your data logger by using Device Configuration Utility.
2. On the **Datalogger** tab, change the data logger **PakBus Address** and **PakBus/TCP Password** to match the values entered in the Konect PakBus Router setup. The **PakBus/TCP Password** will make the data logger authenticate any incoming or outgoing PakBus/TCP connection.

The screenshot shows the 'Deployment' utility window with the 'Datalogger' tab selected. The 'PakBus Address' dropdown is set to '1'. The 'PakBus Security' section includes three 'Security Code' dropdowns (all set to '0'), 'PakBus Encryption Key' and 'PakBus Encryption Key Confirm' text boxes, and 'PakBus/TCP Password' and 'Confirm PakBus/TCP Password' text boxes with masked characters. Red boxes highlight the 'Datalogger' tab, the 'PakBus Address' dropdown, and the password fields.

3. On the **Network Services** tab in the **PakBus/TCP Client** field, enter the DNS address and Port number noted during the Konect PakBus Router setup.
4. On the **PPP** tab, set **Config/Port Used** to **CS I/O SDC8** or **RS-232**, depending on how you are connected to the data logger.
5. (Optional) On the **PPP** tab, set **User Name** and **Password** if required by your cellular carrier (usually outside of the United States).
6. Verify the **Modem Dial String** setting is blank.
7. If connecting through RS-232, on the **Comport Settings** tab, set **RS232 BaudRate** to **115200 Fixed**.

- Click **Apply** to save the changes. Verify the settings in the summary window. (Recommended) **Save** a copy of the settings to a file on the computer. Click **OK**.
- Shut down Device Configuration Utility and start it again. This will activate the **Cellular** tab needed for the next step.
- On the **Cellular** tab, enter the **APN** provided by your cellular provider.



- Click **Apply** to save the changes. Verify the settings in the summary window. (Recommended) **Save** a copy of the settings to a file on the computer. Click **OK**.
- Click **Connect** to reconnect in the Device Configuration Utility.
- (Optional) By default, the CELL200 series will accept incoming communications from any IP address. This can be a security risk. You may specify up to four IP addresses, with wild cards, to limit connections to only those trusted sources. Use an asterisk (\*) as a wild card. For example, a setting of 166.22.\*.\* would allow connections from devices that have IP addresses starting with 166.22. Both IPv4 and IPv6 addresses are supported.

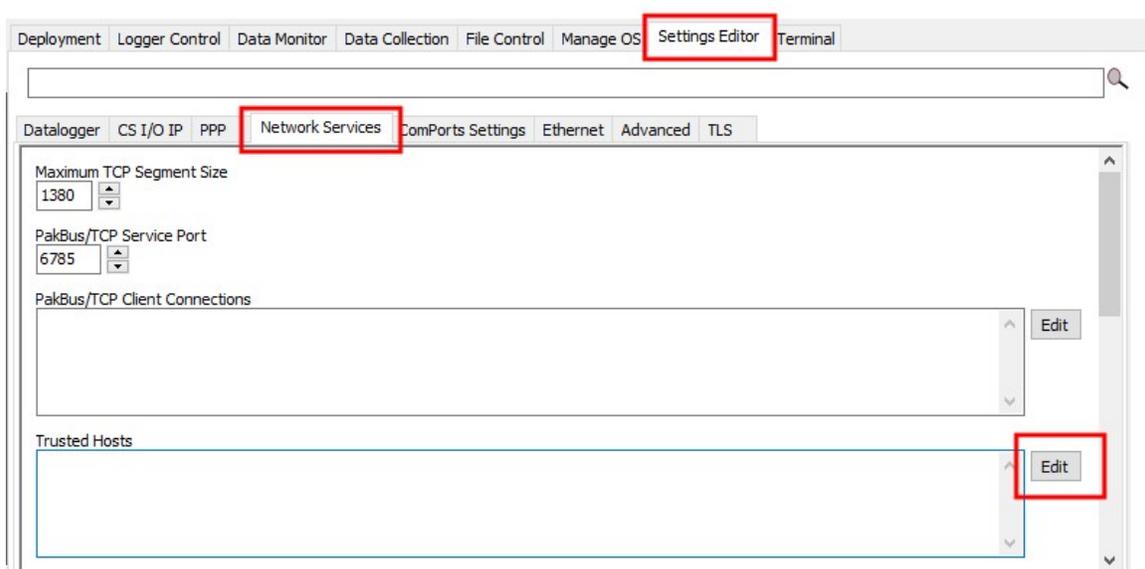
**CAUTION:**

Only set a Trusted IP address if you are familiar with their use. Consult your IT department or Campbell Scientific for assistance.

**NOTE:**

This setting does not affect outbound connections, only incoming connections.

In the **Settings Editor > Network Services** tab, next to the **Trusted Hosts** field, click **Edit** and **Add** your trusted IP addresses, one at a time.



14. Click **Apply** to save the changes. Verify the settings in the summary window. (Recommended) **Save** a copy of the settings to a file on the computer. Click **OK**.
15. Click **Disconnect** and close Device Configuration Utility.

## 6.1.3 Set up LoggerNet

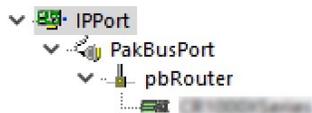
The LoggerNet Network Map is configured from the **LoggerNet Setup** screen.

### NOTE:

Setup has two options, EZ (simplified) and Standard. Click on the **View** menu at the top of the **Setup** screen, and select **Standard** view.

From the LoggerNet toolbar, click **Main > Setup** and configure the Network Map as described in the following steps:

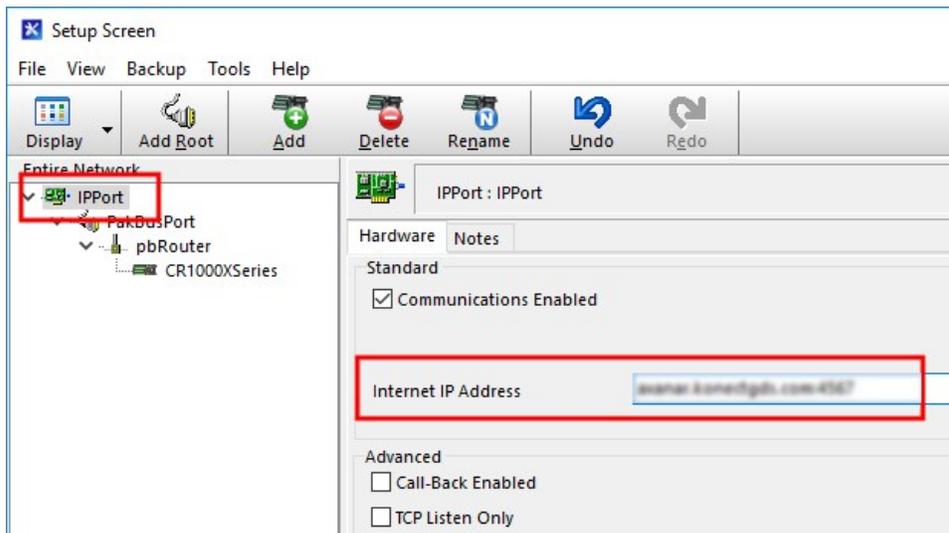
1. Select **Add Root > IPPort**.
2. Select **PakBusPort** and **pbRouter** for PakBus data loggers such as the CR6 or CR1000X.



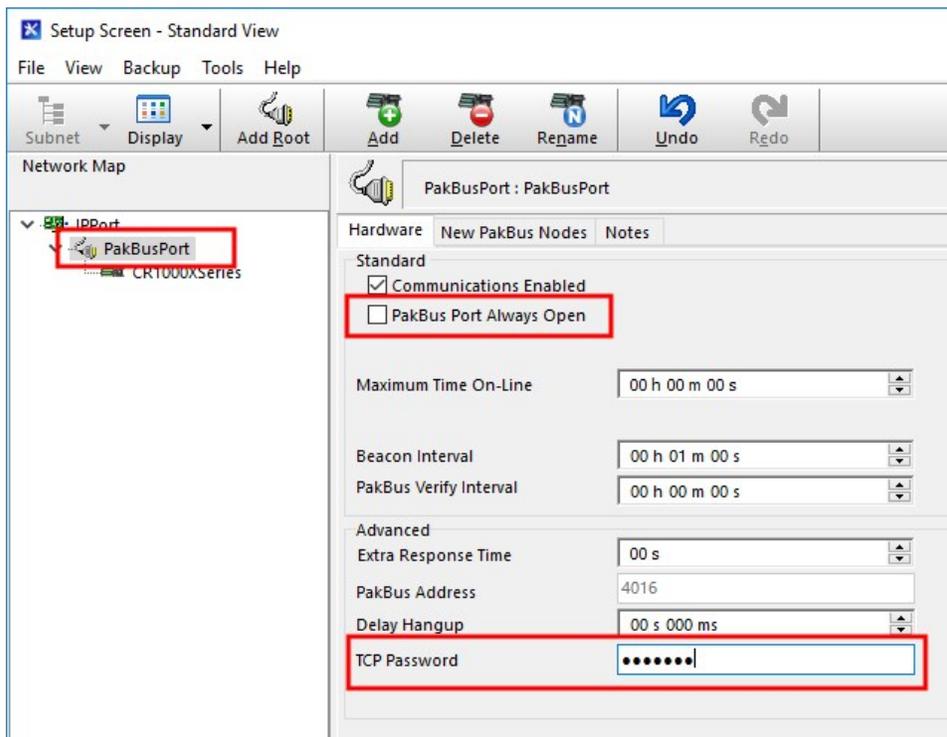
**NOTE:**

PakBus data loggers include the following models: GRANITE-series, CR6, CR3000, CR1000X, CR800-series, CR300-series, CR1000, and CR200(X)-series.

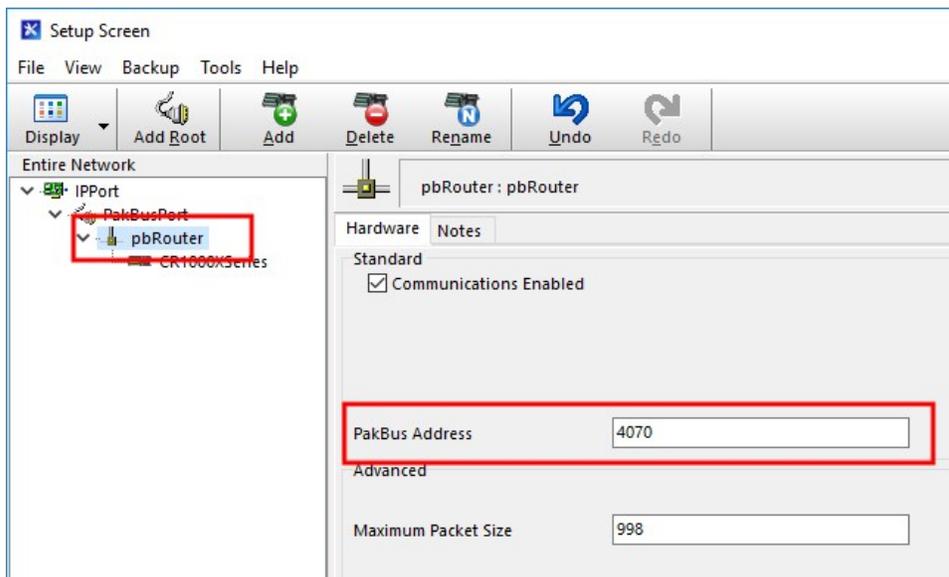
3. Add a data logger to the **pbRouter**.
4. From the Entire Network, on the left side, select the **IPPort**. Enter the Konect PakBus Router DNS address and port number as noted in the Konect PakBus Router setup ([Set up Konect PakBus Router](#) (p. 6)). Enter them into the **Internet IP Address** field in the format DNS:Port with a colon separating DNS and Port. For example, axanar.konectgds.com:pppp where pppp is the port number.



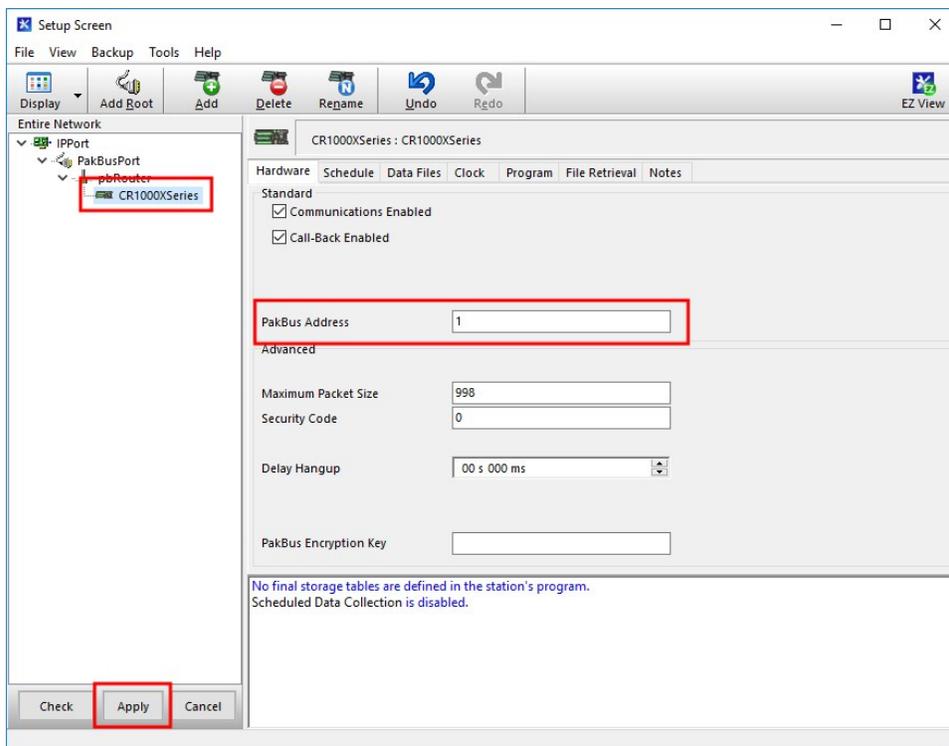
5. Leave the default settings for the **PakBusPort**. **PakBus Port Always Open** should **not** be checked. In the **TCP Password** field enter the TCP Password; this must match the value entered in the Konect PakBus Router setup and LoggerNet setup.



- For PakBus data loggers, select the pbRouter in the Network Map and set the **PakBus Address** to 4070.



- For PakBus data loggers, select the data logger in the Network Map and set the **PakBus Address** to match that of the data logger (default address in the data logger is 1). If a **PakBus Encryption Key** was entered during data logger setup, also enter it here. Click **Apply** to save the changes.



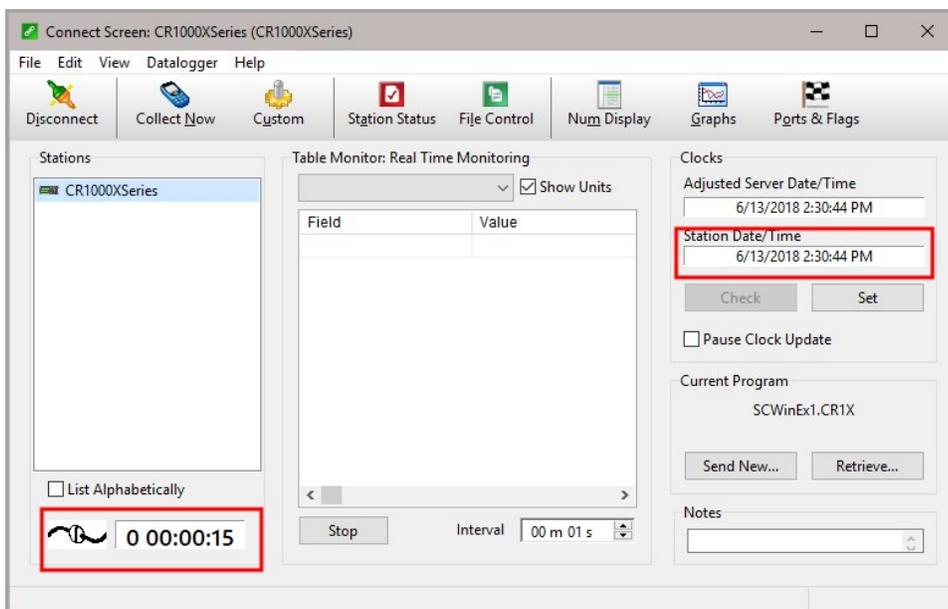
## 6.1.4 Test the connection

After the Network Map has been configured, test the cellular connection by using the **Connect** screen as shown in the following image. Click on the appropriate station and click **Connect** to initiate a call to the data logger.

### TIP:

The connection time is subject to many external factors. It is often less than 30 seconds but could be up to 15 minutes. Be patient.

If the connection is successful, the connectors icon at the bottom of the screen will come together and clock information from the data logger will be displayed in the **Station Date/Time** field. If the connection fails, a **Communications Failure** message will be displayed.



## 6.2 Modules using a public static IP

### 6.2.1 Set up hardware

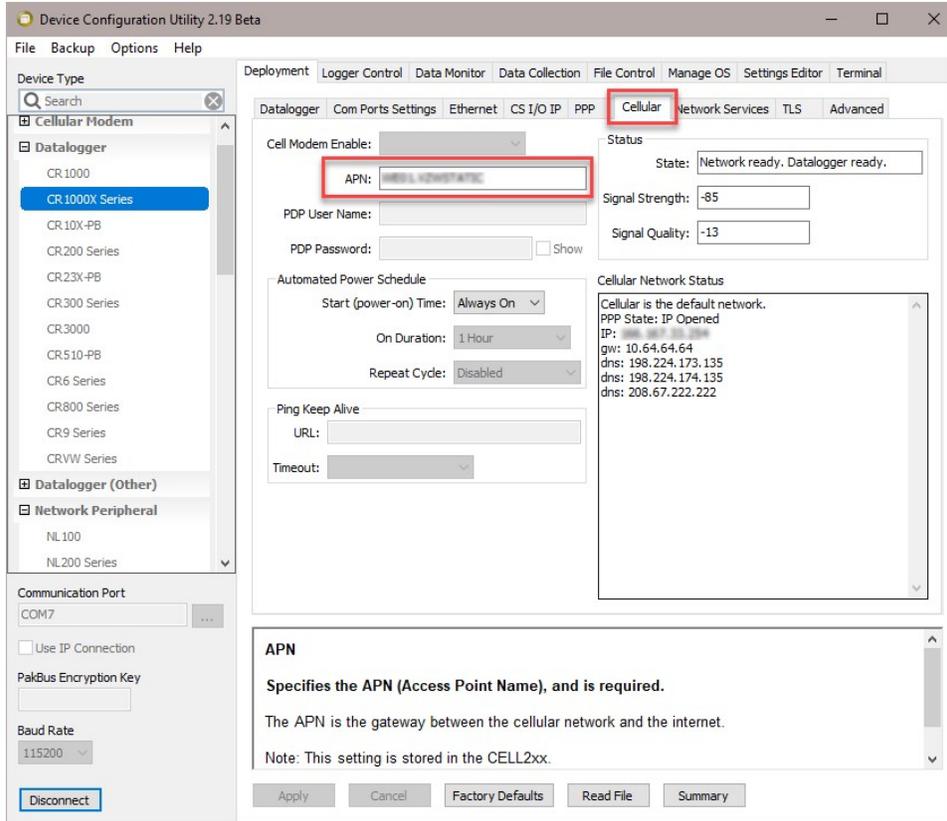
1. Connect the cellular antenna, if it is not already connected. When using a MIMO antenna with multiple cellular connections, connect the primary cable to **Cellular** and the secondary to **Diversity**. If the cables are not marked in this way, they can be connected to either antenna port.

