

5.2 Preparation

This section provides the steps required to prepare the radios for placement in the field.

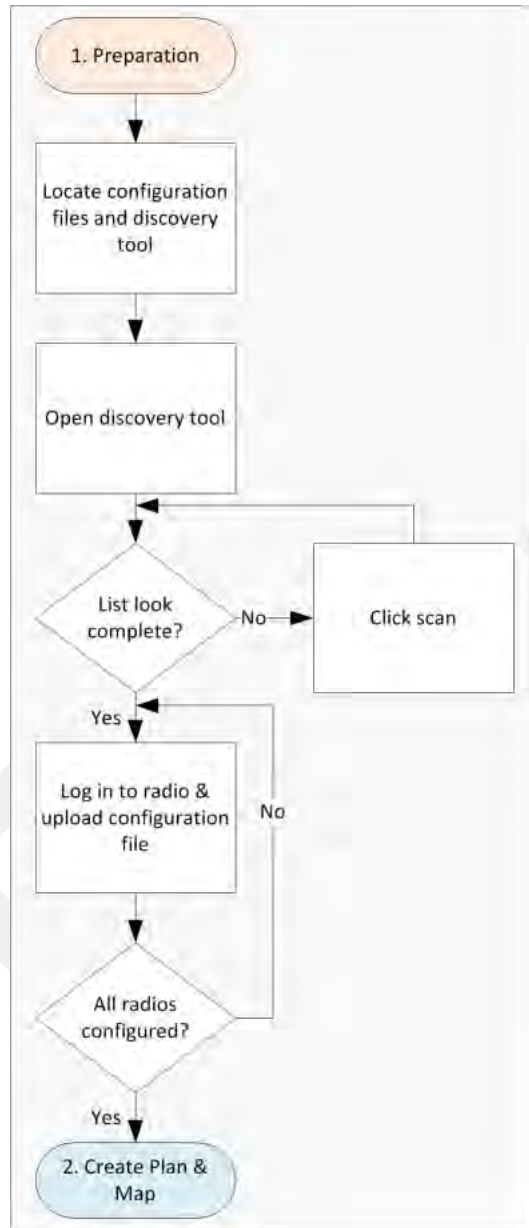


Figure 5–6 Preparation Troubleshooting Flow

There are two versions of the radios. one for use in the United States of America and Canada, and one for use internationally. Verify that you are using the correct radio and configuration files for your location.

Table 5–1 Supported Backhaul Radios

Radio	Antenna	Use For	US	INTL
			5745 - 5825 MHz	5470 - 5825 MHz
Rocket	External Omni	Recorder	15-0052	15-0054
Bullet	External Directional	Line Station	56-0019	56-0024
NanoStation	Internal Directional	Recorder -or- Line Station	56-0035	56-0032

WARNING

Operating outside of the allowed frequency range could result in sanctions by governmental regulatory agencies. Verify that all radios are correct for the market in which they will be used.

AVERTISSEMENT

Le fait de faire marcher à l'extérieur de la bande de fréquences permise pourrait s'ensuivre dans les sanctions par les agences gouvernementales de contrôle. Vérifiez que toutes les radios sont correctes pour le marché dans lequel ils seront utilisés.

OSTRZEŻENIE

Działających poza zakres częstotliwości dozwolonych może skutkować sankcjami przez rządowe agencje regulacyjne. Sprawdź, czy wszystkie radia są poprawne dla rynku, w którym będą one wykorzystywane.

If you use an international configuration file with a United States radio, or a United States configuration file with an international radio, an error message is displayed:

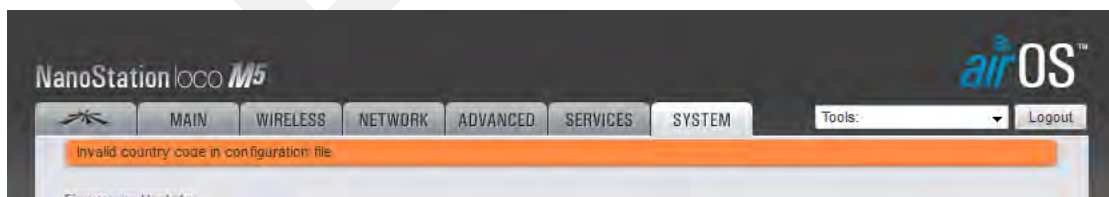


Figure 5–7 Invalid Country Code Error Message

5. Point-to-Multipoint Backhaul

Preparation



TIP

Country codes are three-digit codes defined in ISO 3166-1. See the following link for more information:

http://www.iso.org/iso/home/standards/country_codes.htm

See “H. Country Codes” on page 187 for a list of codes.



TIP

Use a Rocket radio at the recording truck in the following cases:

- You need an omni-directional antenna
- or–
- Bullet radios are used at the line stations

Use a NanoStation radio at the recording truck when you need a directional antenna.

To discover and configure the radios:

→ RT System 2 Windows computer

- 1 Verify that the configuration files for the radios and the discovery tool are on the RT System 2 Windows computer. The configuration files and the **Ubiquiti Discovery Tool** files are provided as a ZIP file. Extract the files if necessary.

The following table provides example file names for the common installation configurations. The files provided to you may have a different naming convention based on the specific job requirements; however, there will be one or more configuration files for the recorder radios and one or more configuration files for the line station radios:

Table 5–2 Example File Names

Standard Configuration	Redundant Configuration	Custom Configuration
RECORDER_A.cfg	RECORDER_A.cfg	RECORDER_A.cfg
LINE_RADIO_1.cfg	RECORDER_B.cfg	RECORDER_B.cfg
LINE_RADIO_2.cfg	LINE_RADIO_1.cfg	RECORDER_C.cfg
LINE_RADIO_3.cfg	LINE_RADIO_2.cfg	LINE_RADIO_1_RECORDER_A.cfg
LINE_RADIO_4.cfg	LINE_RADIO_3.cfg	LINE_RADIO_2_RECORDER_B.cfg
LINE_RADIO_5.cfg	LINE_RADIO_4.cfg	LINE_RADIO_3_RECORDER_C.cfg
LINE_RADIO_6.cfg	LINE_RADIO_5.cfg	LINE_RADIO_4_RECORDER_A.cfg
LINE_RADIO_7.cfg	LINE_RADIO_6.cfg	LINE_RADIO_5_RECORDER_B.cfg
LINE_RADIO_8.cfg	LINE_RADIO_7.cfg	LINE_RADIO_6_RECORDER_C.cfg

Table 5–2 Example File Names

Standard Configuration	Redundant Configuration	Custom Configuration
LINE_RADIO_9.cfg	LINE_RADIO_8.cfg	LINE_RADIO_7_RECORDER_A.cfg
LINE_RADIO_10.cfg	LINE_RADIO_9.cfg	LINE_RADIO_8_RECORDER_B.cfg
LINE_RADIO_11.cfg	LINE_RADIO_10.cfg	LINE_RADIO_9_RECORDER_C.cfg

 **NOTE**

When using a radio link (pendant) to the recording truck, the following configuration files are also required:

- Recorder-AP.cfg
- Recorder-S.cfg

- Configure the computer to be a private network with a static IP address of 192.168.1.100. See the *Troubleshooting Guide, Additional Information chapter, Setting a Static IP Address* section if you need instructions on setting the IP address (**Control Panel** → **Network and Internet** → **Network and Sharing** → **Change adapter settings** → **LAN** → **Properties** → **IPv4** → **Properties**).
- Connect a single radio to the computer.

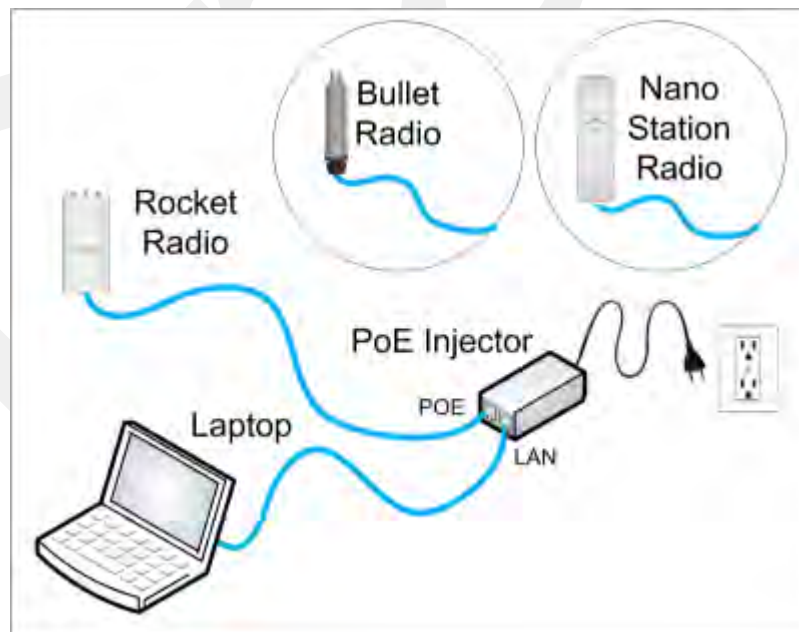


Figure 5–8 Ubiquiti Rocket/Bullet Private Network Connection

- Open the **Ubiquiti Discovery Tool** by double-clicking the shortcut on the desktop.

5. Point-to-Multipoint Backhaul

Preparation



Figure 5–9 Ubiquiti Discovery Tool Icon



TIP

Ensure that the `.bat` file and the `.jar` file are in the same directory.



NOTE

The discovery tool can also be downloaded from the following location:

<http://www.ubnt.com/download#app>

Extract the files from the downloaded ZIP file to the desktop.

- 5 The **Discovery** window opens and displays a list of all **Discovered Devices**:



NOTE

The factory default IP address for the radios is `192.168.1.20`. Configure the radios one at a time.