2. Connect your data logger RS-232 or CS I/O port to the CELL200-series module RS-232 or CS I/O port. Ensure the same port is used for each device, for example RS-232 to RS-232. See [Wiring and connections](#) (p. 28).
3. If not connecting through CS I/O, provide power to the CELL200 series. The data logger provides power through the CS I/O port. USB power is not sufficient to power the CELL200 series; 12 V is required.

## 6.2.2 Configure data logger

1. Connect to your data logger by using Device Configuration Utility.
2. On the **PPP** tab, set **Config/Port Used** to **CS I/O SDC8** or **RS-232**, depending on how you are connected to the data logger.
3. (Optional) On the **PPP** tab, set **User Name** and **Password** if required by your cellular carrier (usually outside of the United States).
4. Verify the **Modem Dial String** setting is blank.
5. If connecting through RS-232, on the **Comport Settings** tab, set **RS232 BaudRate** to **115200 Fixed**.

6. On the **Cellular** tab, enter the **APN** provided by your cellular provider.



7. (Optional) By default, the CELL200 series will accept incoming communications from any IP address. This can be a security risk. You may specify up to four IP addresses, with wild cards, to limit connections to only those trusted sources. Use an asterisk (\*) as a wild card. For example, a setting of 166.22.\*.\* would allow connections from devices that have IP addresses starting with 166.22. Both IPv4 and IPv6 addresses are supported.

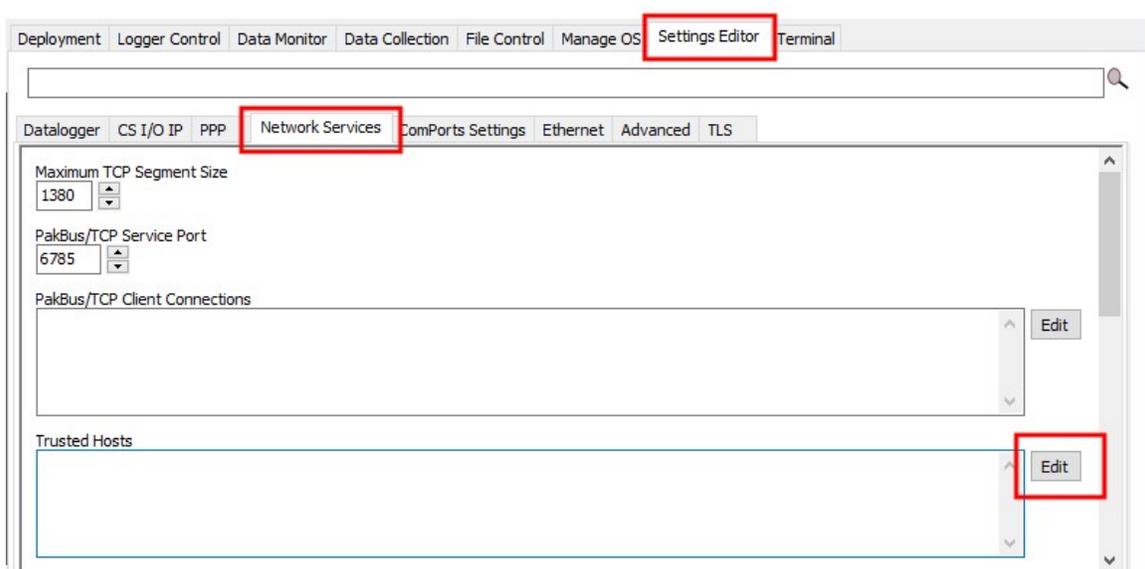
**CAUTION:**

Only set a Trusted IP address if you are familiar with their use. Consult your IT department or Campbell Scientific for assistance.

**NOTE:**

This setting does not affect outbound connections, only incoming connections.

In the Device Configuration Utility go to the **Settings Editor** then **Network Services**. Next to the **Trusted Hosts** field, click **Edit** and **Add** your trusted IP addresses, one at a time.



8. Click **Apply** to save the changes.

## 6.2.3 Set up LoggerNet

The LoggerNet Network Map is configured from the **LoggerNet Setup** screen.

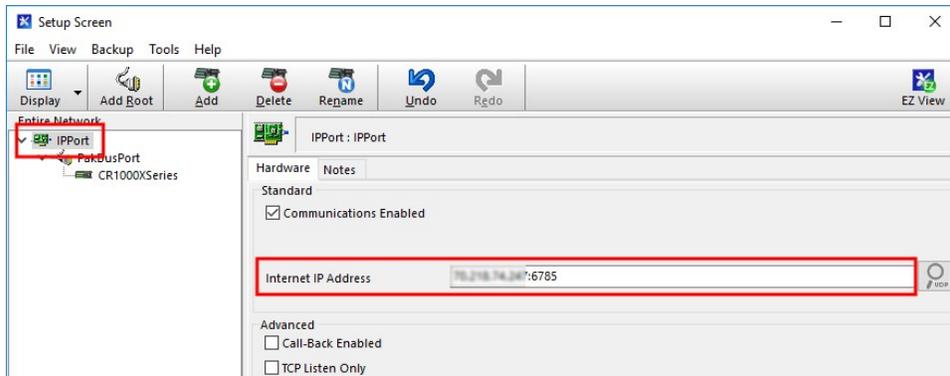
### NOTE:

Setup has two options, EZ (simplified) and Standard. Click on the **View** menu at the top of the **Setup** screen, and select **Standard** view.

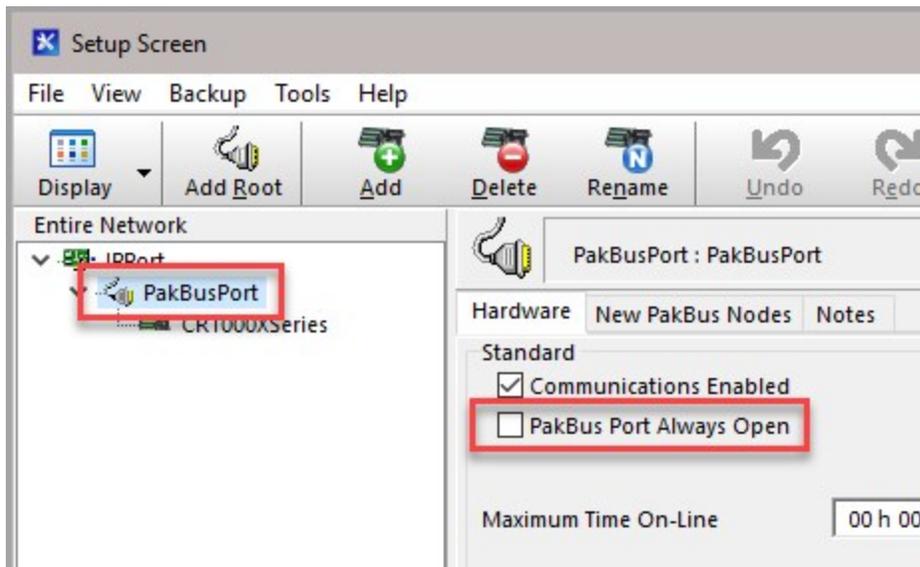
From the LoggerNet toolbar, click **Main > Setup** and configure the Network Map as described in the following steps:

1. Select **Add Root > IPPort**.
2. Select **PakBusPort**.
3. Add a data logger to the **PakBusPort**.

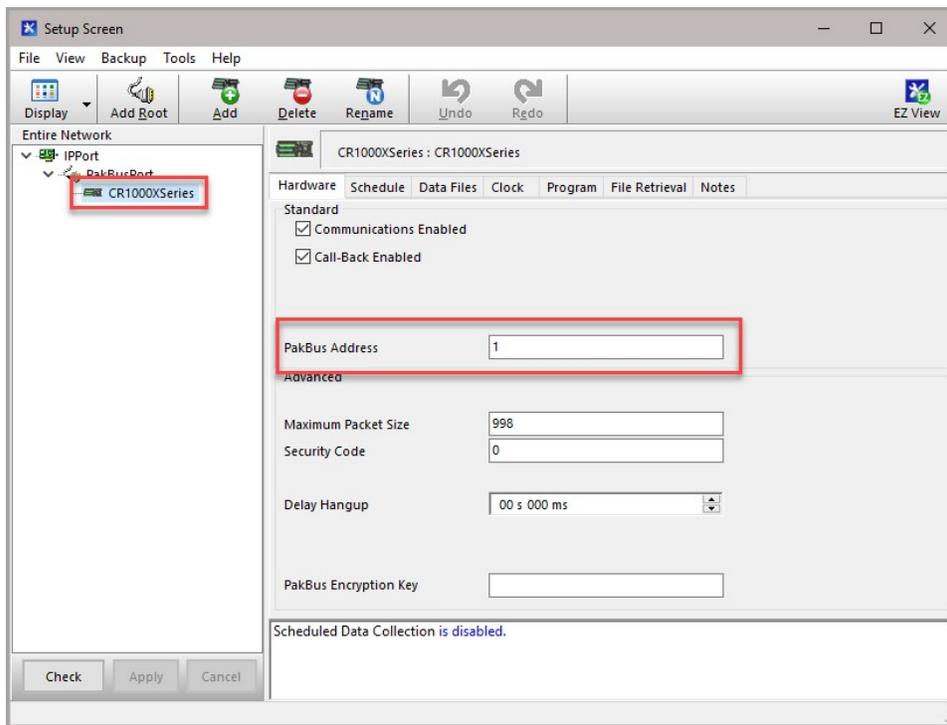
4. Select the **IPPort** in the Network Map. Enter the CELL200 series IP address and port number. The IP address and port number are input in the **Internet IP Address** field separated by a colon. Preceding zeros are not entered in the **Internet IP Address** (for example, 070.218.074.247 is entered as 70.218.74.247). The default port number is 6785.



5. For PakBus data loggers, leave the default settings for the **PakBusPort**. **PakBus Port Always Open** should **not** be checked. If a **TCP Password** is used, enter it.



- For PakBus data loggers, select the data logger in the Network Map and set the **PakBus Address** to match that of the data logger (default address in the data logger is 1). If a **PakBus Encryption Key** was entered during data logger setup, also enter it here. Click **Apply** to save the changes.



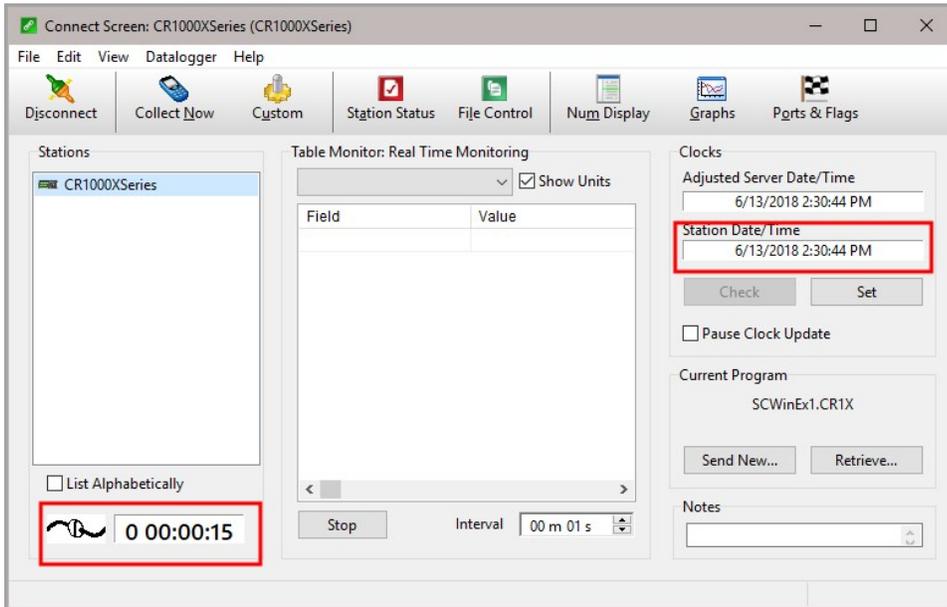
## 6.2.4 Test the connection

After the Network Map has been configured, test the cellular connection by using the **Connect** screen as shown in the following image. Click on the appropriate station and click **Connect** to initiate a call to the data logger.

### TIP:

The connection time is subject to many external factors. It is often less than 30 seconds but could be up to 15 minutes. Be patient.

If the connection is successful, the connectors icon at the bottom of the screen will come together and clock information from the data logger will be displayed in the **Station Date/Time** field. If the connection fails, a **Communications Failure** message will be displayed.



## 7. Specifications

### Data Logger Compatibility

The CELL200 series is compatible with the GRANITE-series, CR6, CR3000, CR1000X, CR800-series, CR300-series, CR1000, CR200(X) series, CR5000, CR10X, CR10X-PB, CR510, CR510-PB, CR23X, and CR23X-PB. See [Module communications connections](#) (p. 28) for information on communications options with each data logger model.

### Cellular WAN

See [https://s.campbellsci.com/documents/us/miscellaneous/Cellular Modem Frequency Bands.pdf](https://s.campbellsci.com/documents/us/miscellaneous/Cellular%20Modem%20Frequency%20Bands.pdf) for a complete list of supported frequency bands.

### Host Interfaces

- CS I/O communications port, DB9 male
- RS-232 serial port, DB9 female
- USB version 2.0 with micro-B connector

## RF Connectors

- 2 SMA antenna connectors (primary and diversity)

## Power

- Operating Voltage: 10 to 30 VDC
- Low Power Mode: 300  $\mu$ A
- Typical Idle: 14 mA @ 12 VDC
- Typical Active: 39 mA @ 12 VDC (CELL205, CELL215, CELL220, CELL225)  
25 mA @ 12 VDC (CELL210)

## Size

- Dimensions: 13.46 X 8.1 X 2.86 cm (5.3 X 3.19 X 1.13 in)
- Weight: 215.5 g (7.6 oz)

## Environmental

- Operating Temperature Range:  $-40$  to  $80$   $^{\circ}$ C
- Storage Temperature:  $-45$  to  $80$   $^{\circ}$ C
- Humidity: 10 to 90%

## Industry Certifications

- Environmental: RoHS

## SIM (Subscriber Identity Module) card interface

- Micro-SIM (3FF) (6 position / contacts)
- Supports SIMs that require 1.8 or 3 VDC

## Data Speeds

- LTE: Max 10 Mbps (download) / Max 5 Mbps (upload)
- WCDMA: Max 384 Kbps (download) / Max 384 Kbps (upload)
- GSM
  - EDGE: Max 296 Kbps (download) / Max 236.8 Kbps (upload)
  - GPRS: Max 107 Kbps (download) / Max 85.6 Kbps (upload)

## Compliance

- Industry Canada (IC): 10224A-201611EC21A
- View Declaration of Conformity at:  
[www.campbellsci.com/cell205](http://www.campbellsci.com/cell205)   
[www.campbellsci.com/cell210](http://www.campbellsci.com/cell210)   
[www.campbellsci.com/cell215](http://www.campbellsci.com/cell215)   
[www.campbellsci.com/cell220](http://www.campbellsci.com/cell220)   
[www.campbellsci.com/cell225](http://www.campbellsci.com/cell225) 

# 8. Installation

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## 8.1 Base station requirements

A computer running Campbell Scientific LoggerNet software with access to the Internet is needed.

## 8.2 Data logger site equipment

- CELL200-series module with power cable (included with module)
- Data logger — GRANITE series, CR6 series, CR3000, CR1000X series, CR300 series, CR1000, CR800 series, and CR5000
- Module Interface, see [Module communications connections](#) (p. 28)
- Environmental Enclosure — ENC10/12, ENC12/14, ENC14/16 or ENC16/18

### If connecting to CS I/O port:

SC12 cable (preferred for GRANITE series, CR6 series, CR3000, CR1000X series, CR1000, CR800 series, and CR5000 data loggers) — connects the module to current data logger with a **CS I/O** port. See [CS I/O connection](#) (p. 30)

SC105 Interface — connects the module to any data logger with a **CS I/O** port. It must be configured using Device Configuration Utility. Settings should be:

- CS I/O Mode: SDC Address 8
- CS I/O ME Baud Rate: 115.2k
- RS-232 Mode: Modem (default)
- Baud Rate:
  - 115.2k fixed for GRANITE series, CR6 series, CR3000, CR1000X series, CR1000, CR800 series, and CR5000 data loggers
  - 9600 for CR10X, CR10X-PB, CR510, CR510-PB, CR23X, and CR23X-PB data loggers
- 8 data bits, 1 stop bit, no parity

### If connecting to RS-232 port:

Null Modem Cable (9 pin, male-to-male) — connects the module to the CR300 series, CR1000, CR3000, CR800 series, and CR200(X) series **RS-232** port.

CPI/RS-232 RJ45 to DB9 Cable — connects the module to the CR6 series or CR1000X series **CPI/RS-232** port.

- Antenna — the following antennas are available from Campbell Scientific. Contact Campbell Scientific for help in determining the best antennas for your application.
  - 2 dBd 4G/3G Omnidirectional Antenna: An omnidirectional antenna with mounting bracket that is ideally suited for use with 4G and 3G cellular gateways. The mounting bracket attaches to a mast or crossarm, and it serves as the antenna ground plane. The antenna has an N type (female) threaded permanent stud for easy mounting to the included bracket or through an enclosure wall. A coaxial cable, sold separately, is required to connect this antenna to the inline surge suppression or module antenna

jack. The antenna includes a mount/U-bolt assembly for attaching the antenna to a mast, post, or crossarm up to 3.8 cm (1.5 in) in diameter.



- The 38485 antenna is a wideband, dual-port, directional-panel antenna with slant 45 polarization that covers US LTE700/Cellular/PCS/AWS/MDS and global GSM900/GSM1800/UMTS/LTE2600 bands. The antenna is designed for fixed installations and is ideal for both indoor and outdoor applications. It includes a UV-stable enclosure that provides years of use without degradation to either mechanical properties or aesthetics. It also includes a mount assembly that secures the antenna to a mast or pole using hose clamps and mast mount adapter. The antenna can also be directly mounted on a wall.



- 8 dBd Yagi Wideband Antenna: A higher gain antenna that should be “aimed” at the service provider antenna. It covers both the 800-MHz band and the 1.9-GHz band. The antenna comes with bracket/U-bolt assembly for attaching the antenna to a mast or post. A coaxial cable, sold separately, is required to connect this antenna to the inline surge suppression or module antenna jack. This antenna is recommended for areas that require a higher gain antenna.



- 4G/3G Cellular Whip Antenna with SMA Connector: A wideband termination antenna with SMA connector and articulating base. This antenna is intended for short-term testing use only. It is not intended for long-term use. Campbell Scientific recommends that customers use external antennas for the best reception and transmission of cellular signals.

**NOTE:**

When antennas are located away from the CELL200 series, keep the cables as short as possible to prevent the loss of antenna gain. Route the cables to protect them from damage and so they will not be snagged or pulled on. Avoid binding or sharp corners in the cable routing. Bundle and tie off excess cable. Make sure the cables are secured so their weight will not loosen the connector from the CELL200 series over time.

**TIP:**

Cellular phone apps, such as OpenSignal (<https://opensignal.com/> ) , show the direction to point an antenna to get the best signal strength.

## 8.3 Wiring and connections

This section explains how to connect the module for different communications methods. It also describes how to power the module and connect an antenna.

### 8.3.1 Module communications connections

The following table shows communications options for each Campbell Scientific data logger model.

**Table 8-1: CELL200 series data logger compatibility chart**

Data logger model	Connecting to CELL200 series via its CS I/O port	Connecting to CELL200 series via its RS- 232 port
CR300	N/A	RS-232 null modem cable, or C-port to RS-232 cable (PPP or serial server)
CR310	N/A	RS-232 null modem cable, or C-port to RS-232 cable (PPP or serial server)
GRANITE 6 CR6	SC12 CS I/O cable (PPP and serial server)	CPI/RS-232 cable, or C- or U-port to RS-232 cable, or SC105 CS I/O to RS-232 interface
GRANITE 10/9 CR1000X	SC12 CS I/O cable (PPP and serial server)	CPI/RS-232 cable, or C-port to RS-232 cable, or SC105 CS I/O to RS-232 interface
CR200(X)	N/A	RS-232 null modem cable (serial server only)
CR800	SC12 CS I/O cable (PPP and serial server)	RS-232 null modem cable (PPP or serial server), or C-port to RS-232 cable, or SC105 CS I/O to RS-232 interface
CR1000	SC12 CS I/O cable (PPP and serial server)	RS-232 null modem cable (PPP or serial server), or C-port to RS-232 cable, or SC105 CS I/O to RS-232 interface
CR3000	SC12 CS I/O cable (PPP and serial server)	RS-232 null modem cable (PPP or serial server), or C-port to RS-232 cable, or SC105 CS I/O to RS-232 interface
CR5000	N/A	RS-232 null modem cable (serial server only)
CR510 and CR10X	N/A	SC105 CS I/O to RS-232 interface

Table 8-1: CELL200 series data logger compatibility chart		
Data logger model	Connecting to CELL200 series via its CS I/O port	Connecting to CELL200 series via its RS-232 port
CR510-PB and CR10X-PB	SC12 CS I/O cable (serial server only) (SDC7 and SDC8 only)	SC105 CS I/O to RS-232 interface
CR23X	N/A	RS-232 null modem cable (serial server only), or SC105 CS I/O to RS-232 interface
CR23X-PB	SC12 CS I/O cable (serial server only) (SDC7 and SDC8 only)	RS-232 null modem cable (serial server only), or SC105 CS I/O to RS-232 interface

FIGURE 8-1 (p. 30), FIGURE 8-2 (p. 31), and FIGURE 8-3 (p. 31) illustrate the most common communications connections between a data logger and a CELL200 series.

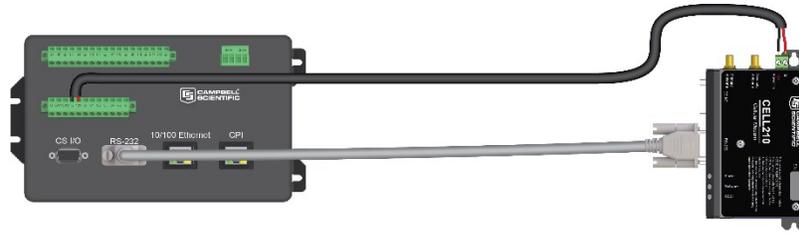
#### CS I/O connection using an SC12 cable



The SC12 is used to connect the module to a data logger CS I/O port.

FIGURE 8-1. CS I/O connection

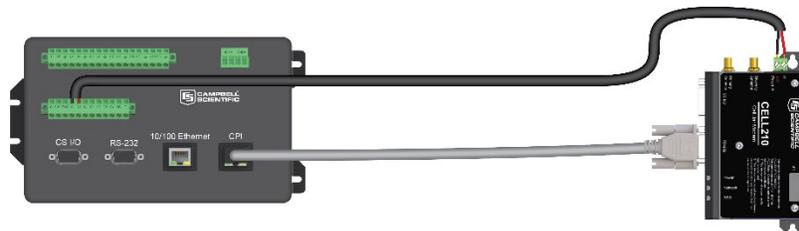
### RS-232 connection using a null modem cable



Null Modem Cable is used to connect the module to the CR3000, CR800, CR2XX, CR300 series, or CR1000 **RS-232** port. Power is provided from the **12V** or **SW12V** port of the data logger.

*FIGURE 8-2. RS-232 connection*

### CR1000X or CR6 RS-232 connection using a CPI/RS-232 cable



RS-232/CPI RJ45 to DB9 Male DTE is used to connect the module to the CR6 or CR1000X. Power is provided from the **12V** or **SW12V** port of the data logger.

*FIGURE 8-3. CR6/CR1000X RS-232 connection*

## 8.3.2 Module power connections

When connecting through the **CS I/O port**, power for the module is provided by the data logger. When connecting through the **RS-232** port, power must be supplied through the **Power In** connector.

[Controlling power to the CELL200 series](#) (p. 61) provides an example CRBasic program using the **IPNetPower()** instruction to control power to the CELL200 series. This functionality is available in the CR300 series (all operating systems), the CR6 series with operating system 09.00 or greater, and the CR1000X with operating system 03.00 or greater. To control power in these data loggers with older operating systems or any CR1000, CR800 series, or CR3000, you will need to use a **SW12V** port on the data logger and communicate over RS-232.

Alternatively, GRANITE series, CR6 series, CR3000, CR1000X series, CR300 series, CR1000, CR800 series, and CR5000 can use terminal commands to control power. Downloadable example programs are available at [www.campbellsci.com/downloads/cell200-example-programs](http://www.campbellsci.com/downloads/cell200-example-programs). Search for "**deep sleep**" and "**wakeup**" in the **CELL2XX-Settings** program.

CR1000, CR800 series, and CR3000 CRBasic programs require **PPPClose** before the "deep sleep" command and **PPPOpen** before the "wakeUp" command.

The **USB** port provides power for module configuration, but is not sufficient for normal operation.

### 8.3.3 Antenna connections

Use of a diversity antenna can improve system performance. It is required in 4G networks, but not 2G or 3G.



FIGURE 8-4. Antenna connections

1. Connect the cellular antenna to the **Primary Antenna** connector. Mount the cellular antenna so there is at least 20 cm between the antenna and the user or any bystander.
2. Connect a second antenna, if used, to the **Diversity Antenna** connector.

Antenna diversity, also called space diversity, is a scheme that uses two or more antennas to improve the quality and reliability of a wireless link. Often, especially in urban and indoor environments, there is no clear line of sight between transmitter and receiver. Instead, the signal is reflected along multiple paths before finally being received. Each bounce can introduce phase shifts, time delays, attenuations, and distortions that can destructively interfere with one another at the aperture of the receiving antenna. Diversity-antenna-capable devices support multiple antennas (usually two) in order to combat this phenomenon and minimize its effects.

Diversity antennas are not required for 2G/3G connections; however, they are highly recommended in order to get the most reliable connection, especially in areas of low coverage. Identical or very similar antennas should also be used for the best results.

For 4G networks, the second antenna operates as a MIMO (multiple input, multiple output) antenna, providing a second receive path. This connection is required for operation on 4G/LTE networks.

Service	Frequency (MHz)	Wavelength ( $\lambda$ ) (mm)	Best antenna separation (mm) ( $1/2 \lambda$ )	Good antenna separation (mm) ( $1/4 \lambda$ )
LTE	700	428	214	107
LTE	800	375	187	94
LTE	900	333	167	83
LTE	1800	167	83	42
LTE	2100	143	71	36
LTE	2600	115	58	29
WCDMA	850	353	176	88
WCDMA	900	333	167	83
WCDMA	1900	158	79	39
WCDMA	2100	143	71	36
CDMA/EV-DO	800	375	187	94
CDMA/EV-DO	1900	158	79	39
GSM/GPRS/EDGE	850	353	176	88
GSM/GPRS/EDGE	900	333	167	83
GSM/GPRS/EDGE	1800	167	83	42
GSM/GPRS/EDGE	1900	158	79	39

**WARNING:**

Antenna may not exceed the maximum gain specified in [RF exposure](#) (p. 81).

In more complex installations, such as those requiring long cable lengths or multiple connections, you must follow the maximum dBi gain guidelines specified by the radio communications

regulations of the Federal Communications Commission (FCC), Industry Canada, ACMA in Australia, or your country's regulatory body.

## 8.4 CELL200 series and data logger configuration

### NOTE:

Instructions in this section assume that the steps in [Pre-installation](#) (p. 2) have been completed. Cellular service must be setup before web access using [cell.linktodevice.com](http://cell.linktodevice.com)  is available.

Select the installation option that best suits your application. The [Overview](#) (p. 8) section describes the differences.

<a href="#">8.4.1 Integrated mode option</a> .....	34
<a href="#">8.4.2 Non-integrated mode option</a> .....	34
<a href="#">8.4.3 Serial server mode option</a> .....	40
<a href="#">8.4.4 Serial client mode option</a> .....	46
<a href="#">8.4.5 Serial server/client mode option</a> .....	52

### 8.4.1 Integrated mode option

[QuickStart \(integrated mode\)](#) (p. 9) describes setting up the CELL200 series in integrated mode with its default settings.

If the module is not in its default settings, the settings in the CELL200 series must match those in the data logger for integrated mode to work. This includes the **SDC Address** for CS I/O communications or the **RS-232 Baud Rate** for RS 232 communications. Once these settings match, all other configuration changes can be done in the data logger as described in [QuickStart \(integrated mode\)](#) (p. 9).

See [Non-integrated mode option](#) (p. 34) for information on changing these settings in the CELL200 series and data logger.

### 8.4.2 Non-integrated mode option

In non-integrated mode, the module mimics the behavior of our older cellular modems. This mode should be used when doing a direct replacement of a Raven or an RV50 modem.

**NOTE:**

This section only applies to CR3000, CR1000 and CR800-series users.

### 8.4.2.1 Configure CELL200 series

1. Connect a USB cable between your module and computer.
2. Connect the cellular antenna, if it is not already connected. When using a MIMO antenna with multiple cellular connections, connect the primary cable to **Cellular** and the secondary to **Diversity**. If the cables are not marked in this way, they can be connected to either antenna port. See [Antenna connections](#) (p. 32).
3. Open a web browser and go to: [cell.linktodevice.com](http://cell.linktodevice.com) .

**TIP:**

If this doesn't work browse to 192.168.86.1.

4. On the **Settings** tab, enter the **APN** provided by your cellular provider.
5. If you will be connecting through CS I/O, select the desired **SDC Address**.
6. If you will be connecting through RS-232, select the desired **RS232 Baud Rate**.

### 8.4.2.2 Configure data logger

1. Connect to your data logger using Device Configuration Utility.
2. If using the Konect PakBus Router:
  - a. On the **Datalogger** tab, change the data logger **PakBus Address** and optional **PakBus/TCP Password** to match the values entered in the Konect PakBus Router setup.
  - b. On the **Network Services** tab in the **PakBus/TCP Client** field, enter the DNS address and Port number noted during the Konect PakBus Router setup.
3. On the **PPP** tab, set **Config/Port Used** to the CS I/O SDC address selected in the module or RS-232 depending on how you will be connected to the data logger.
4. Verify the **Modem Dial String** setting is blank.
5. (Optional) If using CS I/O communications, the throughput can be enhanced by changing the SDC Baud Rate from 115200 to 460800. On the **Advanced** tab, set the **SDC Baud Rate** to 460800. Note that if there are other devices on the **CS I/O** port, they all must be able to support this higher baud rate.

### 8.4.2.3 Set up hardware

1. Connect the cellular antenna, if it is not already connected. When using a MIMO antenna with multiple cellular connections, connect the primary cable to **Cellular** and the secondary to **Diversity**. If the cables are not marked in this way, they can be connected to either antenna port.
2. Connect your data logger RS-232 or CS I/O port to the CELL200-series module RS-232 or CS I/O port. Ensure the same port is used for each device, for example RS-232 to RS-232. See [Wiring and connections](#) (p. 28).
3. If not connecting through CS I/O, provide power to the CELL200 series. The data logger provides power through the CS I/O port. USB power is not sufficient to power the CELL200 series; 12 V is required.

### 8.4.2.4 Set up LoggerNet

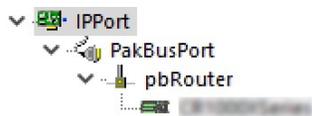
The LoggerNet Network Map is configured from the **LoggerNet Setup** screen.

**NOTE:**

Setup has two options, EZ (simplified) and Standard. Click on the **View** menu at the top of the **Setup** screen, and select **Standard** view.

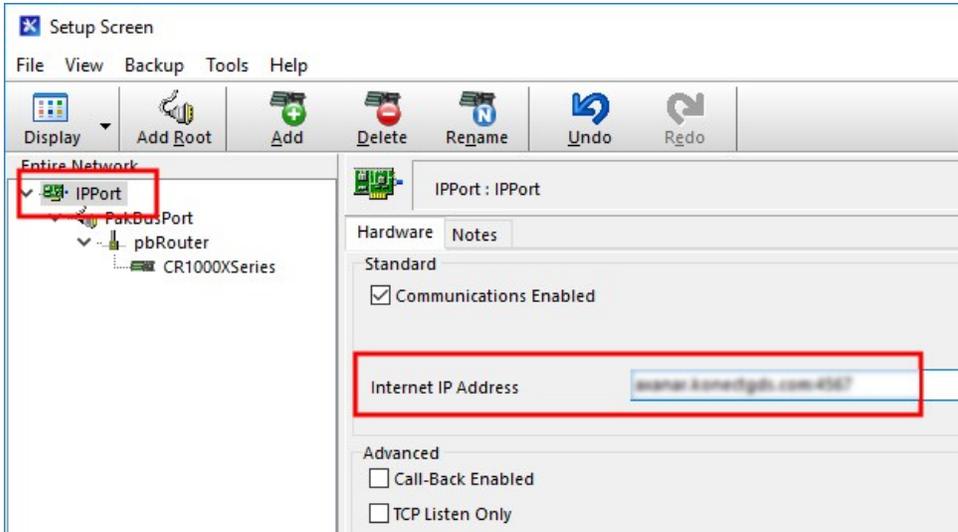
From the LoggerNet toolbar, click **Main > Setup** and configure the Network Map as described in the following steps:

1. Select **Add Root > IPPort**.
2. Select **PakBusPort** and **pbRouter**.

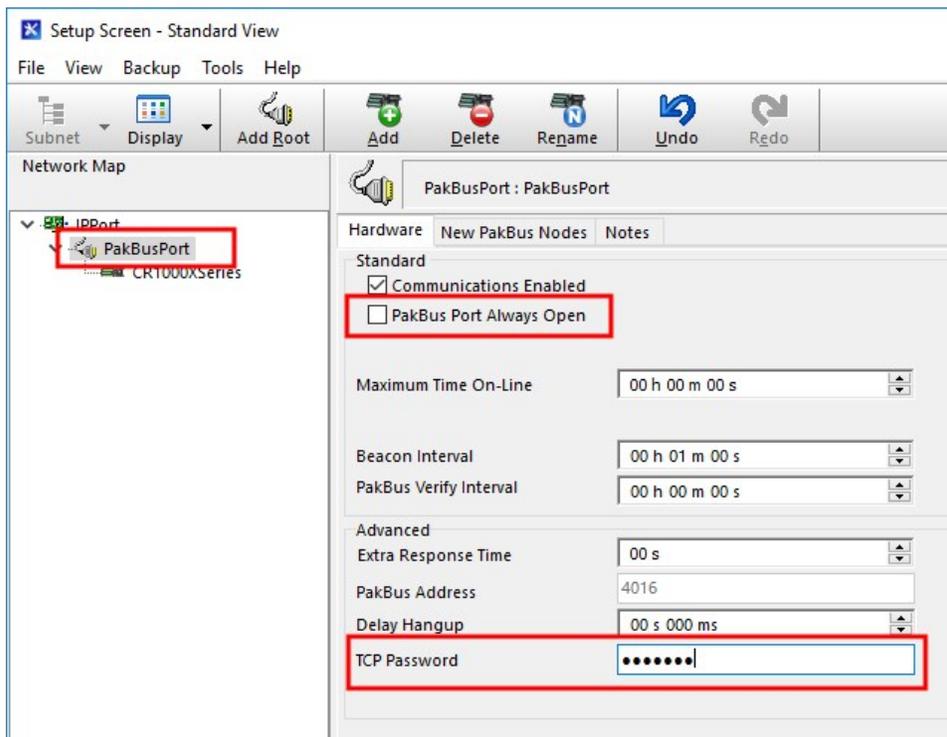


3. Add a data logger to the **pbRouter**.

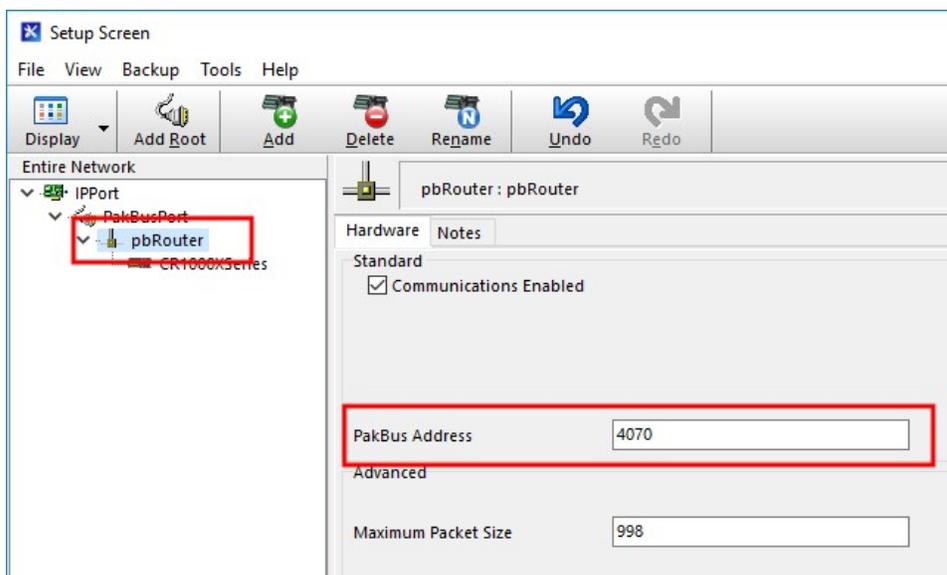
4. Select the **IPPort** in the Network Map. Enter the CELL200 series IP address (public static IP) or the Konect PakBus Router DNS address (private dynamic IP), along with the port number. The address and port number are input in the **Internet IP Address** field separated by a colon. Preceding zeros are not entered (for example, 070.218.074.247 is entered as 70.218.74.247). When not using Konect, the default port number is 6785.