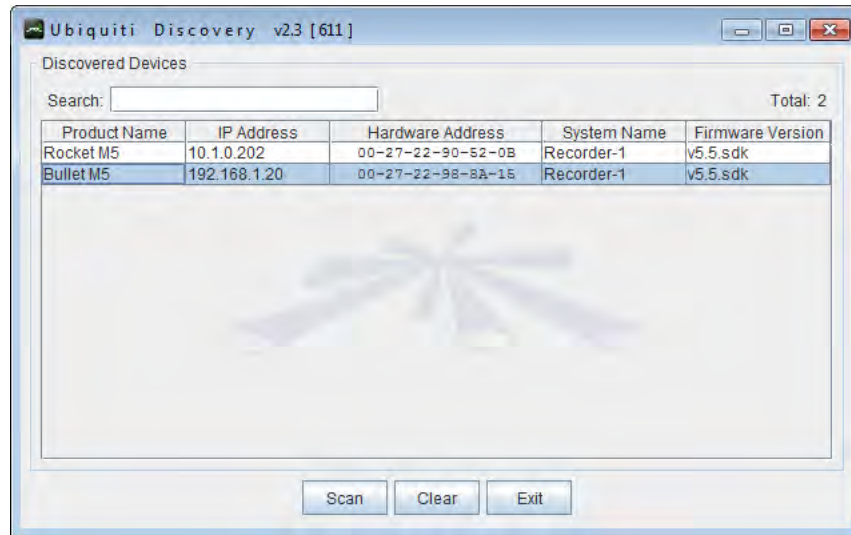


Figure 5–10 Ubiquiti Discovery Window

- 6 If the list does not look correct, click Scan.
- 7 Right-click one of the radios and then click **Web UI**. For example, right-click the following row:

Bullet M5 | 192.168.1.20 | 00-27-22-98-8A-15 | Recorder-1

and then click **Web UI**. The **airOS** login window opens:

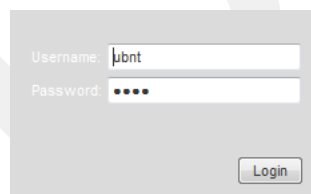
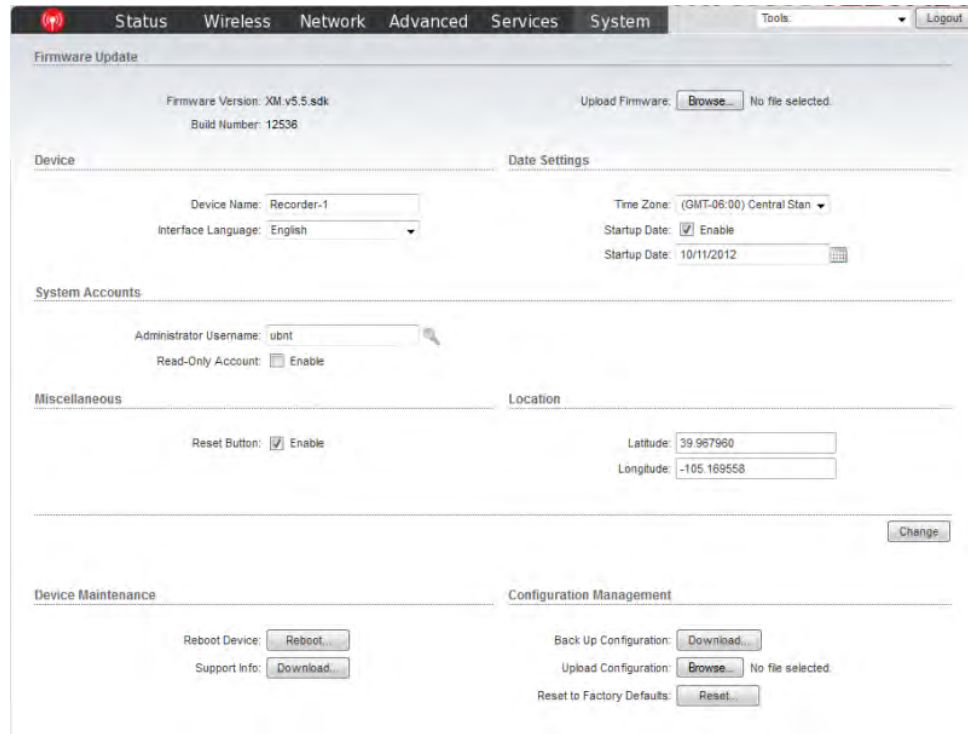


Figure 5–11 Ubiquiti Login Window

- 8 Type the following credentials and click **Login**:
 - Username: ubnt
 - Password: ubnt
- 9 The radio configuration window opens. Click the **System** tab.

5. Point-to-Multipoint Backhaul

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The screenshot shows the 'System' tab in the Ubiquiti WebUI. The top navigation bar includes 'Status', 'Wireless', 'Network', 'Advanced', 'Services', and 'System'. The 'Firmware Update' section shows 'Firmware Version: XM v5.5.sdk' and 'Build Number: 12536'. The 'Device' section includes 'Device Name: Recorder-1' and 'Interface Language: English'. The 'Date Settings' section shows 'Time Zone: (GMT-06:00) Central Stan', 'Startup Date: [checked] Enable', and 'Startup Date: 10/11/2012'. The 'System Accounts' section shows 'Administrator Username: ubnt' and 'Read-Only Account: [unchecked] Enable'. The 'Miscellaneous' section shows 'Reset Button: [checked] Enable'. The 'Location' section shows 'Latitude: 39.967960' and 'Longitude: -105.169558'. The 'Device Maintenance' section includes 'Reboot Device: Reboot...' and 'Support Info: Download...'. The 'Configuration Management' section includes 'Back Up Configuration: Download...', 'Upload Configuration: Browse... No file selected.', and 'Reset to Factory Defaults: Reset...'. A 'Change' button is located at the bottom right of the main configuration area.

Figure 5–12 Ubiquiti Rocket/Bullet Window, System Tab

- 10 In the **Device Maintenance** → **Upload Configuration** area, click **Browse**. Browse to the configuration file (for example `LINE_RADIO_1.cfg`), and then click **Upload**.



This close-up shows the 'Configuration Management' section. It includes 'Back Up Configuration: Download...', 'Upload Configuration: Browse... LINE_RADIO.cfg' (with the 'Browse...' button highlighted), and 'Reset to Factory Defaults: Reset...'. An 'Upload' button is also visible.

Figure 5–13 Upload Configuration File

- 11 Click **Apply**.

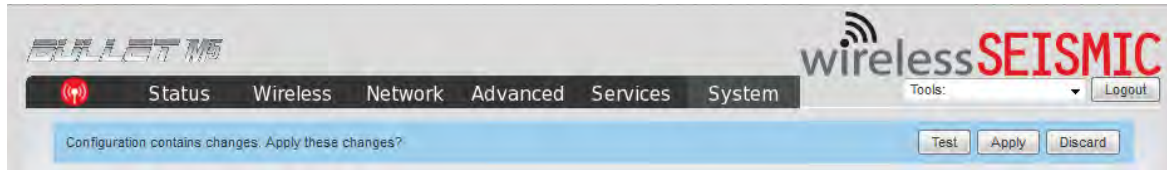


Figure 5–14 System Tab, Apply Changes

- 12 The radio reboots and obtains a new IP address if a DHCP server is active. The current session of airOS is no longer valid since the IP address of the radio has changed.
- 13 Close the browser window.
- 14 Disconnect the radio. It is now ready for deployment.
- 15 Continue connecting radios and uploading configuration files until they are all configured.
- 16 Configure a second recorder radio (RECORDER_B) if you are creating a redundant setup.
- 17 Configure any backup recorder radios if required.

5.3 Create Plan and Map

Using the documents provided for the job (survey, planned LIU locations, and so on), create a plan to plot radio locations and map the layout of the radios.



Figure 5–15 Create Plan and Map Troubleshooting Flow

Keep the following in mind as you create the layout plan:

- ◆ Point the radio pairs directly at each other whenever possible maintaining line-of-sight around obstructions (see *"Maintain Line-of-Sight"* on page 110).
- ◆ Use a tool such as Google Earth or Global Mapper to create an Elevation Profile to assist with determining the best locations for radio towers. See *"Creating a Google Earth Elevation Profile"* on page 111 for an example.

5. Point-to-Multipoint Backhaul

Create Plan and Map

- ◆ An Access Point communicates only with a Station. An Access Point cannot communicate with an Access Point, and a Station cannot communicate with a Station.