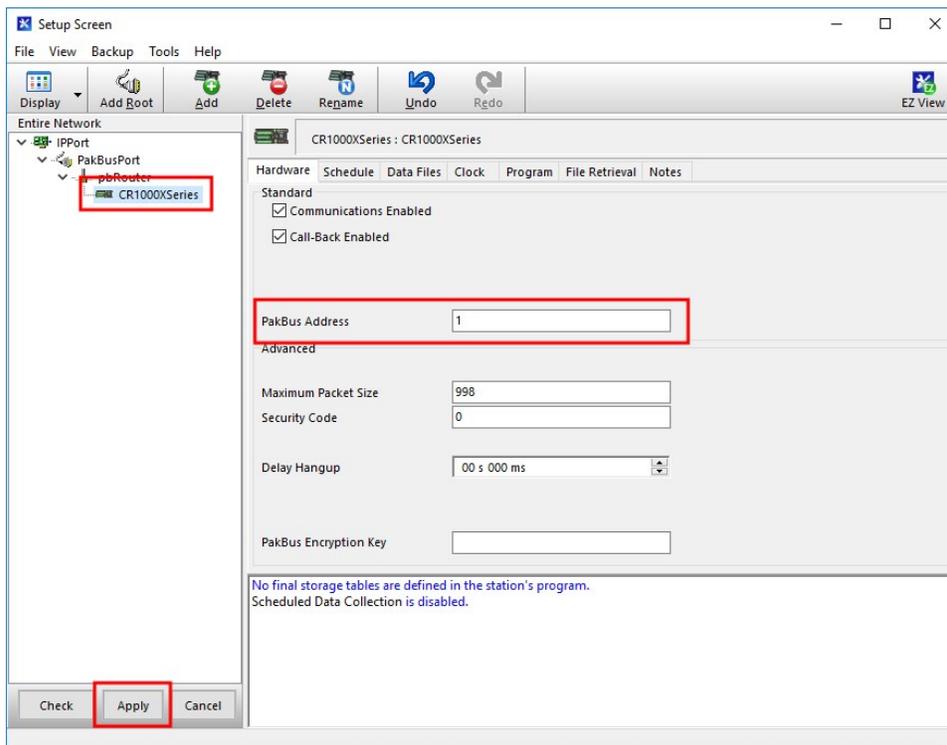
5. Leave the default settings for the **PakBusPort**. **PakBus Port Always Open** should **not** be checked. Enter the **TCP Password**; this must match the value entered in the Konect PakBus Router setup and LoggerNet setup.



6. Select the pbRouter in the Network Map and set the **PakBus Address** to 4070.



7. Select the data logger in the Network Map and set the **PakBus Address** to match that of the data logger (default address in the data logger is 1). If a **PakBus Encryption Key** was entered during data logger setup, also enter it here. Click **Apply** to save the changes.



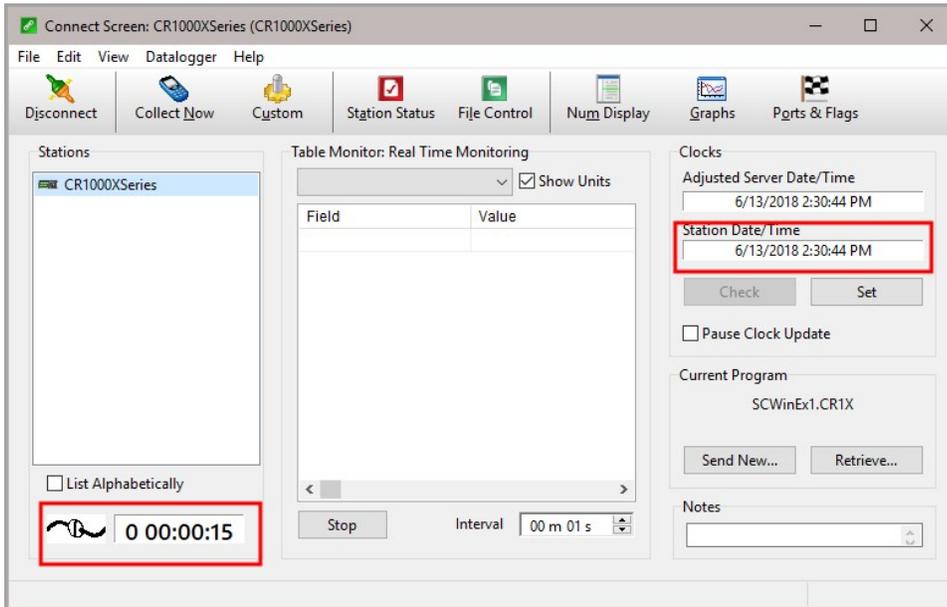
### 8.4.2.5 Test the connection

After the Network Map has been configured, test the cellular connection by using the **Connect** screen as shown in the following image. Click on the appropriate station and click **Connect** to initiate a call to the data logger.

#### TIP:

The connection time is subject to many external factors. It is often less than 30 seconds but could be up to 15 minutes. Be patient.

If the connection is successful, the connectors icon at the bottom of the screen will come together and clock information from the data logger will be displayed in the **Station Date/Time** field. If the connection fails, a **Communications Failure** message will be displayed.



### 8.4.3 Serial server mode option

In serial server mode, the module receives IP communications over the cellular network and converts those to serial communications to pass on to the data logger. From the perspective of the data logger, this is no different than a serial cable connecting it to a computer.

This is the mode used with CR200-Series and Edlog (CR23X, CR10X, and CR510) data loggers, and cellular-to-RF networks. Only one IP connection at a time is supported.

#### NOTE:

A public static IP account must be used when the module is set up in serial server mode. Private dynamic IP accounts do not support the serial server mode.

#### NOTE:

Instructions in this section assume that you have established cellular service and the SIM card has been installed as described in [QuickStart \(integrated mode\)](#) (p. 9).

### 8.4.3.1 Configure CELL200 series

To set up the CELL200 series in serial server mode:

1. Connect a USB cable between your module and computer.
2. Connect the cellular antenna, if it is not already connected. When using a MIMO antenna with multiple cellular connections, connect the primary cable to **Cellular** and the secondary to **Diversity**. If the cables are not marked in this way, they can be connected to either antenna port. See [Antenna connections](#) (p. 32).
3. Open a web browser and go to: [cell.linktodevice.com](http://cell.linktodevice.com) .

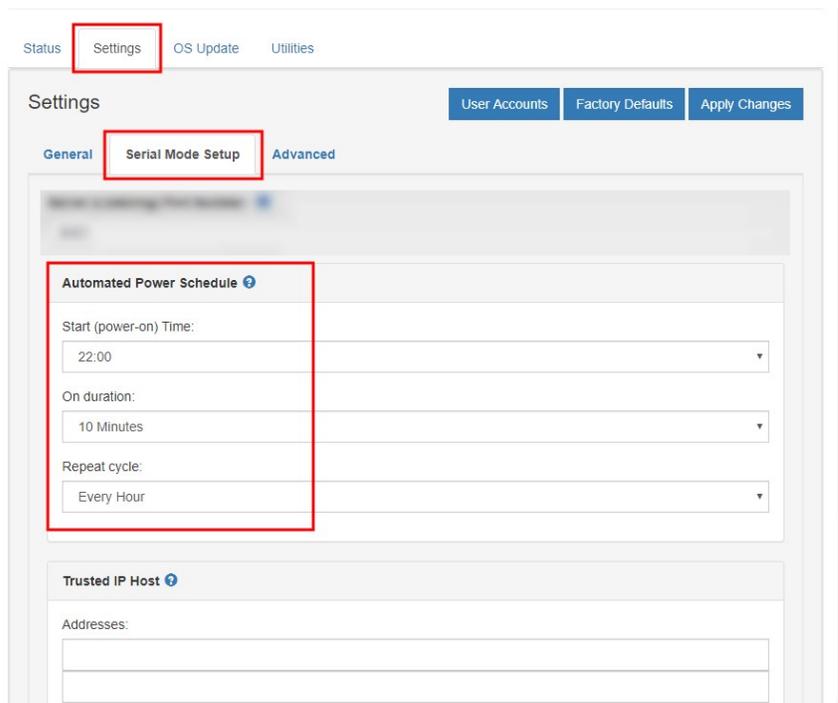
**TIP:**

If this doesn't work browse to 192.168.86.1.

4. On the **Settings > General** tab, enter the **APN** provided by your cellular provider.
5. Set **Mode** to **Serial Server**.
6. On the **Settings > Serial Mode Setup** tab, set **Serial Server Listen Port Number**. Default is 3001. This is entered along with the IP address as part of the LoggerNet configuration.
7. When using a CR200(X), set **RS-232 baud rate** to **9600** baud.

- (Optional) In this mode, an **Automated Power Schedule** can be setup to save on battery life or on cellular charges. Go to the **Settings** then **Serial Mode Setup** tab. Enter a **Start (power-on) Time**, **On duration**, and **Repeat cycle**.

The modem automatically turns off at midnight. It turns on at the **Start (power-on) Time** for the **On duration**. It then turns on again every **Repeat cycle** until midnight, at which point it will turn off.



For example: With the following settings of **Start (power-on) Time** of 22:00, **On Duration** of 10 minutes, and **Repeat Cycle** of Every Hour the cellular module will turn on for ten minutes only twice each day. It will turn on at 10:00 pm and 11:00 pm. It will not turn on at midnight since it is powered off at the start of the next day.

- (Optional) By default, the CELL200 series will accept incoming communications from any IP address. This can be a security risk. You may specify up to four IP addresses, with wild cards, to limit connections to only those trusted sources. Use an asterisk (\*) as a wild card. For example, a setting of 166.22.\*.\* would allow connections from devices that have IP addresses starting with 166.22. Both IPv4 and IPv6 addresses are supported.

**CAUTION:**

Only set a Trusted IP address if you are familiar with their use. Consult your IT department or Campbell Scientific for assistance.

**NOTE:**

This setting does not affect outbound connections, only incoming connections.

Staying on the **Settings > Serial Mode Setup** tab, enter your trusted IP addresses, one per line, in the **Trusted IP Host Addresses** box.

10. (Optional, for modules with static IP addresses.) To get remote access to the module you must first set up a **User Account**. For security purposes there is no default account. Select **Settings > User Accounts > Logon > Create a new Account**. Provide **Name**, **Password**, and select the **Permission Level**. **Close** then **Apply Changes**.

Once the module has an account it can be accessed remotely using its static IP address. Type the IP address into a web browser to be prompted for the user name and password.

### 8.4.3.2 Configure data logger

1. Connect to your data logger by using Device Configuration Utility.
2. On the **PPP** tab, set **Config/Port Used** to **Inactive**.
3. When using RS-232 serial server mode, it is recommended that you use a fixed baud rate on the data logger RS-232 port. On the **Com Ports Settings** tab, select the RS-232 port and set the **Baud Rate** to the fixed option to match the RS 232 baud rate set in the CELL200-series module.
4. If using CS I/O communication, the throughput can be enhanced by changing the SDC Baud Rate from 115200 to 460800. On the **Advanced** tab, set the **SDC Baud Rate** to 460800. Note that if there are other devices on the **CS I/O** port, they all must be able to support this higher baud rate.

### 8.4.3.3 Set up hardware

1. Connect the cellular antenna, if it is not already connected. When using a MIMO antenna with multiple cellular connections, connect the primary cable to **Cellular** and the secondary to **Diversity**. If the cables are not marked in this way, they can be connected to either antenna port.
2. Connect your data logger RS-232 or CS I/O port to the CELL200-series module RS-232 or CS I/O port. Ensure the same port is used for each device, for example RS-232 to RS-232. See [Wiring and connections](#) (p. 28).
3. If not connecting through CS I/O, provide power to the CELL200 series. The data logger provides power through the CS I/O port. USB power is not sufficient to power the CELL200 series; 12 V is required.

### 8.4.3.4 Set up LoggerNet

The LoggerNet Network Map is configured from the **LoggerNet Setup** screen.

**NOTE:**

Setup has two options, EZ (simplified) and Standard. Click on the **View** menu at the top of the **Setup** screen, and select **Standard** view.

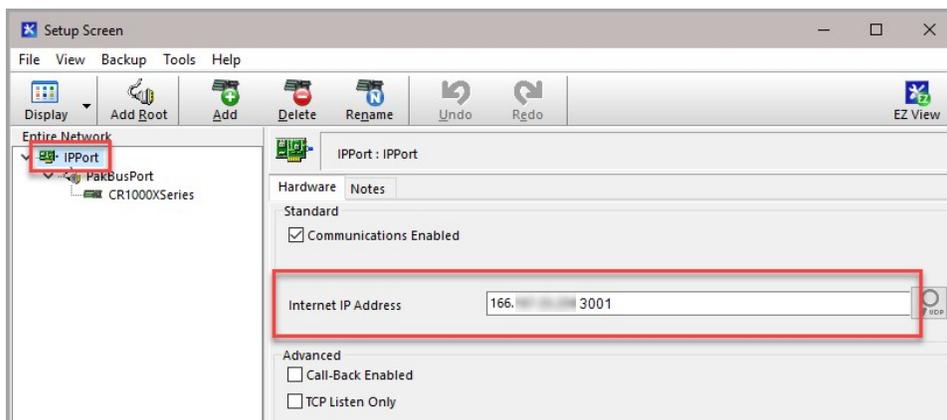
From the LoggerNet toolbar, click **Main > Setup** and configure the Network Map as described in the following steps:

1. Select **Add Root > IPPort**.
2. For PakBus data loggers select **PakBusPort**.

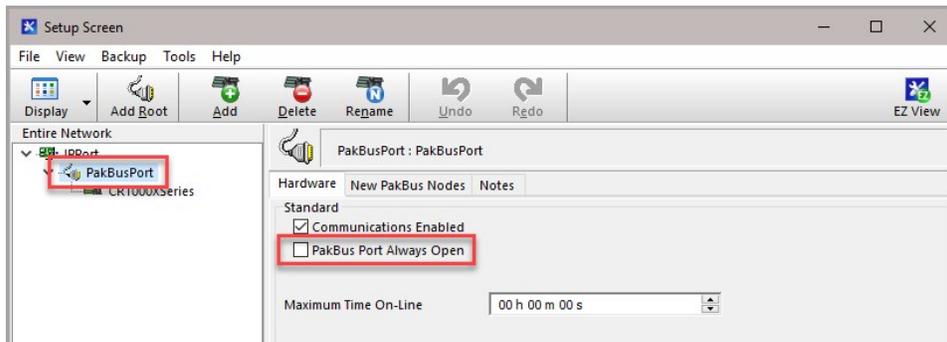
**NOTE:**

PakBus data loggers include the following models: GRANITE-series, CR6, CR3000, CR1000X, CR800-series, CR300-series, CR1000, and CR200(X)-series.

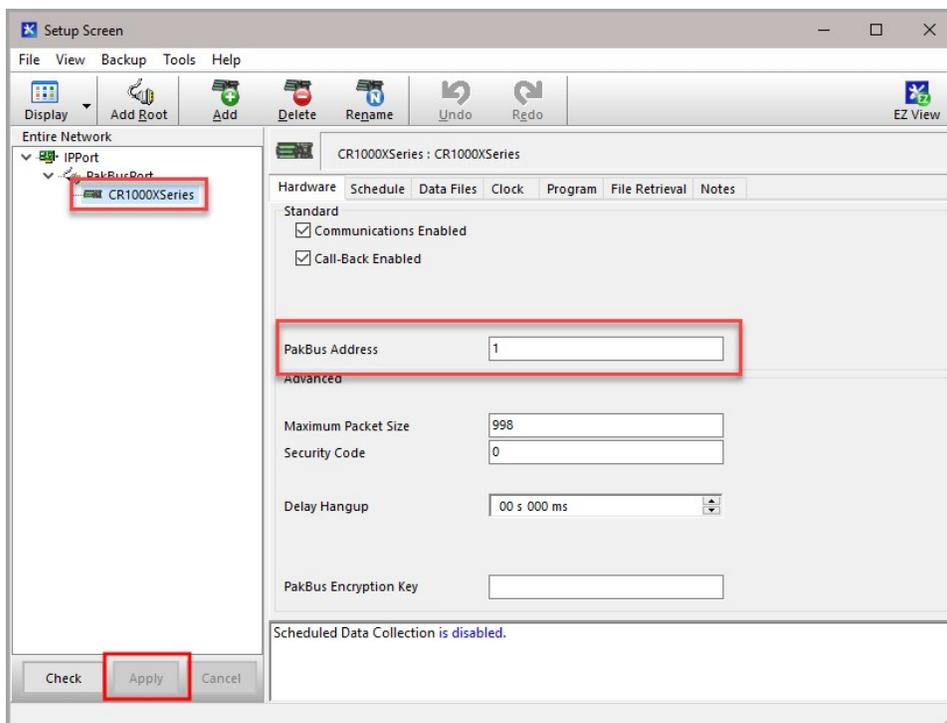
3. Add a data logger.
4. Select the **IPPort** in the Network Map. Enter the CELL200 series IP address (public static IP), along with the port number. The address and port number are input in the **Internet IP Address** field separated by a colon. Preceding zeros are not entered (for example, 070.218.074.247 is entered as 70.218.74.247). For serial server mode, the default port number is 3001.



- For PakBus data loggers, leave the default settings for the **PakBusPort**. **PakBus Port Always Open** should not be checked. If used, enter the **TCP Password**.



- For PakBus data loggers, select the data logger in the Network Map and set the **PakBus Address** to match that of the data logger (default address in the data logger is 1). Click **Apply** to save the changes.



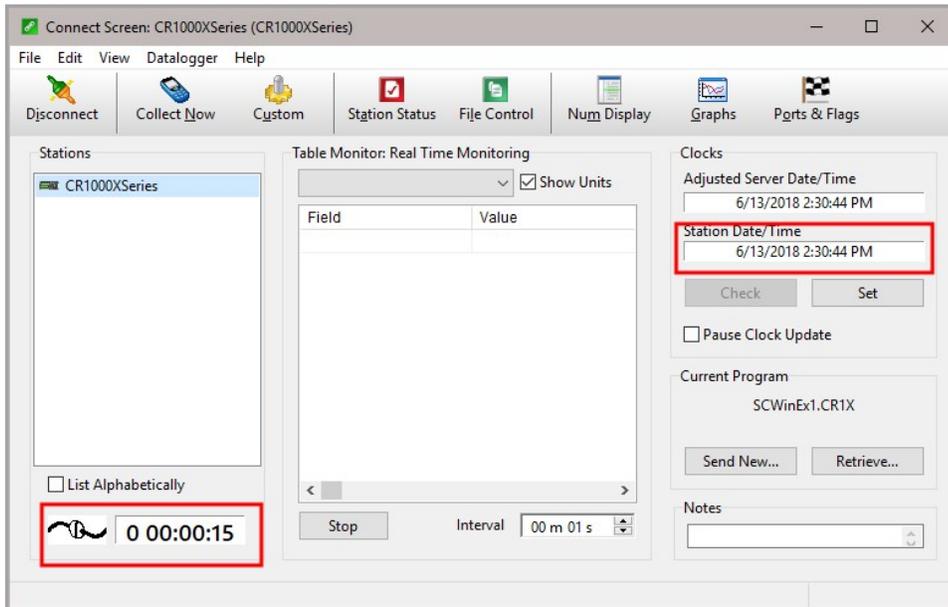
### 8.4.3.5 Test the connection

After the Network Map has been configured, test the cellular connection by using the **Connect** screen as shown in the following image. Click on the appropriate station and click **Connect** to initiate a call to the data logger.

## TIP:

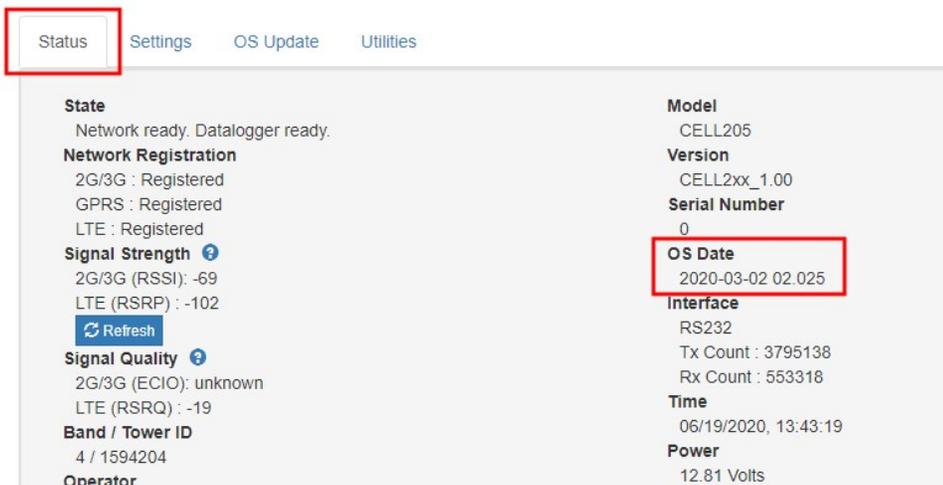
The connection time is subject to many external factors. It is often less than 30 seconds but could be up to 15 minutes. Be patient.

If the connection is successful, the connectors icon at the bottom of the screen will come together and clock information from the data logger will be displayed in the **Station Date/Time** field. If the connection fails, a **Communications Failure** message will be displayed.



## 8.4.4 Serial client mode option

This mode requires CELL200 series operating system 2.00 or newer. Find the CELL200 series OS version in the **OS Date** field of the **Status** Tab. For more information, see [Updating the operating system and firmware](#) (p. 64).



In serial client mode the module will connect to the cellular network and initiate a TCP client socket connection. When data is sent to the active port (RS-232 or CS I/O) it will be sent out on the TCP client connection. When data is received on the TCP client socket connection, it is passed to the active port (RS-232 or CS I/O).

Use this mode when the module is behind a cellular provider firewall and it has a private dynamic IP address. This mode requires the receiving TCP/IP connection be on a public static IP address, on the same private cellular network, DNS name or there be a hole in the firewall. For connections involving firewalls, such as office networks, contact your IT department to ensure all relevant settings are configured correctly.

When the same server IP and port are used for multiple data logger connections, each data logger must have a unique PakBus address.

**NOTE:**

Instructions in this section assume that you have established cellular service and the SIM card has been installed as described in [QuickStart \(integrated mode\)](#) (p. 9)

### 8.4.4.1 Configure CELL200 series

To set up the CELL200 series in serial client mode:

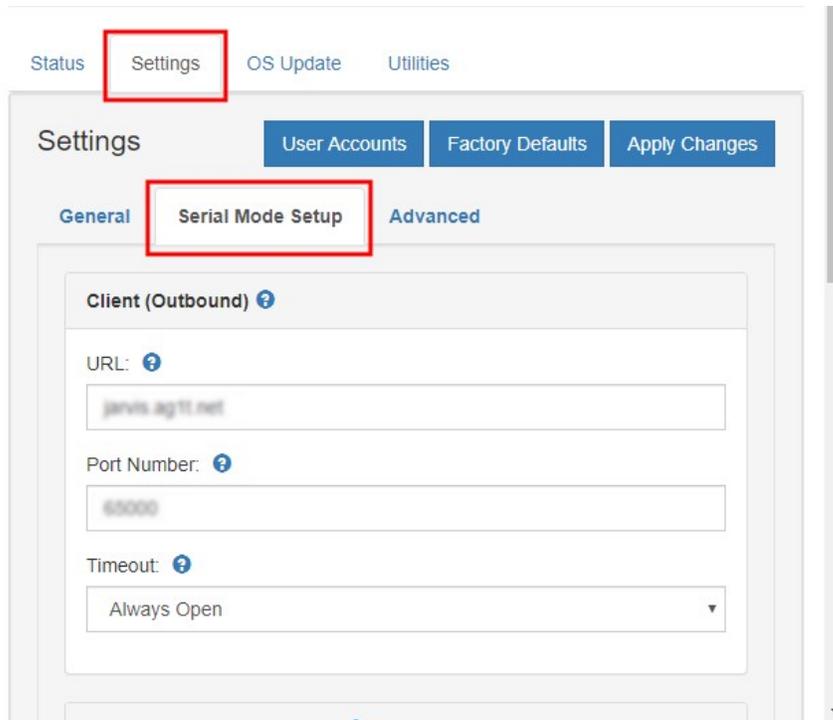
1. Connect a USB cable between your module and computer.
2. Connect the cellular antenna, if it is not already connected. When using a MIMO antenna with multiple cellular connections, connect the primary cable to **Cellular** and the secondary to **Diversity**. If the cables are not marked in this way, they can be connected to either antenna port. See [Antenna connections](#) (p. 32).
3. Open a web browser and go to: [cell.linktodevice.com](http://cell.linktodevice.com) .

**TIP:**

If this doesn't work browse to 192.168.86.1.

4. On the **Settings** tab, enter the **APN** provided by your cellular provider.
5. On the **General** tab, set **Mode** to **Serial Client**.
6. When using a CR200(X), set **RS-232 baud rate** to **9600** baud.

7. Select the **Serial Mode Setup** tab.

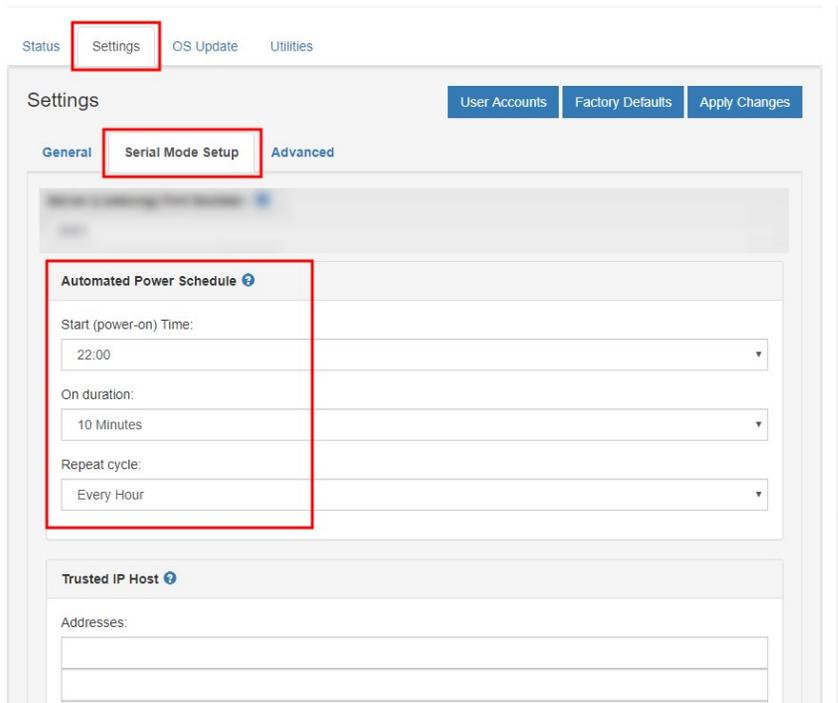


8. Enter the **URL** and **Port Number** of the server/device that the module will connect to.

9. (Optional) Select **Always Open** for the **Timeout**.

- (Optional) In this mode, an **Automated Power Schedule** can be setup to save on battery life or on cellular charges. Go to the **Settings** then **Serial Mode Setup** tab. Enter a **Start (power-on) Time**, **On duration**, and **Repeat cycle**.

The modem automatically turns off at midnight. It turns on at the **Start (power-on) Time** for the **On duration**. It then turns on again every **Repeat cycle** until midnight, at which point it will turn off.



For example: With the following settings of **Start (power-on) Time** of 22:00, **On Duration** of 10 minutes, and **Repeat Cycle** of Every Hour the cellular module will turn on for ten minutes only twice each day. It will turn on at 10:00 pm and 11:00 pm. It will not turn on at midnight since it is powered off at the start of the next day.

#### 8.4.4.2 Configure data logger (optional)

**SendVariables()** is used to initiate a data logger call-back attempt to a computer running LoggerNet. It has the following syntax:

```
SendVariables (ResultCode, ComPort, NeighborAddr, PakBusAddr, Security, Timeout, "TableName", "FieldName", Variable, Swath )
```

The **ComPort** needs to be set to **ComRS232** or **ComSDC8** depending on how you have the module connected to the data logger. Set the **TableName** to **"Public"** and the **FieldName** to **"Callback"**. The remaining parameters in the instruction are ignored. The resulting instruction will look similar to:

```
SendVariables (SendResult, COMRS232, 0, 4094, 0000, 0, "Public", "Callback", Scratch, 1)
```

After LoggerNet receives the variable "**Callback**" it will begin collecting data from the data logger and store it to a file based on the data collection settings in the Setup window. See the CRBasic help for more information.

### 8.4.4.3 Set up hardware

1. Connect the cellular antenna, if it is not already connected. When using a MIMO antenna with multiple cellular connections, connect the primary cable to **Cellular** and the secondary to **Diversity**. If the cables are not marked in this way, they can be connected to either antenna port.
2. Connect your data logger RS-232 or CS I/O port to the CELL200-series module RS-232 or CS I/O port. Ensure the same port is used for each device, for example RS-232 to RS-232. See [Wiring and connections](#) (p. 28).
3. If not connecting through CS I/O, provide power to the CELL200 series. The data logger provides power through the CS I/O port. USB power is not sufficient to power the CELL200 series; 12 V is required.

### 8.4.4.4 Set up LoggerNet

The LoggerNet Network Map is configured from the **LoggerNet Setup** screen.

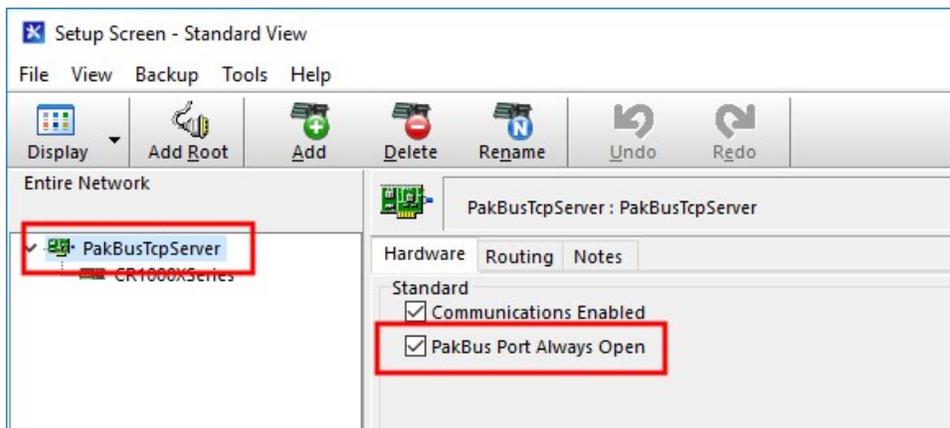
**NOTE:**

Setup has two options, EZ (simplified) and Standard. Click on the **View** menu at the top of the **Setup** screen, and select **Standard** view.

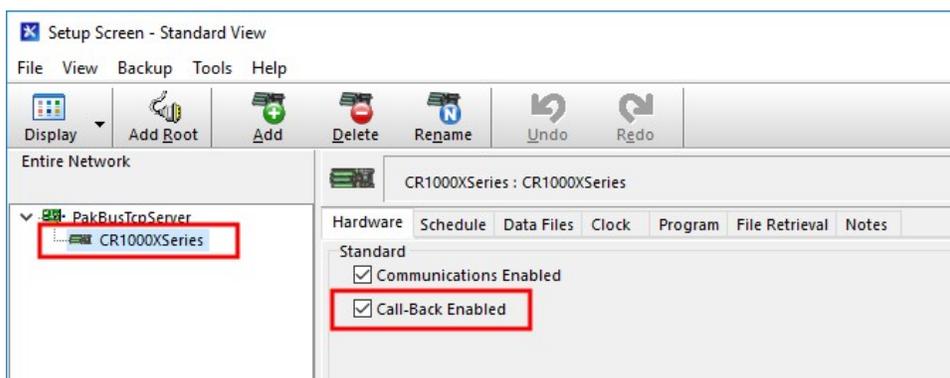
From the LoggerNet toolbar, click **Main > Setup** and configure the Network Map as described in the following steps:

1. Select **Add Root > PakBusTcpServer**.
2. Add a data logger to the **PakBusTcpServer**.

3. Select the **PakBusTcpServer** in the Network Map. **PakBus Port Always Open** should be checked.



4. Select the data logger in the Network Map. Select **Call-Back Enabled**; the box should have a check.



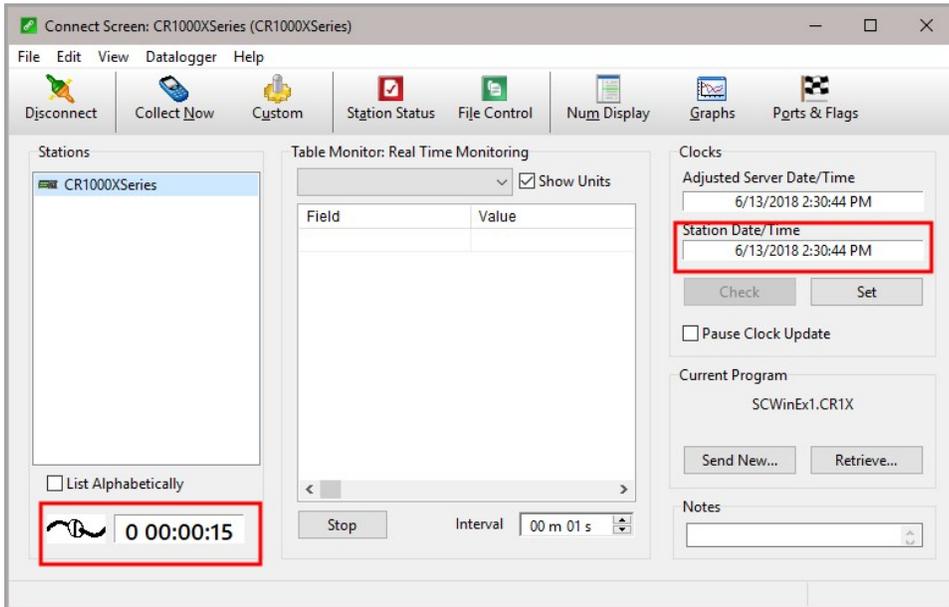
#### 8.4.4.5 Test the connection

After the Network Map has been configured, test the cellular connection by using the **Connect** screen as shown in the following image. Click on the appropriate station and click **Connect** to initiate a call to the data logger.

**TIP:**

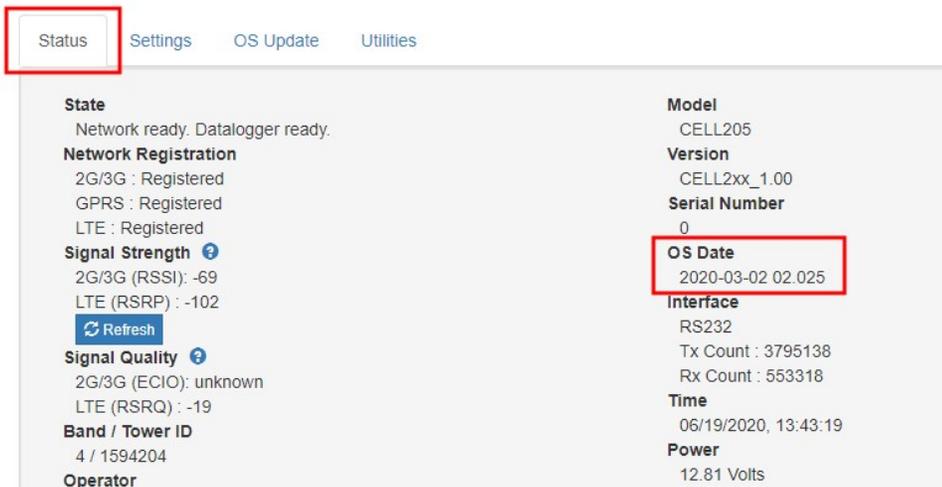
The connection time is subject to many external factors. It is often less than 30 seconds but could be up to 15 minutes. Be patient.