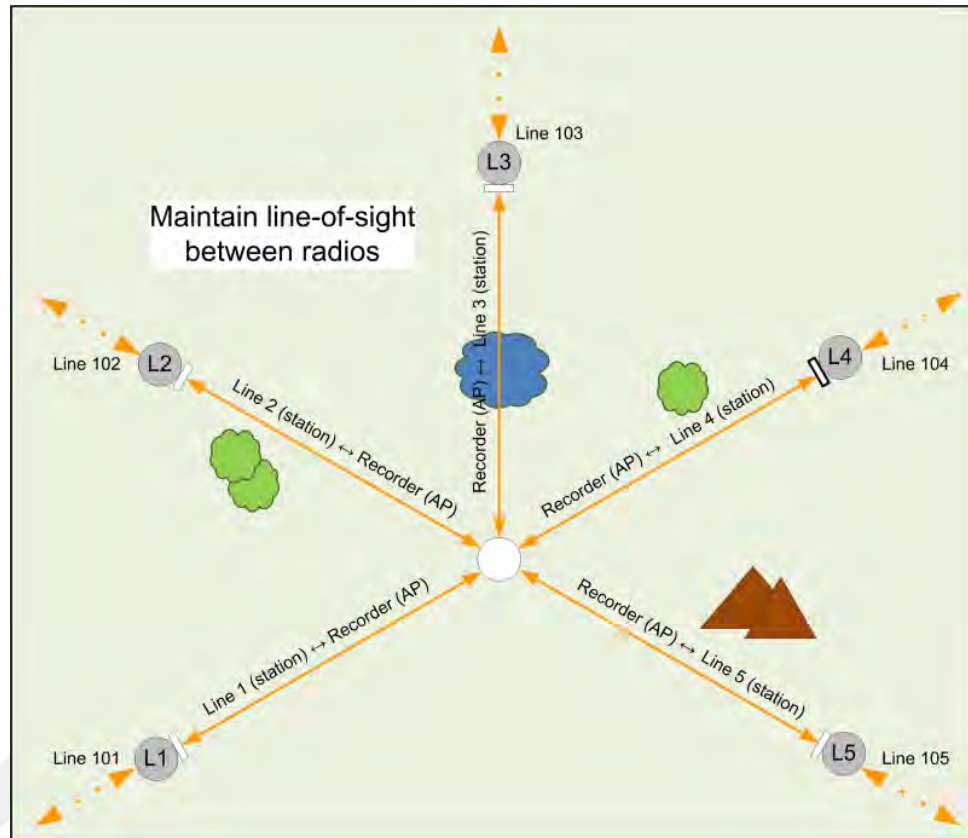
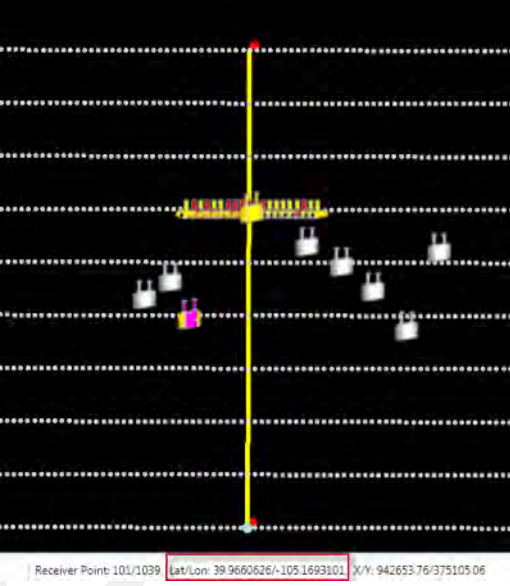
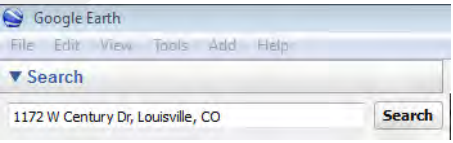
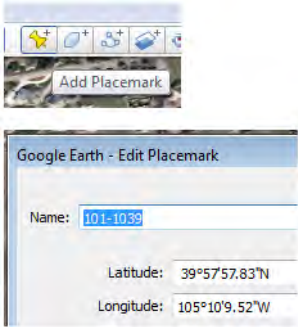


Figure 5–16 Maintain Line-of-Sight

Table 5–3 Creating a Google Earth Elevation Profile

Step	Instructions	Example Image
1	<p>In the RT System 2 Spread Manager, make a note of the Lat/Lon coordinates for the starting and ending point of the planned backhaul.</p> <p>For example:</p> <ul style="list-style-type: none"> Line101, Receiver Point 1030 Lat/Lon = 39.9660626/-105.1693101 Line 110, Receiver Point 1030 Lat/Lon = 39.9701155/-105.1692904 	
2	<p>Open Google Earth and navigate to your survey location. For example, type an address or Lat/Lon coordinates in the text box and then click Search.</p>	
3	<p>Add a placemark for the beginning and ending points of the planned backhaul.</p> <ul style="list-style-type: none"> Click Add Placemark. Type a Name, Latitude, and Longitude. The decimal value entered is automatically converted to degrees/minutes/seconds. Click OK. 	

5. Point-to-Multipoint Backhaul

Create Plan and Map

Table 5–3 Creating a Google Earth Elevation Profile (cont.)


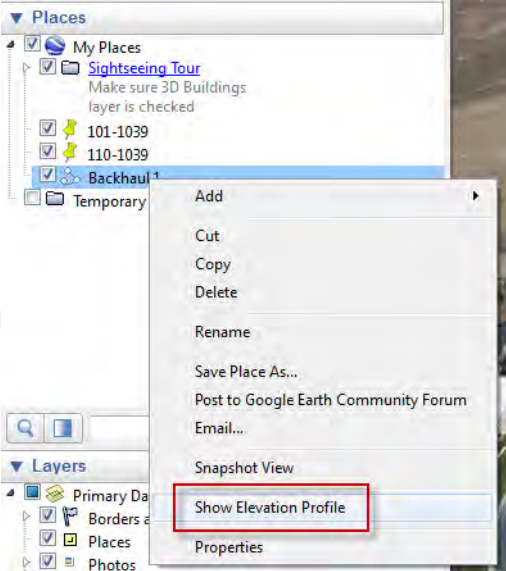
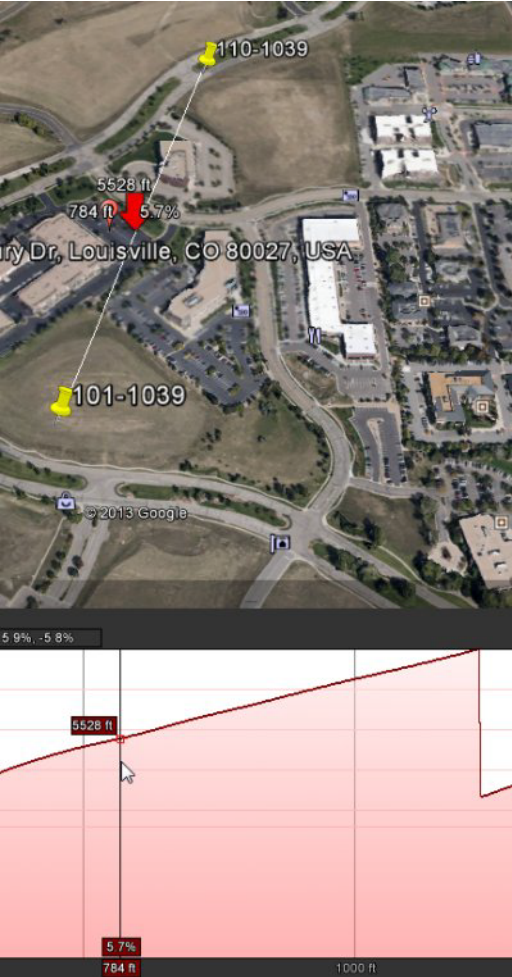
Step	Instructions	Example Image
4	<p>Add a path between the placemarks.</p> <ul style="list-style-type: none"> Click Add Path Click the first placemark. Click the second placemark. A line is drawn between the two placemarks. Type a Name and then click OK. 	
5	<p>Right-click the saved path and then click Show Elevation Profile.</p>	

Table 5–3 Creating a Google Earth Elevation Profile (cont.)

Step	Instructions	Example Image
6	<p>Refer to the elevations and numbers displayed when planning the tower locations and heights.</p> <p>See the following link for more assistance in creating and using Google Earth Elevation Profiles.</p> <p>https://support.google.com/earth/answer/181393?hl=en&ref_topic=2376756</p>	

5.4 Install and Troubleshoot

This section describes how to install the radios and troubleshoot the radio communications.

5. Point-to-Multipoint Backhaul

Install and Troubleshoot

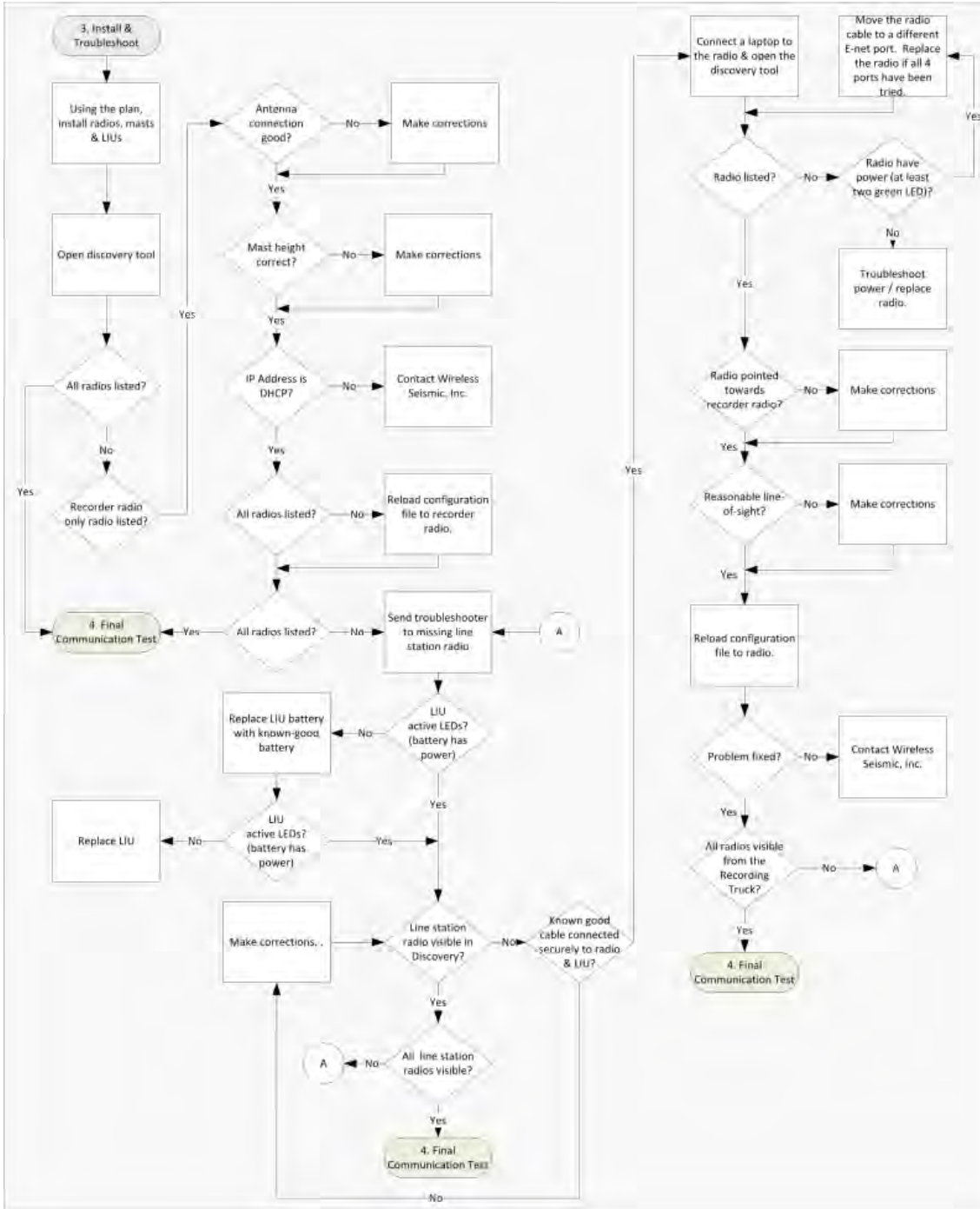


Figure 5-17 Install and Troubleshoot the Radios Flow

5.4.1 Using one Recorder Radio

This section describes how the steps to configure one recorder radio, and multiple line station radios.