If the connection is successful, the connectors icon at the bottom of the screen will come together and clock information from the data logger will be displayed in the **Station Date/Time** field. If the connection fails, a **Communications Failure** message will be displayed.



## 8.4.5 Serial server/client mode option

This mode requires CELL200 series operating system 2.00 or newer. Find the CELL200 series OS version in the **OS Date** field of the **Status** Tab. For more information, see [Updating the operating system and firmware](#) (p. 64).



In serial server/client mode the module connects to the cellular network and opens a listening port. When a client connects to the listening port, the CELL200 series will be in "serial server" mode. In serial server mode, all data on the active port (RS-232 or CS I/O) will be routed through the listening port. When no client is connected to the listening port, the CELL200 series will be in

"**serial client**" mode and all data on the active port will be sent and received through the initiated TCP client socket connection.

The incoming connection, or serial server mode, takes precedence. An outbound, or client, connection will be interrupted if a connection is made on the incoming, or server, listening port.

**NOTE:**

Instructions in this section assume that you have established cellular service and the SIM card has been installed as described in [QuickStart \(integrated mode\)](#) (p. 9).

### 8.4.5.1 Configure CELL200 series

To set up the CELL200 series in serial server/client mode:

1. Connect a USB cable between your module and computer.
2. Connect the cellular antenna, if it is not already connected. When using a MIMO antenna with multiple cellular connections, connect the primary cable to **Cellular** and the secondary to **Diversity**. If the cables are not marked in this way, they can be connected to either antenna port. See [Antenna connections](#) (p. 32).
3. Open a web browser and go to: [cell.linktodevice.com](http://cell.linktodevice.com) .

**TIP:**

If this doesn't work browse to 192.168.86.1.

4. On the **Settings** tab, enter the **APN** provided by your cellular provider.
5. On the **General** tab, set **Mode** to **Serial Server/Client**.

6. Select the **Serial Mode Setup** tab.

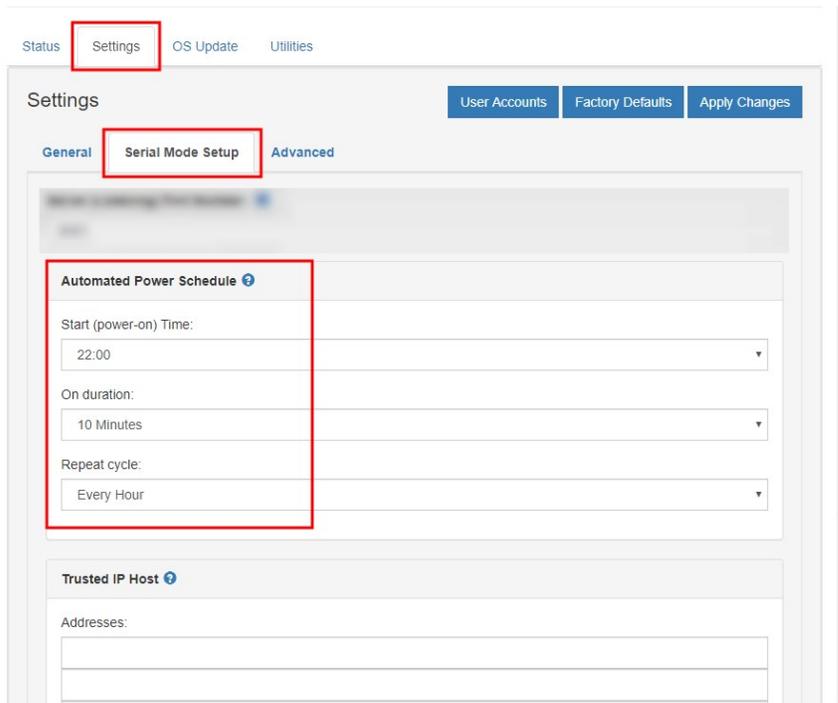
The screenshot shows a web interface with a top navigation bar containing 'Status', 'Settings', 'OS Update', and 'Utilities'. The 'Settings' tab is highlighted with a red box. Below this is a 'Settings' section with three sub-tabs: 'User Accounts', 'Factory Defaults', and 'Apply Changes'. Underneath, there are three tabs: 'General', 'Serial Mode Setup', and 'Advanced'. The 'Serial Mode Setup' tab is highlighted with a red box. The main content area contains the following fields:

- Server (Listening) Port Number:** A text input field containing '3001'.
- Client (Outbound):** A section containing three fields:
  - URL:** A text input field containing 'janis.agtt.net'.
  - Port Number:** A text input field containing '65000'.
  - Timeout:** A dropdown menu with 'Always Open' selected.

7. Set **Server (Listening) Port Number**. Default is 3001. This is entered along with the IP address as part of the LoggerNet configuration.
8. Enter the **URL** and **Port Number** that the module will connect with.
9. (Optional) Select **Always Open** for the **Timeout**.

- (Optional) In this mode, an **Automated Power Schedule** can be setup to save on battery life or on cellular charges. Go to the **Settings** then **Serial Mode Setup** tab. Enter a **Start (power-on) Time**, **On duration**, and **Repeat cycle**.

The modem automatically turns off at midnight. It turns on at the **Start (power-on) Time** for the **On duration**. It then turns on again every **Repeat cycle** until midnight, at which point it will turn off.



For example: With the following settings of **Start (power-on) Time** of 22:00, **On Duration** of 10 minutes, and **Repeat Cycle** of Every Hour the cellular module will turn on for ten minutes only twice each day. It will turn on at 10:00 pm and 11:00 pm. It will not turn on at midnight since it is powered off at the start of the next day.

- (Optional) By default, the CELL200 series will accept incoming communications from any IP address. This can be a security risk. You may specify up to four IP addresses, with wild cards, to limit connections to only those trusted sources. Use an asterisk (\*) as a wild card. For example, a setting of 166.22.\*.\* would allow connections from devices that have IP addresses starting with 166.22. Both IPv4 and IPv6 addresses are supported.

**CAUTION:**

Only set a Trusted IP address if you are familiar with their use. Consult your IT department or Campbell Scientific for assistance.

**NOTE:**

This setting does not affect outbound connections, only incoming connections.

Staying on the **Settings > Serial Mode Setup** tab, enter your trusted IP addresses, one per line, in the **Trusted IP Host Addresses** box.

### 8.4.5.2 Configure data logger

1. Connect to your data logger by using Device Configuration Utility.
2. On the **PPP** tab, set **Config/Port Used** to **Inactive**.
3. When using RS-232 serial server mode, it is recommended that you use a fixed baud rate on the data logger RS-232 port. On the **Com Ports Settings** tab, select the RS-232 port and set the **Baud Rate** to the fixed option to match the RS 232 baud rate set in the CELL200-series module.
4. If using CS I/O communication, the throughput can be enhanced by changing the SDC Baud Rate from 115200 to 460800. On the **Advanced** tab, set the **SDC Baud Rate** to 460800. Note that if there are other devices on the **CS I/O** port, they all must be able to support this higher baud rate.

### 8.4.5.3 Set up hardware

1. Connect the cellular antenna, if it is not already connected. When using a MIMO antenna with multiple cellular connections, connect the primary cable to **Cellular** and the secondary to **Diversity**. If the cables are not marked in this way, they can be connected to either antenna port.
2. Connect your data logger RS-232 or CS I/O port to the CELL200-series module RS-232 or CS I/O port. Ensure the same port is used for each device, for example RS-232 to RS-232. See [Wiring and connections](#) (p. 28).
3. If not connecting through CS I/O, provide power to the CELL200 series. The data logger provides power through the CS I/O port. USB power is not sufficient to power the CELL200 series; 12 V is required.

### 8.4.5.4 Set up LoggerNet

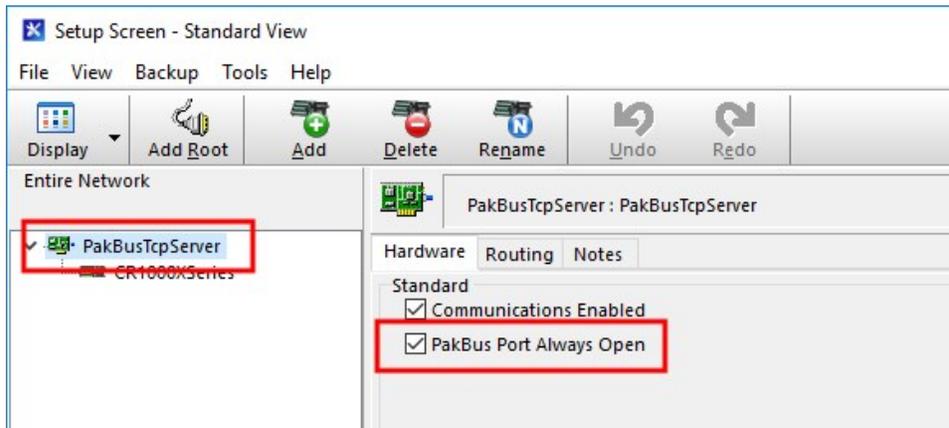
The LoggerNet Network Map is configured from the **LoggerNet Setup** screen.

**NOTE:**

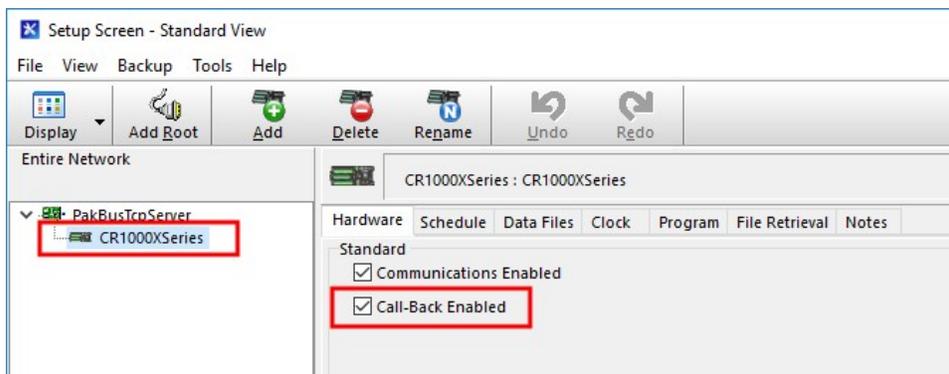
Setup has two options, EZ (simplified) and Standard. Click on the **View** menu at the top of the **Setup** screen, and select **Standard** view.

From the LoggerNet toolbar, click **Main > Setup** and configure the Network Map as described in the following steps:

1. Select **Add Root > PakBusTcpServer**.
2. Add a data logger to the **PakBusTcpServer**.
3. Select the **PakBusTcpServer** in the Network Map. **PakBus Port Always Open** should be checked.



4. Select the data logger in the Network Map. Select **Call-Back Enabled**; the box should have a check.



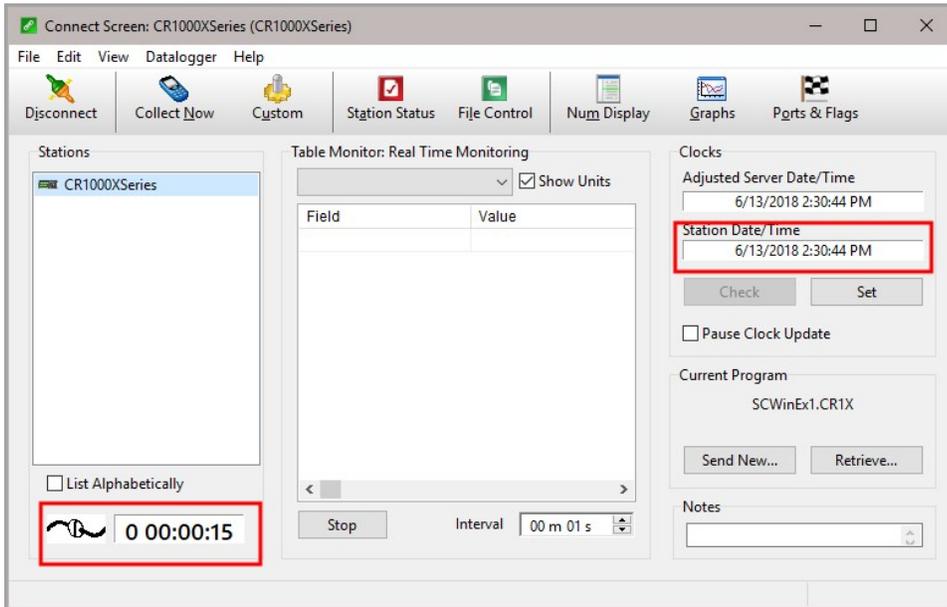
#### 8.4.5.5 Test the connection

After the Network Map has been configured, test the cellular connection by using the **Connect** screen as shown in the following image. Click on the appropriate station and click **Connect** to initiate a call to the data logger.

**TIP:**

The connection time is subject to many external factors. It is often less than 30 seconds but could be up to 15 minutes. Be patient.

If the connection is successful, the connectors icon at the bottom of the screen will come together and clock information from the data logger will be displayed in the **Station Date/Time** field. If the connection fails, a **Communications Failure** message will be displayed.



## 9. Operation and maintenance

### 9.1 Ports

The **CS I/O** port is the main port used with Campbell Scientific data loggers. Its function is described throughout this manual.

The **RS-232** port can also be used with Campbell Scientific data loggers through a null modem cable (or CPI/RS-232 RJ45 to DB9 cable for the CR1000X and CR6 series).

The **USB** port is used to check the module status, configure the module, send a new operating system, or watch low-level communications. This is done by opening a web browser and using the following URL: [cell.linktodevice.com](http://cell.linktodevice.com) .

#### TIP:

If your computer does not have access to a DNS server, browse to 192.168.86.1.

## 9.2 LED indicator lights

When your CELL200-series module is connected to power and an antenna, there is a specific pattern to the lights to indicate its operation mode as described in [LED Indicator Lights](#) (p. 59).

	Green	Blue	Red
Network	Flashes every 8 seconds when authenticated with cellular network	Flashes with traffic to/from internal cell modem	Flashes every 8 seconds when issue with network/settings
Signal	Flashes every 8 seconds to indicate good signal strength	Flashes every 8 seconds to indicate fair signal strength	Flashes every 8 seconds to indicate marginal or no signal strength
Power/Traffic	Flashes every 8 seconds to indicate all is good in network	Flashes with traffic on RS-232 or CS I/O	Used to let user know it is in low power state (only LED flashing)

## 9.3 Signal strength and quality

Both signal strength and quality contribute to successful cellular data communications. The factors that influence signal strength and quality include but are not limited to:

- proximity to the cellular tower
- tower load
- competing signals
- physical barriers (mountains, buildings, vegetation)
- weather

Because signal strength and quality can vary due to many factors, they may not give a true indication of communications performance or range. However, they can be useful for activities such as:

- determining the optimal direction to aim a Yagi antenna
- determining the effects of antenna height and location
- trying alternate Yagi antenna (reflective) paths
- seeing the effect of vegetation and weather over time

## 9.3.1 Signal strength

Signal strength is how strong the received signal is. The closer your CELL200 series is to the cellular tower, the more signal the antenna will pick up. Signal strengths are lower the farther away from the tower the CELL200 series is.

For 3G networks, signal strength is reported as RSSI (Received Signal Strength Indicator). For 4G, it is RSRP (Reference Signal Received Power).

Signal strength units are  $-dBm$ ;  $-70$  is a stronger signal than  $-100$ .

Strength estimate	RSSI (3G) dBm	RSRP (4G) dBm
Excellent	$-70$ or greater	$-90$ or greater
Good	$-71$ to $-85$	$-91$ to $-105$
Fair	$-86$ to $-100$	$-106$ to $-115$
Poor	less than $-100$	less than $-115$

## 9.3.2 Signal quality

Signal quality shows how much interference there is between the cellular tower and CELL200 series, or how noisy a band is. Cellular signal noise comes from reflections, ghosting and other interference. Better signal quality is an indicator of more successful communications during precipitation events such as rain and snow.

For 3G networks, signal quality is ECIO (Energy to Interference Ratio). For 4G, this is RSRQ (Reference Signal Received Quality).

Signal quality units are  $-dBm$ ;  $0$  is a better signal than  $-10$ .

Quality estimate	ECIO (3G) dBm	RSRQ (4G) dBm
Excellent	$0$ to $-6$	$> -9$
Good	$-7$ to $-10$	$-9$ to $-12$
Fair to poor	$-11$ to $-20$	$-13$ or less

# Appendix A. Controlling power to the CELL200 series

This example shows how to control power to the CELL200 series by using the CRBasic `IPNetPower()` instruction. The program uses the `TimeIsBetween()` instruction to power the CELL200 series for 15 minutes every 60 minutes between 9:00 a.m. and 5:00 p.m.

Downloadable example programs are available at [www.campbellsci.com/downloads/cell200-example-programs](http://www.campbellsci.com/downloads/cell200-example-programs). See the **CELL2XX-Power** program.

## NOTE:

The `IPNetPower()` functionality shown in this example is available in the CR300 series with operating system 08.00 or greater, the CR6 series with operating system 09.00 or greater, and the CR1000X with operating system 03.00 or greater. To control power in these data loggers with older operating systems or any CR1000, CR800 series, or CR3000, you will need to use a **SW12V** port on the data logger and communicate over RS-232. When using a **SW12V** port, we recommend using a `PPPClose()` instruction to shut down the network prior to powering down the CELL200 series.

## NOTE:

`TimeIsBetween()` requires operating system version 28.00 or greater in the CR1000, CR3000, or CR800. It is supported in all CR1000X, CR6, and CR300 operating systems.

### CRBasic Example 1: Turn CELL200 series ON and OFF under data logger control

```
'Declare Variables and Units
Public BattV
Public PTemp_C
Public ModuleState As Boolean

Units BattV=Volts
Units PTemp_C=Deg C

'Define Data Tables
DataTable(Daily,True,-1)
  DataInterval(0,1440,Min,10)
  Minimum(1,BattV,FP2,False,False)
EndTable
```

## CRBasic Example 1: Turn CELL200 series ON and OFF under data logger control

```
'Main Program
BeginProg
  'Main Scan
  Scan(5,Sec,1,0)
  'Default Data Logger Battery Voltage measurement 'BattV'
  Battery(BattV)
  'Default Wiring Panel Temperature measurement 'PTemp_C'
  PanelTemp(PTemp_C,60)
  'Between the hours of 9:00 and 17:00, turn the CELL200 series
  'on for 15 minutes at the start of every hour
  If TimeIsBetween(9,17,24,Hr) AND TimeIsBetween(0,15,60,Min) Then
    ModuleState=True
    IPNETPower(5,1)
  Else
    ModuleState=False
    IPNETPower(5,0)
  EndIf
  'Always turn OFF CELL200 series if battery drops below 11.5 volts
  If BattV<11.5 Then
    'Set CELL200 series power to the state of 'ModuleState' variable
    IPNETPower(5,0)
  EndIf
  'Call Data Tables and Store Data
  CallTable Daily
NextScan
EndProg
```

# Appendix B. Configuring settings and retrieving status information with the CRBasic program

---

## B.1 Using the SetSetting() instruction

**NOTE:**

This functionality is available in the CR1000X, CR300-series, and CR6 dataloggers only.

Downloadable example programs are available at [www.campbellsci.com/downloads/cell200-example-programs](http://www.campbellsci.com/downloads/cell200-example-programs) . The **CELL2XX-SetSettings** example shows how to set up the cellular module using the **SetSetting()** instruction. It also illustrates how to retrieve status information from the module in the CRBasic program.

# Appendix C. Updating the operating system and firmware

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Campbell Scientific updates data logger and CELL200 series operating systems (OS) as new features are developed and bugs fixed. It is recommended that before deploying instruments, you check operating system versions and update them as needed. This section applies to updating the CELL200 series module operating system. Refer to your data logger manual for information on updating its OS.

The CELL200 series itself uses two operating systems. The first is the Campbell Scientific CELL200 series operating system. We will refer to that as the **CELL200 series OS**. The second is contained in the cellular radio module; we will refer to that one as the **module firmware**. One or both may need to be updated from time to time.

## CAUTION:

To prevent data loss, collect all data from the data logger before proceeding to update the data logger operating system and cellular module firmware.

Updating the module firmware is done over the air (OTA), even with a direct USB connection to the data logger. Therefore, it can take from 5 minutes to several hours depending on signal strength between the cell tower and the CELL200 series, cellular network congestion, and OTA server availability. OTA updates use some of the cellular device data plan for each attempt. Care should be taken to plan accordingly to avoid cellular data plan overages.

## C.1 Using the web interface (cell.linktodevice.com)

### NOTE:

Instructions in this section assume that the steps in [Pre-installation](#) (p. 2) have been completed. Cellular service must be setup before web access using [cell.linktodevice.com](http://cell.linktodevice.com)  is available.

## NOTE:

This section applies to modules set up in serial server mode with a public static IP account when connecting over the Internet using the cellular interface.

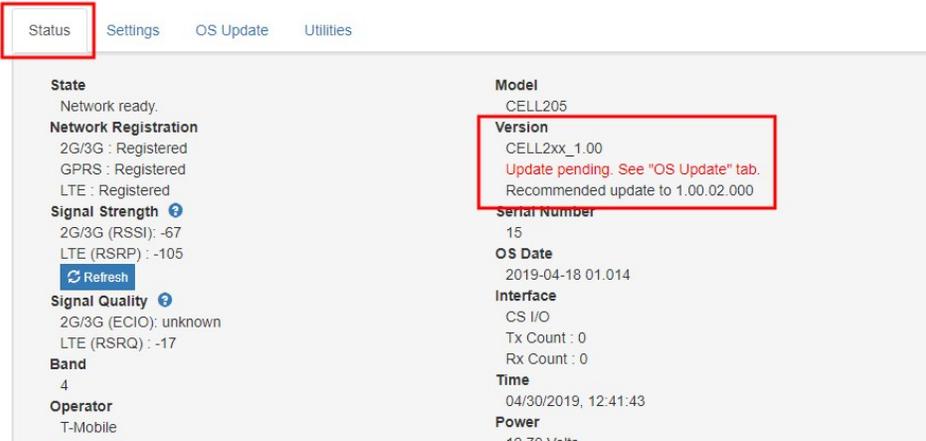
This section also applies to all modules when connecting via USB.

1. Connect the **Cellular** antenna.
2. Connect the **Diversity** antenna, if used. (Not required. See [Antenna connections](#) (p. 32).)
3. (Option 1, local connection) Connect a USB cable between your module and computer.
  - a. Open a web browser and go to: [cell.linktodevice.com](http://cell.linktodevice.com) .

### TIP:

If your computer does not respond to the DNS server correctly, browse to 192.168.86.1.

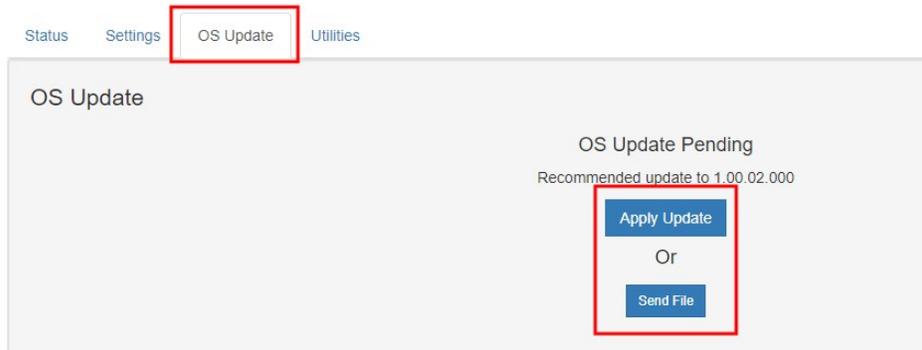
4. (Option 2, remote connection) No additional setup for modules connecting remotely.
  - a. Open a web browser and enter the module static IP address.
5. Every 14 days, the module automatically checks for a CELL200 series OS update. When a new OS is available you will see a red notification in the **Version** field of the **Status** Tab.



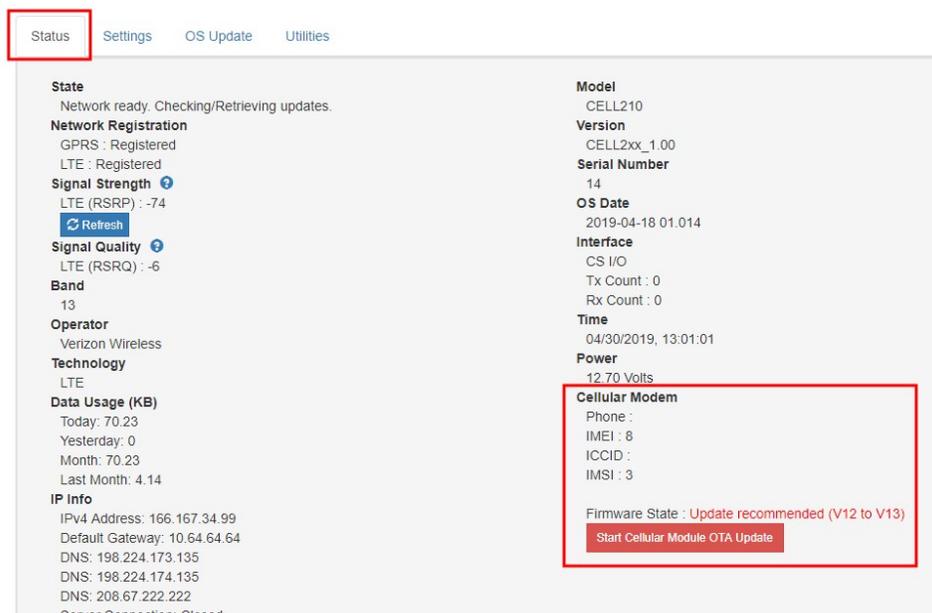
The screenshot shows the 'Status' tab of a web interface. The 'Status' tab is highlighted with a red box. The interface displays various system and network parameters. A red box highlights the 'Version' field, which contains the text: 'CELL2xx\_1.00', 'Update pending. See "OS Update" tab.', and 'Recommended update to 1.00.02.000'. Other fields include 'State' (Network ready), 'Network Registration' (2G/3G: Registered, GPRS: Registered, LTE: Registered), 'Signal Strength' (2G/3G (RSSI): -67, LTE (RSRP): -105), 'Signal Quality' (2G/3G (ECIO): unknown, LTE (RSRQ): -17), 'Band' (4), 'Operator' (T-Mobile), 'Technology', 'Model' (CELL205), 'Serial Number' (15), 'OS Date' (2019-04-18 01:014), 'Interface' (CS I/O, Tx Count: 0, Rx Count: 0), 'Time' (04/30/2019, 12:41:43), and 'Power' (12.70 Volts).

Field	Value
State	Network ready.
Network Registration	2G/3G : Registered GPRS : Registered LTE : Registered
Signal Strength	2G/3G (RSSI) : -67 LTE (RSRP) : -105
Signal Quality	2G/3G (ECIO) : unknown LTE (RSRQ) : -17
Band	4
Operator	T-Mobile
Technology	
Model	CELL205
Version	CELL2xx_1.00 Update pending. See "OS Update" tab. Recommended update to 1.00.02.000
Serial Number	15
OS Date	2019-04-18 01.014
Interface	CS I/O Tx Count : 0 Rx Count : 0
Time	04/30/2019, 12:41:43
Power	12.70 Volts

6. Select the **OS Update** Tab. Clicking the **Apply Update** button will retrieve the CELL200 series OS from the Campbell Scientific website and begin the update process. If you already downloaded the OS from the Campbell Scientific website to your computer you can click the **Send File** button and follow the prompts.



7. When new module firmware is available you will see a red notification in the **Cellular Modem** field of the **Status** Tab. To begin the update process, click the red **Start Cellular Module OTA Update** button.

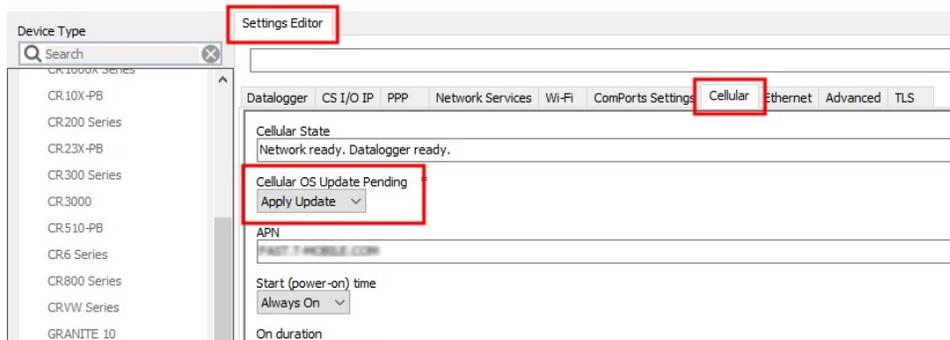


## C.2 Using Device Configuration Utility

### NOTE:

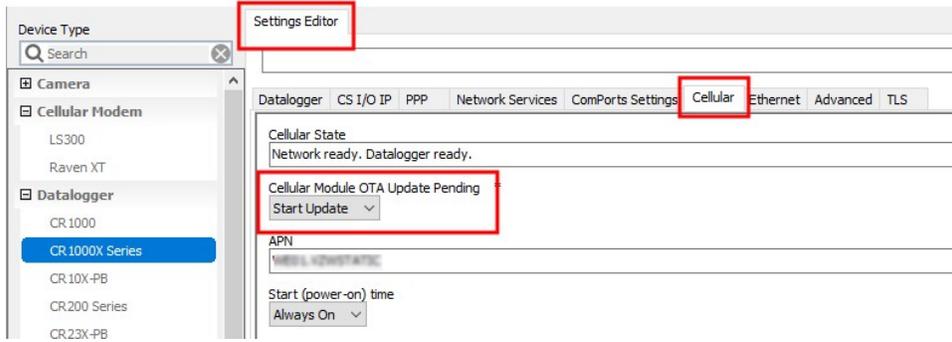
This section applies to modules set up in integrated PPP mode which requires data logger operating system 03.00 or later for the CR1000X, 09.00 or greater for the CR6 series, and 08.00 or later for the CR300 series.

1. Connect the cellular antenna, if it is not already connected. When using a MIMO antenna with multiple cellular connections, connect the primary cable to **Cellular** and the secondary to **Diversity**. If the cables are not marked in this way, they can be connected to either antenna port. See [Antenna connections](#) (p. 32).
2. Connect your data logger to the CELL200-series module RS-232 or CS I/O port. See [Wiring and connections](#) (p. 28).
3. If not connecting through CS I/O, provide power to the CELL200 series.
4. Connect a USB cable between your data logger and computer.
5. Connect to your data logger by using Device Configuration Utility.
6. When a new CELL200 series OS is available, in the **Settings Editor** on the **Cellular** Tab you will see a field called **Cellular OS Update Pending**. This field does not appear unless an update is available. Select **Apply Update** to begin the process, or **Ignore** to update at another time.
7. **Apply** to save your changes.



8. When new module firmware is available, in the **Settings Editor** on the **Cellular** Tab you will see a field called **Cellular Module OTA Update Pending**. This field does not appear unless an update is available. Select **Start Update** to begin the process, or **Ignore** to update at another time.

9. **Apply** to save your changes.



# Appendix D. Cellular module terminal functionality

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This appendix discusses the terminal functionality of the CELL200-series modules. This functionality requires a data logger with a CS I/O port.

To use the terminal functionality of the module, you must enable the terminal port. To do this:

1. Connect a USB cable between your module and computer.
2. Connect the cellular antenna, if it is not already connected. When using a MIMO antenna with multiple cellular connections, connect the primary cable to **Cellular** and the secondary to **Diversity**. If the cables are not marked in this way, they can be connected to either antenna port. See [Antenna connections](#) (p. 32).
3. Open a web browser and go to: [cell.linktodevice.com](http://cell.linktodevice.com) .

**TIP:**

If this doesn't work browse to 192.168.86.1.

4. On the **Settings** > **Advanced** tab, set the **Terminal Port CS I/O SDC Address**. (It must be set to a different address than the one used for the **CS I/O Port SDC Address**.)
5. Click **Apply Changes**.

[Using the SetSetting\(\) instruction](#) (p. 63) illustrates how to use this functionality in a CRBasic program.

The functionality can also be accessed directly using the terminal emulator of the data logger in serial talk through mode. The data logger terminal emulator can be accessed by connecting to the data logger in Device Configuration Utility and selecting the **Terminal** tab. (It can also be accessed from the **Connect** screen by selecting **Datalogger | Terminal Emulator** and then clicking **Open Terminal**.) With the terminal window open, press return a few times until you receive the data logger prompt (for example, CR1000X>). Type P. Then type the number corresponding to the **Terminal Port CS I/O SDC Address** set in the CELL200-series module. You should receive a **CELL2xx>** prompt. The commands in this appendix can be used from this prompt to interact with the CELL200-series module.

## help

Displays all the commands that are available in the cellular module terminal.

# D.1 Using cell modem terminal functionality

## NOTE:

This functionality is available in all CRBasic data loggers with a CS I/O port.

[Using cell modem terminal functionality](#) (p. 70) shows how to set up an attached CELL200-series module using the terminal functionality in the module. It also illustrates how to use the same functionality to retrieve status information from the CELL200 series and put the module into low power mode. Downloadable example programs are available at [www.campbellsci.com/downloads/cell200-example-programs](http://www.campbellsci.com/downloads/cell200-example-programs). See the **CELL2XX-Settings** program for details.

To use the terminal functionality of the module, you must enable the terminal port. To do this:

1. Connect a USB cable between your module and computer.
2. Connect the cellular antenna, if it is not already connected. When using a MIMO antenna with multiple cellular connections, connect the primary cable to **Cellular** and the secondary to **Diversity**. If the cables are not marked in this way, they can be connected to either antenna port. See [Antenna connections](#) (p. 32).
3. Open a web browser and go to: [cell.linktodevice.com](http://cell.linktodevice.com).

## TIP:

If this doesn't work browse to 192.168.86.1.

4. On the **Settings | Advanced** tab, set the **Terminal Port CS I/O SDC Address**. (It must be set to a different address than the one used for the **CS I/O Port SDC Address**.)
5. Click **Apply Changes**.

# D.2 Status commands

Status commands show current values of the information being requested. Some correspond to settings and others are tied to diagnostic information. All values returned are strings. Not all modems return all values. Values returned are also dependent on the network the device is connected to.

<b>show acc tech</b>	Returns the access technology of the network that the modem is connected to.
<b>show apn</b>	Displays the <b>APN</b> (Access Point Name) currently used by the cellular module. Corresponds with the APN setting in the cellular module web interface.
<b>show arev</b>	Returns the alternate or subversion revision of the CELL200 series OS.
<b>show band</b>	Returns the band number the modem is using to connect to the cellular network.
<b>show bat</b>	Returns the current modem battery voltage.
<b>show baud</b>	Displays the current baud rate of the cellular module RS-232 port. Corresponds with the <b>RS232 Baud Rate</b> setting in the cellular module web interface.
<b>show billing</b>	Displays the current value for the billing cycle day. Values can range from 1 to 31. Corresponds to the <b>Billing Cycle Day</b> field in the cellular module web interface.
<b>show cell id</b>	Returns the hexadecimal number of the cellular tower the modem is connected to.
<b>show cellular errors</b>	Returns an error information summary for troubleshooting.
<b>show cellular info</b>	Returns the modem cellular information. Information returned is extensive and includes information from other terminal commands.
<b>show cellular log</b>	Returns a log of events for the device. Useful for troubleshooting.
<b>show client port</b>	Returns the port number in the modem when used in Serial Client Mode.
<b>show client timeout</b>	Returns the time, in seconds, used in Serial Client Mode.
<b>show client url</b>	Returns the cellular module Client (Outbound) URL setting (used in Serial Client Mode).
<b>show device info</b>	Returns the modem device information. Information returned is extensive and includes many values returned from other terminal commands.
<b>show diagnostic report</b>	Returns a diagnostic report that is useful for troubleshooting. Combines the output of many other terminal troubleshooting commands.