To install and troubleshoot the radios:

- 1 Using the plan created in *“Create Plan and Map” on page 109*, install all of the radios, masts, and LIUs. Point radio pairs directly at each other where possible (see *“Maintain Line-of-Sight” on page 110*). Some inaccuracy is tolerable; however, align the radios as close as possible using binoculars or compass bearing.
- 2 If your configuration includes a redundant recorder radio, do not supply power to it yet (RECORDER_B).
- 3 From the recording truck, open the Ubiquiti Discovery Tool. Verify that all of the radios are listed, and verify that each of the radios has a valid IP Address. Note the following:
 - If a radio is listed, that means there is an Ethernet path to the radio.
 - If a line station radio has a valid IP address that means the DHCP is active, DHCP is being accepted by the radios, and DHCP is being passed from the recorder radio.
 - ▶ DHCP server-assigned IP addresses are 10.xxx.xxx.xxx
 - ▶ Non-DHCP server-assigned IP addresses are 192.168.1.xxx
- 4 If the recorder radio is the only radio listed, the problem is probably at the recorder radio. Perform the following steps:
 - a Verify that the recorder radio is connected to the antenna.
 - b Verify that the antenna mast is elevated to the correct height
 - c Verify that the recorder radio has DHCP by validating the IP address displayed in the Ubiquiti Discovery tool. It should not be 192.168.1.20 (factory default). If it is 192.168.1.20, contact Wireless Seismic for DHCP support.
 - d Reload the configuration file on the recorder radio.
 - e If the recorder radio is still the only radio listed, proceed to the line station radios.
- 5 If a line station radio is not listed, send a troubleshooter to the radio that is not listed and perform the following steps:
 - a Verify that the line station radio is securely connected to the LIU with a known-good cable.
 - b Verify that the LIU has active LED lights (the battery has power).
 - c Verify that the LIU has a flashing LNK LED. Note the following:
 - ▶ A flashing LNK LED confirms that the LIU can communicate over the network and obtain an IP address through DHCP.
 - ▶ This step helps identify the exact location in the network where communications are broken by proving the network is active between the two radios on a specific pole.
 - ▶ If the LNK LED is not flashing, replace the Ethernet cable.
 - ▶ If the LNK LED is still not flashing, replace the battery.
 - ▶ If the LNK LED is still not flashing, reload the radio configuration file.
 - ▶ If the LNK LED is still not flashing, replace the LIU.
 - d Verify that a known-good Ethernet cable is securely attached to the radio.
 - e Connect a laptop to the LIU.

IMPORTANT: The Ethernet ports on the LIU are PoE enabled. When connecting a laptop computer to the LIU, use a non-powered cable (60-0039) to protect the computer's Ethernet port. Do not use a powered Ethernet cable (60-0054). See *“Ethernet Cable Connections Comparison” on page 116* for more information.

5. Point-to-Multipoint Backhaul

Install and Troubleshoot

- f Open the discovery tool and verify that the radio is listed. If the radio is not listed, perform the following steps.
 - 1) Verify that the radio has power by visually inspecting the LEDs.
 - 2) If the radio has power but is not visible to the laptop, replace the radio.
 - 3) If the radio does not have power, replace the cable and/or the radio.
- g Verify that the line station radio is pointed in the direction of the recorder radio and has reasonable line-of-sight (see *"Maintain Line-of-Sight"* on page 110).
- h If the line station radio still cannot be seen, replace the radio.

The following table compares the powered Ethernet cable and the non-powered Ethernet cable:

Table 5–4 Ethernet Cable Connections Comparison

60-0039 LIU to Computer		Signal Name	60-0054 LIU to Radio PoE	
14-Pin Connector	RJ-45 Connector		RJ-45 Connector	11-Pin Connector
B	1	TX+	1	B
A	2	TX-	2	A
C	3	RX+	3	C
NC	4	POSITIVE	4	H
NC	5	POSITIVE	5	F
D	6	RX-	6	D
NC	7	RETURN	7	E
NC	8	RETURN	8	L
P	—	SHIELD DRAIN	—	P
—	—	—	NC	R*
—	—	—	NC	M*
			*Jumper pins R and M together.	

5.4.2 Using a Redundant Recorder Radio

This section describes the additional steps required to configure a redundant recorder radio.

To install and troubleshoot the redundant recorder radio:

- 1 Correctly configure the backhaul for RECORDER_A as detailed in *"Using one Recorder Radio"* on page 115.
- 2 Supply power to the RECORDER_B radio.

- 3 Wait 2 minutes to confirm that RECORDER_B completes its boot cycle.
- 4 Disconnect RECORDER_A.
- 5 Verify that all line station radios are listed in the Discovery window through RECORDER_B within 2 minutes. The typical switch over takes 30 seconds but it can take longer.
- 6 Supply power to RECORDER_A and disconnect power from RECORDER_B.
- 7 Verify that all line station radios are listed in the Discovery window through RECORDER_A.
- 8 Supply power to RECORDER_B.
- 9 Verify that all line station radios are listed in the Discovery window.
- 10 Verify that both recorder radios are listed in the Discovery window.

5.4.3 Using a Custom Configuration

Custom configurations may have a number of recorder radios and line station radios.

Correctly configure the backhaul for one of the recorders, for example, RECORDER_A, as detailed in *“Using one Recorder Radio” on page 115*.

Then, configure the backhaul for each additional recorder, for example, RECORDER_B, until the backhaul configuration is complete.



NOTE

Remove power from competing recorder radios during the configuration process. During production is the only time more than one recorder radio should have power applied.

5.5 Final Communication Test

This section describes how to run the final speed test to verify good communication throughout the backhaul. The final communication test should be run from each recorder radio that will be communicating to line radios during production.

5. Point-to-Multipoint Backhaul

Final Communication Test

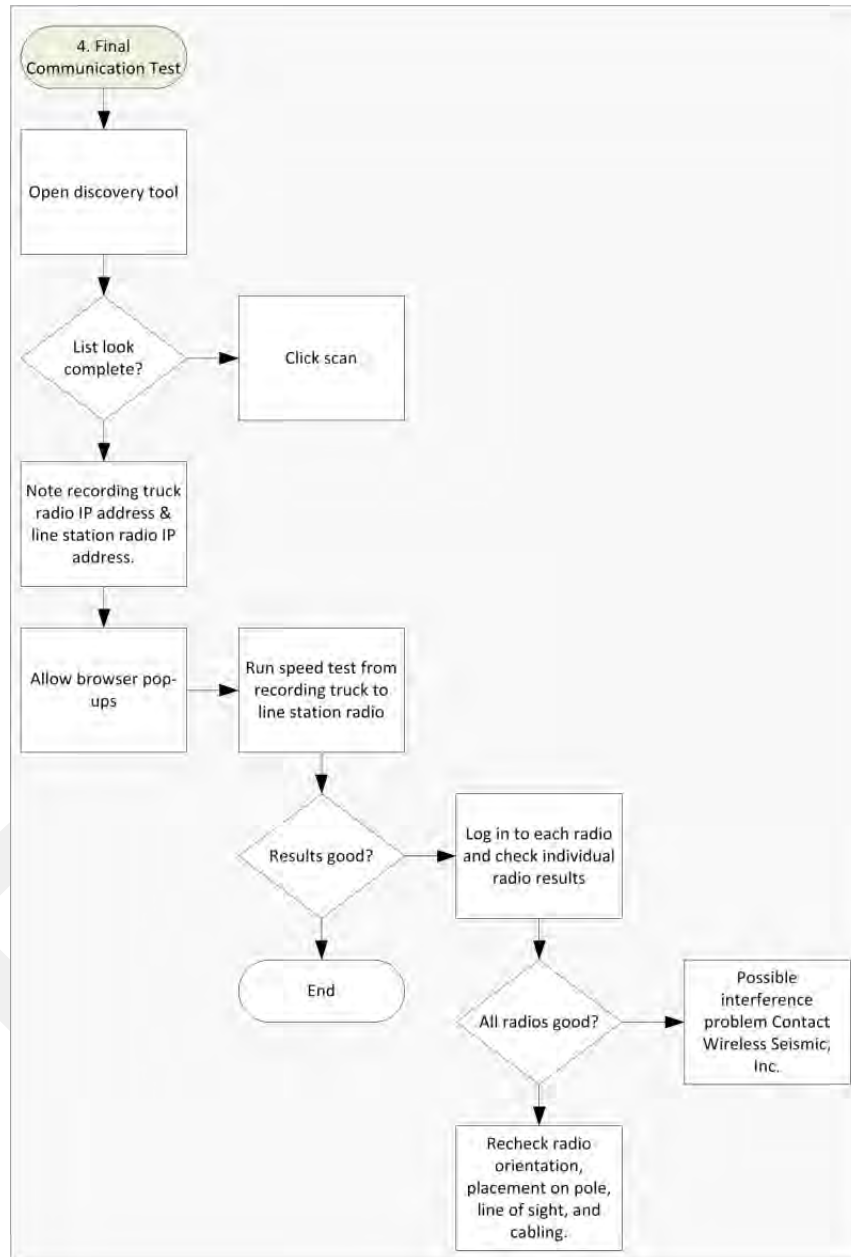


Figure 5–18 Final Communication Test Flow

To run the speed test:

- 1 Verify that all radios are listed in the **Ubiquiti Discovery Tool** as described in *step 3 on page 115* through *step 5 on page 115*

- 2 Make a note of the line segment radio IP addresses, or keep the Discovery window open for easy reference:

_____._____.

_____._____.

_____._____.

_____._____.

- 3 The speed test should be run from the recording truck radio to the line segment radios. Log in to the recording truck radio as described in *step 2 on page 105* through *step 8 on page 107*.
- 4 Verify that browser pop-ups are allowed:
- ▶ **Firefox – Tools → Options → Content** → clear the **Block pop-up windows** check box → click **OK**
 - ▶ **Internet Explorer – Tools → Internet Options → Privacy** → clear the **Turn on Pop-up Blocker** check box → click **OK**
- 5 Click **Tools** → **Speed Test**.