<code>show diversity</code>	Displays the current setting of cellular module antenna configuration. Results are <b>Disabled</b> or <b>Enabled</b> . Corresponds with the <b>Diversity Antenna</b> field in the cellular module web interface.
<code>show ecio</code>	Returns the modem 3G network signal quality (ECIO).
<code>show euiccid</code>	Returns the modem EUICCID (Embedded SIM identification) number.
<code>show iccid</code>	Returns the modem ICCID (SIM identification) number.
<code>show imei</code>	Returns the modem IMEI (International Mobile Equipment Identity) number.
<code>show imsi</code>	Returns the modem IMSI (International Mobile Subscriber Identity) number.
<code>show ip info #net</code>	Returns the modem TCP/IP information for each network. When using this command, replace #net with <b>1</b> for the PPP connection, or <b>2</b> for the Ethernet over USB (RNDIS) connection.
<code>show ipprotocol</code>	Displays the current value of the cellular module IP protocol configuration. Results are <b>IPv4</b> , <b>IPv6</b> , or <b>IPv4/IPv6</b> . Corresponds with the <b>IP Protocol</b> field in the cellular module web interface.
<code>show listen port</code>	Displays the current setting for the cellular module TCP/IP listening port (used in Serial Server mode). Values can range from 1 to 65535. Corresponds with the <b>Serial Server Listen Port Number</b> setting in the cellular module web interface.
<code>show mod arev</code>	Returns the alternate or sub revision of the modem radio chipset.
<code>show mod manu</code>	Returns the manufacturer of the modem radio chipset.
<code>show mod model</code>	Returns the model number of the modem radio chipset.
<code>show mod rev</code>	Returns the model revision of the modem radio chipset.
<code>show mode</code>	Displays the current operating mode of the cellular module. Results are <b>PPP</b> , <b>Serial Server</b> , <b>Serial Client</b> , or <b>Serial Server/Client</b> . Corresponds with the <b>Mode</b> setting in the cellular module web interface.
<code>show model</code>	Returns the model information of the modem. Returned values are <b>CELL205</b> , <b>CELL210</b> , <b>CELL215</b> , or <b>CELL220</b> , <b>CELL225</b> .
<code>show modupdate description</code>	Returns the description or revision history of the firmware update.

<b>show modupdate description</b>	Returns a description of the module firmware update for user review.
<b>show modupdate pending</b>	Returns information regarding the module firmware. Informs the user that an update is available.
<b>show modupdate priority</b>	Returns the priority of the module firmware update, whether it is required or recommended.
<b>show modupdate progress</b>	Returns the progress of the module firmware update.
<b>show operator</b>	Returns the name of the cellular provider or network operator the modem is connected to.
<b>show osdate</b>	Returns the build date and alternate version of the CELL200 series OS.
<b>show osupdate description</b>	Returns a description of the newer operating system for the user to review before installing.
<b>show osupdate pending</b>	Returns information indicating if a newer modem operating system is available.
<b>show osupdate priority</b>	Returns the priority of the operating system update.
<b>show osupdate progress</b>	Returns the progress of the CELL200 series OS update.
<b>show pdp pass</b>	Returns the modem PDP password.
<b>show pdp user</b>	Returns the modem PDP username.
<b>show phone</b>	Returns the modem phone number.
<b>show ping</b>	Returns the status of the cellular module ping setting.
<b>show power duration</b>	Returns the modem on-duration time, in minutes.
<b>show power repeat</b>	Returns the modem Repeat cycle setting.
<b>show power start</b>	Returns the modem Start (power-on) Time.
<b>show ppp pass</b>	Returns the modem PPP password.
<b>show ppp user</b>	Returns the modem PPP username.
<b>show reg 3g</b>	Returns information on whether or not the modem is registered on the 3G network.
<b>show reg gprs</b>	Returns information on whether or not the modem is registered on the GPRS network.
<b>show reg lte</b>	Returns information on whether or not the modem is registered on the LTE network.

<code>show rev</code>	Returns the revision of the CELL200 series OS.
<code>show roaming</code>	Displays the current setting for the modem roaming capabilities. Returned values are <b>Auto</b> and <b>Disabled</b> . Corresponds to the <b>Roaming</b> setting in the cellular module web interface
<code>show rsrp</code>	Returns the modem LTE network signal strength (RSRP).
<code>show rsrq</code>	Returns the modem LTE network signal quality (RSRQ).
<code>show rssi</code>	Returns the modem 3G signal strength information (RSSI).
<code>show sdc</code>	Displays the current setting for the modem SDC address. Values are <b>7, 8, 10, or 11</b> . This value corresponds with the <b>CS I/O Port SDC Address</b> setting in the cellular module web interface.
<code>show sdc term</code>	Returns the current value for the SDC terminal interface in the modem. Returned values are <b>7, 8, 10, and 11</b> . Corresponds to the <b>Terminal Port CS I/O SDC Address</b> setting in the cellular module web interface
<code>show serial</code>	Returns the serial number of the modem.
<code>show settings</code>	Returns all the settings of the cellular modem.
<code>show sms log</code>	Returns a log of SMS messaging logs.
<code>show smssca</code>	Returns the modem SMSSCA (SMS Service Center Address) number.
<code>show state</code>	Returns the modem state in English. Values returned could include (but not limited to) "Power off.", "Powering up.", "Powered up.", "SIM authorized.", "Setting baud rate.", "Waiting for baud rate.", "Baud rate set.", "Baud rate failure.", "Power off. Waiting for retry.", "Powered up. SIM auth failure.", "Querying modem.", "Waiting for network registration.", "Configuring modem.", "Dialing.", "Dialing (retry).", "Dialed.", "PPP negotiation.", "Network ready.", "PPP closing.", "PPP paused.", "PPP dropped.", "Terminal AT command mode.", "Firmware update mode.", "Shutting down."
<code>show state num</code>	Returns the state number associated with show state values.
<code>show time</code>	Returns the modem current time. Time returned by the modem is set by the cellular network.
<code>show trusted 1</code>	Returns the address or DNS Name in the 1st field of the cellular module Trusted IP Host setting.

<code>show trusted 2</code>	Returns the address or DNS Name in the 2nd field of the cellular module Trusted IP Host setting.
<code>show trusted 3</code>	Returns the address or DNS Name in the 3rd field of the cellular module Trusted IP Host setting.
<code>show trusted 4</code>	Returns the address or DNS Name in the 4th field of the cellular module Trusted IP Host setting.
<code>show update check</code>	Returns information concerning the last update check.
<code>show update results</code>	Returns the results of a modem operating system update.
<code>show usage lastmonth</code>	Returns the number of bytes used across the cellular network in the previous month.
<code>show usage month</code>	Returns the number of bytes used across the cellular network in the current month.
<code>show usage today</code>	Returns the number of bytes used across the cellular network since midnight.
<code>show usage yesterday</code>	Returns the number of bytes used across the cellular network during the previous day.

## D.3 Set commands

Set commands are used to set specific settings in the device. Most settings will not take effect until the module is rebooted.

<code>set apn ###</code>	Sets the APN (Access Point Name) in the device. Corresponds to the <b>APN</b> setting in the modem web configuration interface. <b>###</b> is a string that corresponds to the APN issued by the cellular provider when the cellular account was created.
<code>set baud ###</code>	Sets the modem baud rate for the RS-232 port. <b>###</b> is a number corresponding to the desired baud rate. Accepted values are <b>460800, 230400, 115200, 76800, 57600, 38400, 19200, 14400, 9600, 4800, and 2400</b> .
<code>set billing ###</code>	Sets the billing day that will be used to roll over the data usage statistics in the modem. <b>###</b> is a number. Accepted values are <b>1 through 31</b> .

<b>set client port ###</b>	Sets the client port number used in serial client and serial client/server modes. ### is a number. The accepted range is 1 through 65535.
<b>set client timeout ###</b>	Sets the timeout, in seconds, used by serial client and serial client/server modes. ### is a number. The accepted range is 1 through 120.
<b>set client url ###</b>	Sets the client URL or TCP/IP address used in serial client and serial client/server modes. ### is a string.
<b>set comms watch</b>	This command is interactive and allows the user to watch or do a trace on a specific modem interface. The user selects a number corresponding with the interface they wish to view.
<b>set div ###</b>	Sets the modem antenna configuration. ### is a string. <b>Disabled</b> and <b>Enabled</b> are the only two values that are accepted.
<b>set ipprotocol ###</b>	Sets the TCP/IP protocol used by the modem when communicating with the cellular network. ### is a string. Accepted values are <b>IPv4</b> , <b>IPv6</b> , and <b>IPv4/IPv6</b> .
<b>set listen port ###</b>	Sets the listening TCP/IP port of the modem for use in serial server and serial client/server modes. ### is a number. The accepted range is 1 through 65535.
<b>set mode ###</b>	Sets the modem operating mode. ### is a string. Accepted values are <b>PPP</b> and <b>Serial Server</b> .
<b>set pdp pass ###</b>	Sets the PDP password. ### is a string.
<b>set pdp user ###</b>	Sets the PDP username. ### is a string.
<b>set power duration ###</b>	Sets the on duration, in minutes. ### is a number. Accepted values are: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 120, 180, 240, 300, 360, 420, 480, 540, 600, 660, 720, 780, 840, 900, 960, 1020, 1080, 1140, 1200, 1260, 1320, 1380, and 1439.
<b>set power repeat ###</b>	Sets the modem repeat cycle. ### is a number. Accepted values are: 1441, 15, 20, 30, 40, 50, 60, 120, 180, 240, 300, 360, 420, 480, 540, 600, 660, and 720. A value of 1441 or greater will disable the repeat cycle.
<b>set power start ###</b>	Sets the modem Start (power-on) Time, in minutes. ### is a number. Only 15 min increments are accepted (0, 15, 30 to 1440). A value of 1440 will set the modem to "Always On".

<code>set ppp pass ###</code>	Sets the PPP protocol password. <code>###</code> is a string.
<code>set ppp user ###</code>	Sets the PPP protocol username. <code>###</code> is a string.
<code>set roaming ###</code>	Sets the roaming capabilities of the cellular modem. <code>###</code> is a string. Accepted values are <b>Auto</b> and <b>Disabled</b> .
<code>set sdc ###</code>	Sets the modem SDC address for the CS I/O port. <code>###</code> is a number. Accepted values are <b>7</b> , <b>8</b> , <b>10</b> , and <b>11</b> .
<code>set trusted 1 ###</code>	Sets the address or DNS Names in the 1st Trusted IP Host field. <code>###</code> is a string.
<code>set trusted 2 ###</code>	Sets the address or DNS Names in the 2nd Trusted IP Host field. <code>###</code> is a string.
<code>set trusted 3 ###</code>	Sets the address or DNS Names in the 3rd Trusted IP Host field. <code>###</code> is a string.
<code>set trusted 4 ###</code>	Sets the address or DNS Names in the 4th Trusted IP Host field. <code>###</code> is a string.
<code>set ping ###</code>	Enables or disables ping in the modem. <code>###</code> is a string. <b>Disabled</b> and <b>Enabled</b> are the only two values that are accepted.

## D.4 Action commands

Action commands are used to perform actions on the modem such as entering low power mode, rebooting, checking for updates, clearing usage, and more.

<code>check update</code>	Starts the process that checks for both a new CELL200 series OS, and module firmware.
<code>clear logs</code>	Resets all the logs in the modem.
<code>clear usage</code>	Resets the usage counts in the modem.
<code>deep sleep</code>	Puts the modem into low power mode. Modem will not respond across the cellular network.
<code>ping ###</code>	Used to ping a specific TCP/IP address or DNS name via the terminal. <code>###</code> is a string. For example: ping 8.8.8.8 or ping jarvis.ag1t.net.
<code>reboot</code>	Forces the modem to reboot.
<code>refresh network</code>	Forces the modem to refresh its connection to the cellular network. Useful for when the network goes stale (long periods of inactivity).

<b>reset module</b>	Resets the cellular chipset only.
<b>start modupdate</b>	Starts the over-the-air module firmware update.
<b>start osupdate</b>	Starts the over the air (OTA) CELL200 series operating system update process. Not for use with a direct connection.
<b>wakeup</b>	Brings the modem fully back online. Usually done on a schedule after a deep sleep command has been issued.

# Appendix E. Verizon Wireless and AT&T

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## NOTE:

Campbell Scientific can provide Verizon Wireless or AT&T service. This is the simplest way to set up your module on the Verizon Wireless or AT&T network. See [Campbell Scientific cellular data service](#) (p. 3).

## E.1 Verizon Wireless

What you need:

- Verizon Wireless 4G LTE CAT-1 coverage at the data logger site. For a coverage map, refer to: [www.verizonwireless.com/landingpages/better-matters/#maps](http://www.verizonwireless.com/landingpages/better-matters/#maps) 
- Verizon Wireless 4G LTE private dynamic IP account in conjunction with Campbell Scientific Konect PakBus Router Service. (A Verizon Wireless 4G LTE static unrestricted IP account can also be used. However, Verizon generally requires new users to have 50 lines of service to obtain the static unrestricted IP account. Also, there is generally a \$500 one-time-per-customer charge to activate static IP on the account.)

To set up an account, you will need the IMEI number of the module. The IMEI number is listed on a label on the module. To set up an account with Verizon Wireless, call:

800-526-3178 for Business Sales

800-256-4646 for Personal Sales

Verizon Wireless will provide a SIM (Subscriber Identity Module) card for each module. The Micro-SIM (3FF) (6 position / contacts) card must be installed inside of the module as described in [Install the SIM card](#) (p. 4). In addition to the SIM card, you should receive:

- 10-digit MSISDN number (telephone number associated with the SIM, used for billing)
- An APN (Access Point Name) for 4G LTE CAT-1 service. A common APN used for this application is: VZWINTERNET. The user must program the APN into the module.
- For static IP accounts only, an IP Address will be included.

## E.2 AT&T

What you need:

- AT&T 4G LTE CAT-1 coverage at the data logger site. For a coverage map refer to: [www.att.com/maps/wireless-coverage.html](http://www.att.com/maps/wireless-coverage.html) .
- AT&T 4G LTE private dynamic IP account in conjunction with Campbell Scientific's Konect Router Service. (An AT&T 4G LTE static unrestricted IP account can also be used. However, AT&T charges \$3/month/device for the static IP account.)

To set up an AT&T account, contact your AT&T Business Account Representative or Blu-Telecommunications.

Blu-Telecommunications is part of the Alliance Channel with AT&T and can assist any customer nationwide. Blu-Telecommunications will contact AT&T and work with an AT&T account manager to set up an account.

Contact information for Blu-Telecommunication:

Website: [www.blu-tel.com](http://www.blu-tel.com) 

Phone number: (877) 422-2616, or Email box: [i2gold@blu-tel.com](mailto:i2gold@blu-tel.com)

What to ask for: M2M Setup

Who to ask for: Carlos Morales or Andy Tran

An APN (Access Point Name) must be added onto the account to make the module accessible through the Internet. For networks with fewer than 30 modules, the standard 'I2Gold APN' can be used; networks with more than 30 modules will require a 'Custom APN'. A Custom APN has a setup fee starting at \$500 and takes a minimum of 7 to 14 business days to complete. The user must program the APN into the module.

AT&T will provide a Subscriber Identity Module (SIM) card for each module. The Micro-SIM (3FF) (6 position / contacts) card must be installed inside of the module as described in [Install the SIM card](#) (p. 4). In addition to the SIM card, you should receive:

- 10-digit MSISDN number (telephone number associated with the SIM, used for billing)
- An APN (Access Point Name) for 4G LTE CAT-1 service. A common APN used for this application is: BROADBAND. The user must program the APN into the module.
- For static IP accounts only, an IP Address will be included.

# Appendix F. Cellular module regulatory information

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## F.1 Important information for North American users

**NOTE:**

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

**WARNING:**

Changes or modifications to this device not expressly approved by Campbell Scientific could void the user's authority to operate this equipment.

## F.2 RF exposure

In accordance with FCC/IC requirements of human exposure to radio frequency fields, the radiating element shall be installed such that a minimum separation distance of 20 cm should be maintained from the antenna and the user's body.

**WARNING:**

This product is only to be installed by qualified personnel.

To comply with FCC/IC regulations limiting both maximum RF output power and human exposure to RF radiation, the maximum antenna gain must not exceed the specifications listed in the following tables for the device used.

Device	Frequency Band	FCC ID XMR201606EC21A
CELL205	WCDMA Band 2	9.5 dBi
	WCDMA Band 4	6.5 dBi
	WCDMA Band 5	14.9 dBi
	LTE Band 2	9.0 dBi
	LTE Band 4	6.0 dBi
	LTE Band 12	10.7 dBi
CELL210	LTE Band 4	6.5 dBi
	LTE Band 13	10.6 dBi

## F.3 EU

Campbell Scientific hereby declares the CELL200-series devices are in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU" (RED Directive).

The CELL215 displays the CE mark.



**WARNING:**

Changes or modifications to this device not expressly approved by Campbell Scientific could void the user's authority to operate this equipment.

**WARNING:**

This product is only to be installed by qualified personnel.

The Declaration of Conformity made under Directive 2014/53/EU" (RED Directive) is available for viewing at: [www.campbellsci.com/cell215](http://www.campbellsci.com/cell215) .

# Limited warranty

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Products manufactured by Campbell Scientific are warranted by Campbell Scientific to be free from defects in materials and workmanship under normal use and service for twelve months from the date of shipment unless otherwise specified on the corresponding product webpage. See Product Details on the Ordering Information pages at [www.campbellsci.com](http://www.campbellsci.com). Other manufacturer's products, that are resold by Campbell Scientific, are warranted only to the limits extended by the original manufacturer.

Refer to [www.campbellsci.com/terms#warranty](http://www.campbellsci.com/terms#warranty) for more information.

**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.

# Assistance

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Products may not be returned without prior authorization.

Products shipped to Campbell Scientific require a Returned Materials Authorization (RMA) or Repair Reference number and must be clean and uncontaminated by harmful substances, such as hazardous materials, chemicals, insects, and pests. Please complete the required forms prior to shipping equipment.

Campbell Scientific regional offices handle repairs for customers within their territories. Please see the back page for the Global Sales and Support Network or visit [www.campbellsci.com/contact](http://www.campbellsci.com/contact)  to determine which Campbell Scientific office serves your country.

To obtain a Returned Materials Authorization or Repair Reference number, contact your CAMPBELL SCIENTIFIC regional office. Please write the issued number clearly on the outside of the shipping container and ship as directed.

For all returns, the customer must provide a "Statement of Product Cleanliness and Decontamination" or "Declaration of Hazardous Material and Decontamination" form and comply with the requirements specified in it. The form is available from your CAMPBELL SCIENTIFIC regional office. Campbell Scientific is unable to process any returns until we receive this statement. If the statement is not received within three days of product receipt or is incomplete, the product will be returned to the customer at the customer's expense. Campbell Scientific reserves the right to refuse service on products that were exposed to contaminants that may cause health or safety concerns for our employees.

# Safety

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**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](http://www.campbellsci.com). You are responsible for conformance with governing codes and regulations, including safety regulations, and the integrity and location of structures or land to which towers, tripods, and any attachments are attached. Installation sites should be evaluated and approved by a qualified engineer. If questions or concerns arise regarding installation, use, or maintenance of tripods, towers, attachments, or electrical connections, consult with a licensed and qualified engineer or electrician.

## General

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

## Utility and Electrical

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

## Elevated Work and Weather

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

## Maintenance

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

## Internal Battery

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

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



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