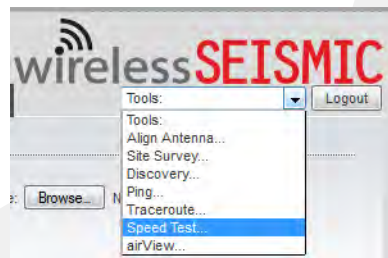


Figure 5–19 Tools, Speed Test

- 6 In the **Speed Test** window, perform the following steps:
- a Click the IP address for a line segment radio in the **Select Destination IP** list:

5. Point-to-Multipoint Backhaul

Final Communication Test

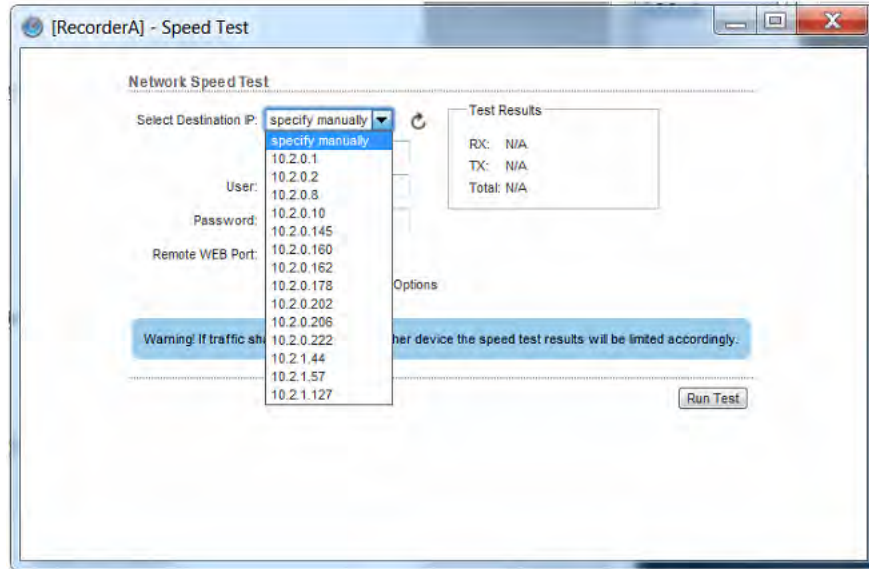


Figure 5–20 Speed Test Window

- b Type `ubnt` in the **User** text box.
- c Type `ubnt` in the **Password** text box.
- d Type `80` in the **Remote WEB Port** text box.
- e The default test **Direction** is duplex; the test is performed for both transmit and receive. If you want to run the test in only one direction, perform the following steps:
 - 1) Select the **Show Advanced Options** check box.
 - 2) Select transmit or receive.
- f Click **Run Test**.
- g If the following error is displayed, type `443` in the **Remote WEB Port** text box and click **Run Test**.

Error: Invalid remote port or web server is not running.

- h Good **Test Results** are as follows:
 - ▶ **RX** (receive) only = 70+ Mbps
 - ▶ **TX** (transmit) only = 70+ Mbps
 - ▶ **Total** (duplex) = 90+ Mbps
 - RX = 40+ Mbps
 - TX = 40+ Mbps

- 7 Click another line segment radio IP address in the **Select Destination IP** list, click **Run Test**, and then check results. Repeat for all line station radios.
- 8 If **Speed Test** results are low, perform the following steps for a Bullet radio. (Go to *step 9 on page 122*):
 - a Log in to the line station radio that displayed low **Speed Test** results.
 - b Click the **Status** tab and verify the following values:
 - ▶ **WSI-MAX (AirMax) Quality** > 80%. If the value is < 80%, check the following:

- Poor line-of-sight
 - Bad antenna connection
 - Faulty hardware (cable and/or antenna)
 - ▶ **WSI-MAX (AirMax) Capacity** >40%. If the value is < 40%, note the following:
 - The maximum capacity for the titanium bullet is 50%
 - Capacity is a reflection of quality. If the quality improves, the capacity should also improve.
 - Poor capacity is typically the result of a misaligned antenna.
 - ▶ Click AP Information in the **Monitor** area. Verify that the **Access Point Signal Strength** is between -80 dBm and -65 dBm.
- c** Verify that line station radios are pointing in the correct direction.
- d** Raise the mast towers to provide the least obstructed view as is reasonable.
- e** Check the condition of the antenna panels.
- f** Check for frayed cables or water intrusion.

5. Point-to-Multipoint Backhaul

Final Communication Test

The screenshot displays the 'Status' tab of the Bullet Radio interface. The top navigation bar includes 'Status', 'Wireless', 'Network', 'Advanced', 'Services', and 'System'. The 'Status' section provides detailed information about the radio device, including its name (Line1- Louisville), network mode (Bridge), wireless mode (Line Radio WDS), SSID (Recorder-1-Louisville), security (WPA2-AES), version (v5.5.sdk), uptime (00:08:02), and date (2012-10-31 00:07:53). It also shows channel/frequency (166 / 5830 MHz), channel width (40 MHz (Lower)), distance (0.1 miles (0.2 km)), TX/RX chains (1X1), WLAN MAC (00:27:22:98:8A:15), LAN MAC (00:27:22:98:8A:15), and LAN speed (100Mbps-Full). The AP MAC is 00:27:22:90:52:0B. Signal strength is shown as a bar chart at -59 dBm, noise floor is -90 dBm, transmit CCQ is 95.5%, and TX/RX rate is 120 Mbps / 150 Mbps. WSI-MAX is enabled with a priority of None, quality of 94%, and capacity of 39%.

The 'Monitor' section includes links for 'Throughput', 'AP Information', 'Interfaces', 'DHCP Client', 'ARP Table', 'Bridge Table', 'Routes', and 'Log'. The 'AP Information' table shows the following data:

Access Point	00:27:22:90:52:0B
Device Name	Recorder-1
Connection Time	00:07:21
Signal Strength	-58 dBm
Noise Floor	-90 dBm
Distance	0.1 miles (0.2 km)
CCQ	98%
Last IP	10.1.0.202
TX/RX Rate	90.0 Mbps / 150.0 Mbps
TX/RX Packets	1536 / 5365
TX/RX Packet Rate, pps	38 / 35
Bytes Transmitted	1109120 (1.06 MBytes)
Bytes Received	721674 (704.76 kBytes)

At the bottom of the monitor section, there are 'Reconnect' and 'Refresh' buttons. The footer of the interface reads 'Copyright 2006-2012 Wireless Seismic, Inc.'

Figure 5–21 Bullet Radio Status Tab

- 9 If **Speed Test** results are low, perform the following steps for a NanoStation radio. Use a systematic approach of testing links to identify the offending radio pairs:
 - a Log in to a Station (S) radio.
 - b Click the **Main** tab and verify the following values:
 - ▶ Signal Strength < -75 dBm
 - ▶ Either the **Vertical** or **Horizontal** (Main Tab, Stations only) < -80 (between -65 and -75 is ideal)
 - ▶ **Transmit CCQ** < 90% (100% is ideal)
 - ▶ Click **AP Information** in the **Monitor** area. Verify that the **Access Point Signal Strength** < -75 dBm

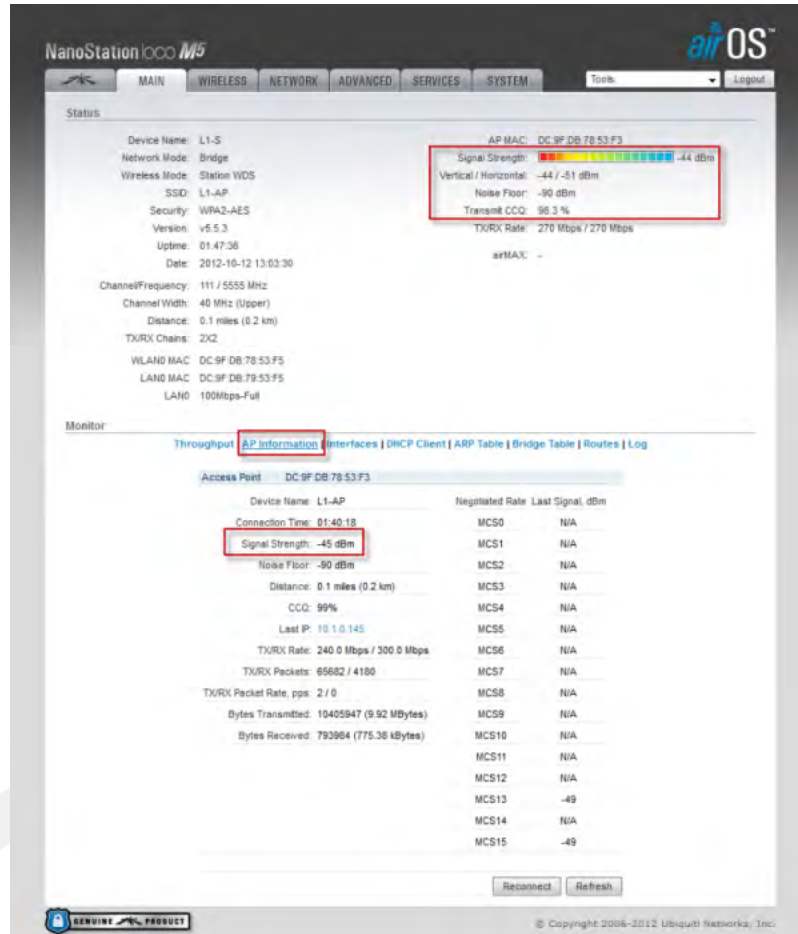


Figure 5–22 NanoStation Main Tab

- c Repeat step a and step b for all of the radios.
- 10 If the individual links are all good but the backhaul as a whole does not deliver the appropriate throughput, it indicates that there is an interference problem.
Contact Andy Prokop, Jerry Stair, or Mike Shilts for project-specific recommendations.
- 11 If there are individual links with low numbers, perform the following steps to fix them:
 - a Verify that the radios are pointing in the correct directions.
 - b Verify that there are no frayed cables or cables with water intrusion.
 - c Verify that shielding is properly installed. The following figure shows the radio/ antenna shielding:

5. Point-to-Multipoint Backhaul

Final Communication Test

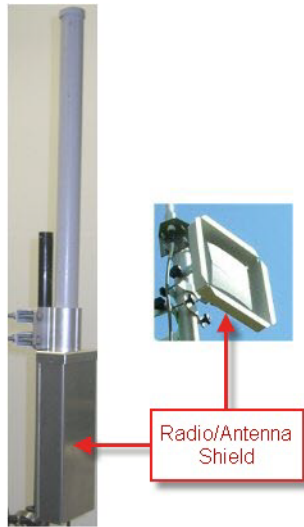


Figure 5–23 Radio/Antenna Shielding

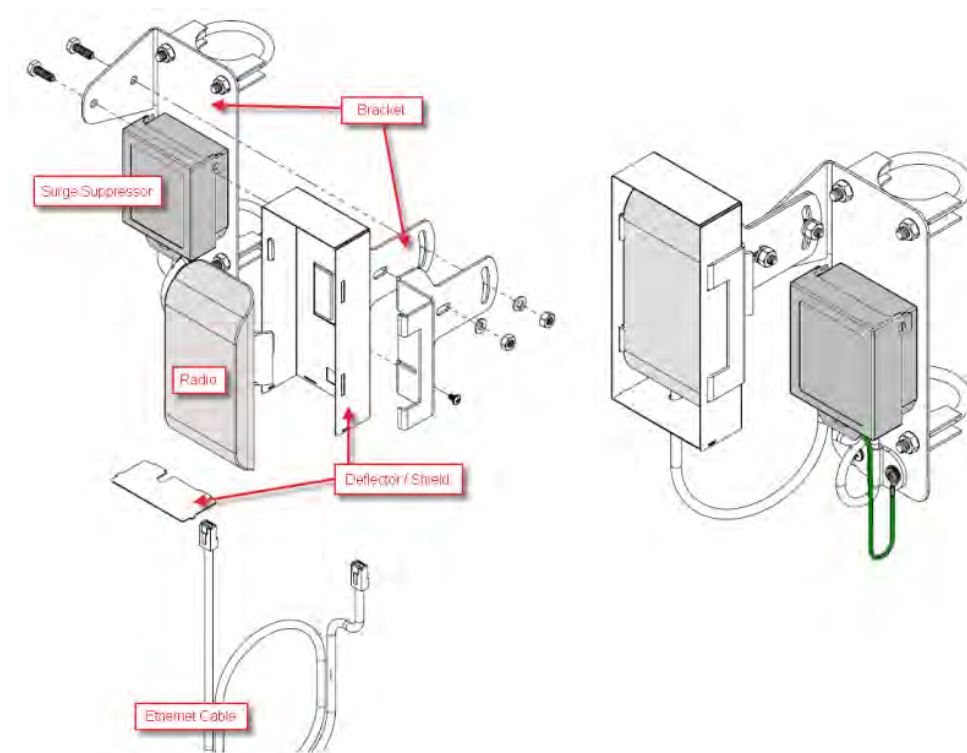


Figure 5–24 NanoStation Radio Shielding and Surge Suppressor

- d For the NanoStation radios:
- 1) Verify that the radios on the same pole are at least three feet apart.
 - 2) Verify that the Access Point (A) radio is three feet higher on the pole than the Station (S) radio.
 - 3) If possible, raise the poles (masts) to provide the least-obstructed view to the partner radio as is reasonable.

5.6 Replacing a Radio

Any number of environmental hazards could destroy an existing radio. When this happens, replace it using the following instructions:

- 1 Identify the radio that needs to be replaced.
- 2 When the radio was initially configured for the point-to-multipoint backhaul, a label was attached to the radio indicating which configuration file was used. Make a note of the configuration label (for example, Line_1_Recorder_A).
- 3 Duplicate the configuration label and attach it to the replacement radio using the same information.
- 4 Locate the corresponding configuration file (for example, Line_1_Recorder_A.cfg) and upload it to the replacement radio according to *step 2 on page 105* through *step 13 on page 109*.

5. Point-to-Multipoint Backhaul

Upload New Firmware

- 5 Mark the faulty radio is so that it does not work its way back into the spread.
- 6 Replace the radio on the pole.

5.7 Upload New Firmware

This section describes how to upload new firmware into the radio.

To upload new firmware:

→ Windows computer → Radio Configuration, System tab

- 1 Click **Browse** next to **Upload Firmware** and navigate to the supplied BIN file.
- 2 Select the file and click **Open**.
- 3 Click **Upload**.
- 4 Click **Update**.
- 5 Do not power off the radio until the firmware is updated.

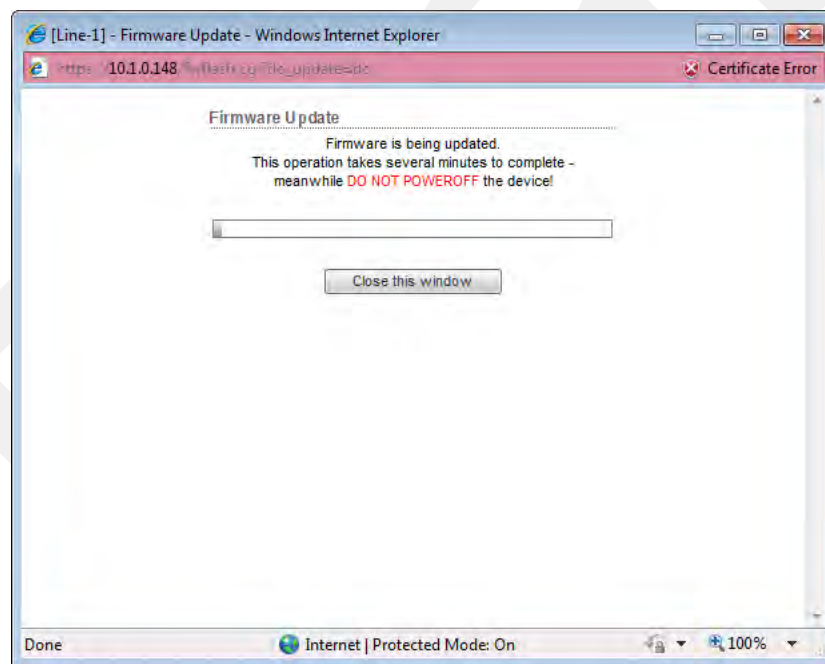


Figure 5–25 Radio Configuration, Updating Firmware

5.8 Unzipping the Configuration Files

The configuration files are delivered combined into one compressed file (config.zip).

To extract the files, use the built-in Windows 7 extraction process, or you can use a third-party tool such as 7-Zip.

To use the Windows 7 process:

- 1 Locate the ZIP file in Windows Explorer.
- 2 Right-click the ZIP file name and then click **Extract All**.
- 3 Browse to and select a folder.
- 4 Click **Extract**.

To use 7-Zip:

- 1 Download and install 7-Zip if it is not already installed:
<http://www.7-zip.org/download.html>
- 2 Locate the ZIP file in Windows Explorer.
- 3 Right-click the ZIP file name and then click **7-zip** → **Extract Files**.
- 4 Browse to and select a folder.
- 5 Click **OK**.

5.9 Connecting to the Recording Truck

The line communicates to the recording truck through an LIU using one of the following methods:

- ◆ Fiber cable
- ◆ Radio link (pendant)

The following figure shows a fiber cable connection example:

5. Point-to-Multipoint Backhaul

Connecting to the Recording Truck

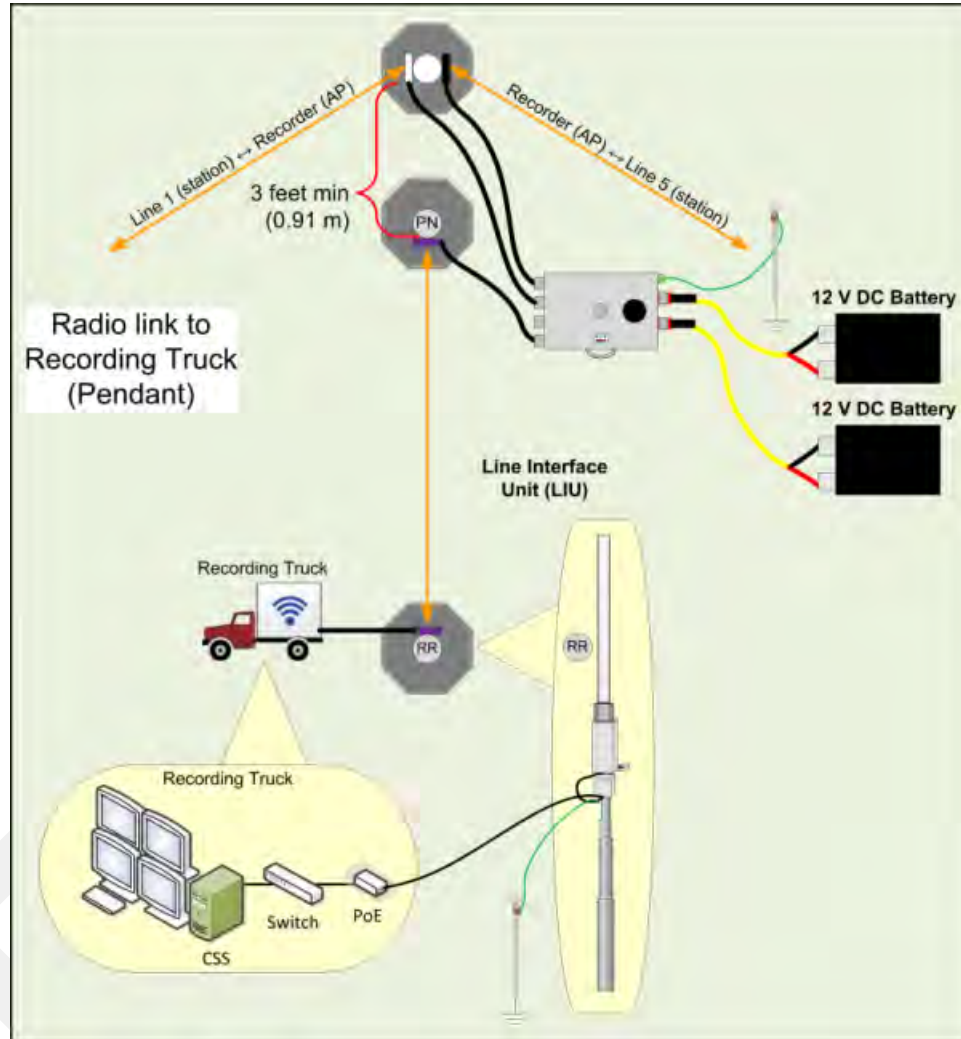


Figure 5–28 Connecting the Pendant Radio Link

The following table lists information about the pendant radio connection.

Table 5–5 Pendant Radio Link Elements

Item	Description
Configuration	<p>The following additional configuration files are provided:</p> <ul style="list-style-type: none"> • Recorder-AP.cfg • Recorder-S.cfg
RR	<ul style="list-style-type: none"> • The radio at the recording truck is a Rocket radio with an Omni antenna and is indicated in the drawings as RR (Recorder/Rocket). • Use the Recorder-AP.cfg file with this radio. • The RR radio should be installed at the top of the pole, pointing directly at the pendant radio (PN).
PN	<ul style="list-style-type: none"> • The radio at the line is a NanoStation radio with a built-in antenna and is indicated in the drawings as PN (Pendant/Nano). • Use the Recorder-S.cfg file with this radio. • The PN radio should be installed at the top of the pole, pointing directly at the recording truck radio antenna (RR). • The PN radio should be at least 3 ft (0.91 m) from the line pole (Pole 1 in the example shown in <i>"Connecting the Recording Truck with a Pendant Radio Link"</i> on page 129). Use as much distance as you can as allowed by your cable lengths. • The PN radio and pole should be between the line and the recording truck as shown in <i>"Connecting the Recording Truck with a Pendant Radio Link"</i> on page 129.
Batteries	<ul style="list-style-type: none"> • Adding a third radio to the LIU increases the battery usage at this position. To ensure that the LIU does not reset due to a low or depleted battery, keep two batteries connected to the LIU at all times. • The battery with the lowest voltage is used until the voltage falls below the Unit Thresholds ? LIU Voltage Warning number (usually about 11V). At this point, the LIU auto-swaps to the battery with the higher voltage. Monitor the battery status in the Ground Equipment Table. Replace the low-voltage battery with a fully-charged battery as soon as possible after the battery auto-swap occurs.

5. Point-to-Multipoint Backhaul

Connecting to the Recording Truck

After the pendant radio link radios are configured and installed, log in to the PN radio and set the power level to the minimum amount required to achieve communication with the RR.

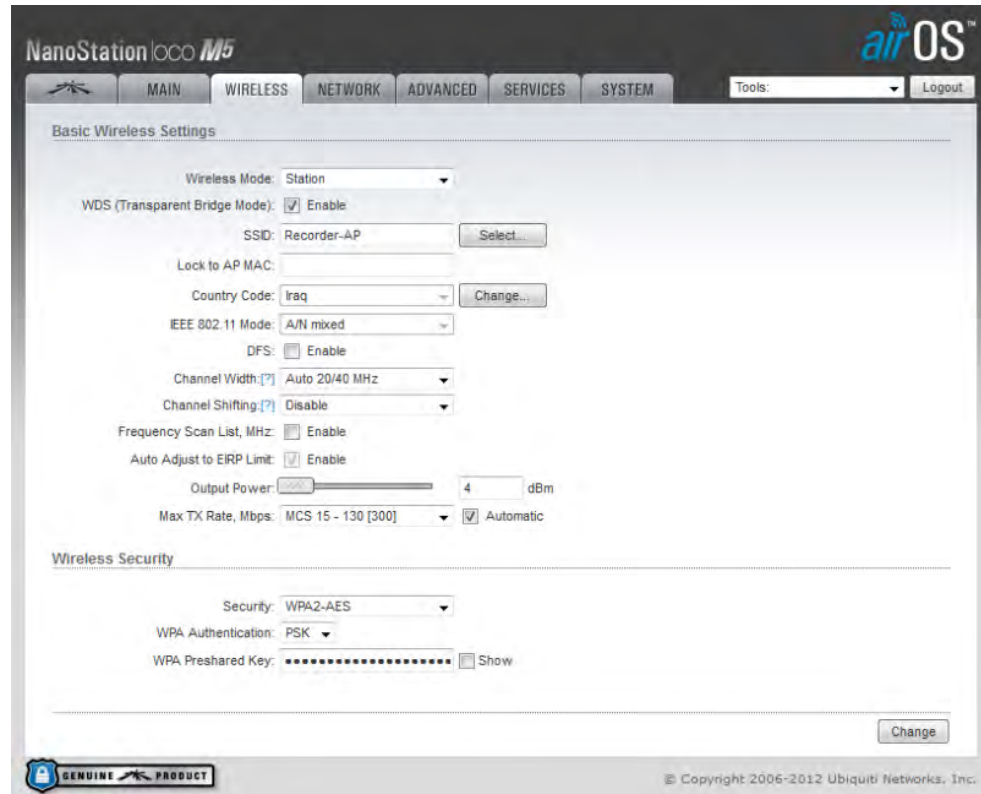


Figure 5–29 Wireless Tab

To set the PN radio power level:

- 1 Click the **Wireless** tab.
- 2 Move the **Output Power** slider bar to the desired power level.
- 3 Click **Change** at the bottom of the window.
- 4 Click **Apply Command** at the top of the window.
- 5 Wait 30 – 60 seconds.

Demobilization

6.1 Overview

This chapter describes how to prepare (undeploy) the ground electronics for transport at the end of a project (demobilization).

6.2 Removing the WRU from the Field

This section describes the process to ready the WRU for movement to a new physical location or to remove it in preparation for demobilization.

To undeploy the WRU:

- 1 Prerequisites:
 - The WRU is assembled with battery, geophone, and antenna (and extender)
 - The WRU is in an active, transitional, or ready state
- 2 Pick up the WRU and point the geophone connector end towards the sky as shown in the following figure. Within a few seconds, all of the LEDs illuminate:

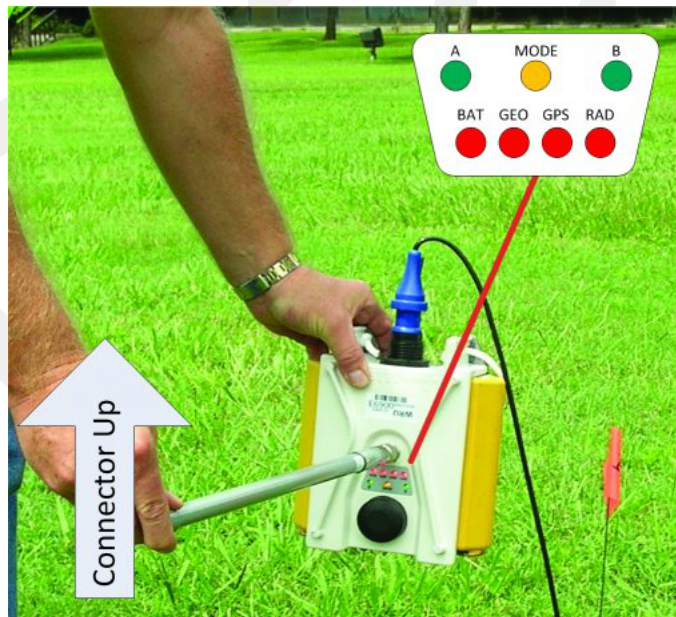


Figure 6–1 Power Off the Unit

- 3 Within 5 seconds, place the unit flat in the transportation vehicle as shown in the following figure. The LEDs on the top of the unit turn off and then flash on briefly to indicate the WRU is undeployed and the unit shuts down.

6. Demobilization

Disassemble the WRU



Figure 6–2 Undeployed Unit

- 4 Optional: Remove batteries, antenna, or geophone as described in *“Disassemble the WRU”* on page 134.

6.3 Disassemble the WRU

This section describes the process to disassemble the WRU prior to demobilization.

To disassemble the WRU:

- 1 Undeploy the equipment as described in *“Removing the WRU from the Field”* on page 133.
- 2 Remove the antenna (and extender) from the unit.
- 3 Remove the geophone from the unit.
- 4 Remove the batteries from the unit.
 - Press the catch on the battery latch.
 - Lift the lever, but do not lift the bail from the molded area on the battery.
 - Continue to lift the lever using the bail to push the battery out of the connector.

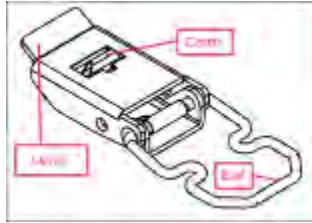


Figure 6–3 Removing the Battery

- 5 Secure the equipment in the transport vehicle.

Batteries

See “Batteries” on page 192 for the French translation of this chapter.

Voir “Batteries” sur la page 192 pour la traduction française de ce chapitre.

This chapter provides information about the batteries and battery requirements used in the Wireless Seismic, Inc. RT System 2.

7.1 Lithium Ion Batteries

This section provides information regarding the characteristics, use, and handling of lithium ion batteries. See the following sections for details:

- ◆ “Specifications” on page 136
- ◆ “Handling and Safety Guidelines” on page 137
- ◆ “Transportation” on page 138
- ◆ “Storage” on page 139

7.1.1 Specifications

The RT System 2 uses one or two custom intelligent lithium-ion batteries with self-contained charging circuitry that protects the batteries from overcharge, discharge, short circuits, or extreme temperature charging.

Battery specifications are shown in the following table:

Table 7–1 Lithium Ion Battery Specifications

Item	Description	Value
Voltage	Nominal	3.7 VDC
	Shut-off	2.8 VDC
	Full (90%) charge	4.1 VDC
	Overcharge Voltage	4.28 VDC
	Over Discharge Voltage	2.80 VDC
Current	Maximum Charge Current	2 A
	Consumption Active Mode	4.2 mA maximum
	Consumption Sleep Mode	66 μ A maximum
Full (90%) charge mAh	Approximately 12,000 mAh at nominal voltage	—
Full (90%) charge mWh	Approximately 44,400 mWh at nominal voltage	—
Capacity		48.8 Watt hours

Table 7–1 Lithium Ion Battery Specifications (cont.)

Item	Description	Value
Connector	5-pin	—
LED	One LED that indicates charging status when connected to the charging station as follows	<ul style="list-style-type: none"> • Green – Charged • Red – Charging • Amber – Transitional phase between charging and charged, or charge temperature limits exceeded
Label	One bar code serial number label	—
Temperature	Operating	From -40°C to +85°C
	Charging	From -5°C to +45°C
	Ambient Storage	<ul style="list-style-type: none"> • From -20°C to +45°C for a maximum period of one month • From -20°C to +35°C for a maximum of 6 months, after which time the battery packs will need to be recharged to above 50% capacity

7.1.2 Handling and Safety Guidelines

Observe the following handling and safety guidelines:

- ◆ If a battery pack has leaking fluids, do not touch any fluids. Dispose of a leaking battery pack. In case of eye contact with fluid, do not rub eyes. Immediately flush eyes thoroughly with water for at least 15 minutes, lifting upper and lower lids until no evidence of the fluid remains. Seek medical attention.
- ◆ Do not disassemble, crush, or puncture a battery
- ◆ Do not short the external contacts on a battery
- ◆ Do not dispose of a battery in fire or water
- ◆ Do not expose a battery to temperatures above 60 °C (140 °F)
- ◆ Keep the battery away from children
- ◆ Avoid exposing the battery to excessive shock or vibration
- ◆ Do not use a damaged battery
- ◆ Lithium Ion battery packs MUST be completely discharged before disposal
- ◆ Although there may be local or state restrictions, lithium ion batteries are considered by the Federal Government as “non-hazardous universal waste”. There are restrictions for large quantity handlers of universal waste that define labeling, containment, and so on. Whenever possible the batteries must be discharged before disposal. Battery leads/ contacts should be taped off to prevent accidental shorting. Each battery pack should be placed in a plastic bag.
- ◆ Recycling is encouraged when practical and applicable. The batteries contain recyclable material and are accepted by several battery recycling companies. Refer to one of the following for more information on recycling and disposal:
 - <http://www.swe.com>

7. Batteries

Lithium Ion Batteries

- <http://www.rbr.org>
- <http://www.call2recycle.org>
- 1-800-8-BATTERY
- 1-877-2-RECYCLE

7.1.3 Transportation

In the United States, large lithium ion battery shipments (more than 24 cells or 12 batteries per package) are regulated as hazardous material (Class 9) by the Federal Government and are subject to the regulations described in the following:

- ◆ Code of Federal Regulations, Title 49 Transportation
http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?sid=92868a82add6feba6afa796572133179&c=ecfr&tpl=/ecfrbrowse/Title49/49tab_02.tpl
- ◆ International Air Transport Association (IATA)
http://www.iata.org/whatwedo/cargo/dangerous_goods/pages/lithium_batteries.aspx

Batteries can be ground shipped only if all of the following conditions are met:

- ◆ Box used meets the 1.2 m drop test box ("UN" rated box) for packaging
- ◆ Battery pack terminals are protected to prevent a short circuit
- ◆ Gross weight does not exceed 30 kg (66 pounds)
- ◆ Outer package is labeled with the current required label. An example is shown in the following figure.



Figure 7–1 Example Battery Shipping Label

Batteries can be air shipped only if all of the following conditions are met:

- ◆ Box used meets the 1.2 m drop test box ("UN" rated box) for packaging
- ◆ Maximum weight of each package does not exceed 10 kg (22 lbs)
- ◆ Battery pack terminals are protected to prevent a short circuit

- ◆ Outer package is labeled with the current required label. An example is shown in the previous figure (“*Example Battery Shipping Label*” on page 138).

WARNING

The information contained in this document is intended to provide general awareness of battery regulations; it is not comprehensive, and the requirements referenced herein may have changed. Nothing in this chapter or the Deployment Guide constitutes legal advice or is intended to address any specific legal, compliance, or regulatory issues that may arise in particular circumstances. This chapter and the Deployment Guide are not intended to replace current, official regulations regarding the packaging and shipment of hazardous materials or independent legal counsel on these issues. You are solely responsible for compliance with all applicable laws, regulations, and other requirements. Please refer to an official copy of the current version of these documents for the latest information.

OSTRZEŻENIE

Informacje zawarte w niniejszym dokumencie ma na celu ogólną świadomość przepisów baterii; nie jest to wyczerpujące i wymogi zawarte w niniejszym dokumencie mogły ulec zmianie. Nic w niniejszym rozdziale lub podręcznik wdrażania jest poradą prawną i jest przeznaczony do żadnych konkretnych prawnych, zgodności lub kwestii regulacyjnych, które mogą powstać w szczególności okoliczności. Ten rozdział i przewodnik wdrażania nie są przeznaczone do zastąpienia bieżącej, oficjalne przepisy dotyczące pakowania i wysyłki materiałów niebezpiecznych lub niezależnego adwokata w tych kwestiach. Jesteś całkowicie odpowiedzialny za przestrzeganie wszystkich przepisów, rozporządzeń i inne wymagania. Zajrzyj do oficjalnej kopię aktualnej wersji tych dokumentów, aby uzyskać najnowsze informacje.

7.1.4 Storage

Proper storage and maintenance of Lithium Ion batteries is essential to maximize their useful life and avoid catastrophic failure. Observe the following storage precautions:

- ◆ Remove the batteries from the WRU for storage
- ◆ The recommended storage temperature for Lithium ion batteries is as follows:
 - From -20°C to +45°C for a maximum period of one month
 - From -20°C to +35°C for a maximum of 6 months, after which time the battery packs will need to be recharged to above 50% capacity
 - Storing at cooler temperatures slows down self discharge and capacity loss over time. Store the batteries at 25°C or less if possible
- ◆ The recommended storage charge levels are as follows:
 - Charge (or discharge) batteries to a 30% to 50% charge level before placing into storage. Higher or lower charge levels can reduce the battery life.
 - Never store the battery completely depleted of charge unless for disposal.
 - Periodic charging is necessary to maintain 30% to 50% charge when stored for a long period of time
- ◆ Store batteries in a well ventilated area
- ◆ Do not leave batteries unused for extended periods of time, either in the product or in storage. When a battery has been unused for 6 months, check the charge status and charge or dispose of the battery as appropriate.

7. Batteries

Charging Lithium Ion Batteries

- ◆ Routinely check the battery's charge status
- ◆ Consider replacing the battery with a new one if you note either of the following conditions:
 - The battery run time drops below about 80% of the original run time
 - The battery charge time increases significantly

7.2 Charging Lithium Ion Batteries

7.2.1 Charging Precautions

Observe the following charging precautions:

- ◆ Prior to charging, inspect the battery for any visible damage to the case or connector that could create an electrical shortage.
- ◆ The temperature range over which the battery can be charged is 0°C to +45°C. Charging the battery outside of this temperature can cause the battery to become hot or to break.
- ◆ Be absolutely sure that only a 5 V source is used when charging the battery.
- ◆ Care should be taken to charge batteries on a fireproof surface.
- ◆ Do not charge batteries near flammable items or liquids.
- ◆ Keep a Class C Dry Chemical fire extinguisher nearby.
- ◆ Do not continue recharging the battery if it does not recharge within the specified charging time.
- ◆ A lithium ion battery should NEVER be left unattended while charging.

7.2.2 Battery Charger

The lithium ion battery charger is designed to operate from a single 10 A, 120 VAC service line.

The power supply to charge the battery pack is a 5VDC regulated voltage supply.



Figure 7–2 Battery Charger



Figure 7–3 Serial Number Label and LED Indicator

7. Batteries

Charging Lithium Ion Batteries

 **CAUTION**

Risk of explosion if battery is replaced by an incorrect type. Dispose of used batteries according to the instructions.

 **PRUDENCE**

Le risque d'explosion si la batterie est remplacée par un type incorrect. Débarrassez-vous utilisées batteries selon les instructions.

 **UWAGA**

Ryzyko eksplozji, jeśli bateria zastępuje niepoprawny typ. Wrzucaj baterii używany zgodnie z instrukcjami.

Legal Information

See "l'information juridique" on page 198 for the French translation of this chapter.

Voir "l'information juridique" sur la page 198 pour la traduction française de ce chapitre.

A.1 FCC Rules and Regulations Compliance

The Federal Communications Commission (FCC) regulates the use of antennas in the "Code of Federal Regulations – Title 47, Part 15 – Radio Frequency Devices, Subpart C – Intentional Radiators, Section 15.203 Antenna Requirement."

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.

When used as intended, the RT System 2 complies with FCC Section 15.203 and Industry Canada RSS-Gen 7.1.2 requirements as follows:

- ◆ The RT System 2 antennas shall be installed and handled by professionals specifically designated for this purpose.
- ◆ Changes or modifications not expressly approved by Wireless Seismic, Inc. can void the users's authority to operate the equipment.
- ◆ The RT System 2 shall be used with only the supplied antennas (Table A–1) attached to the WRU or LIU with an integrated type N male connector.

Table A–1 Antenna Specifications

Model	Frequency (MHz)	Gain	Vertical Bandwidth	Weight	Dimension (Length x Diameter)
WSI 65-0204 (antenna-standard)	2400	5.5 dBi	25°	0.4 lbs .2 kg	32 x 0.6 in 810.5 x 15 mm
WSI 65-0091 (extender-standard)	2400	0 dBi	N/A	0.6 lbs 0.3 kg	30 x 0.7 in 762 x 18.5 mm

WARNING

In order to comply with radio frequency (RF) exposure requirements, the RT System 2 units must be installed so that a minimum separation distance of 20 cm is maintained between the antenna(s) and the body of all persons at all times during normal operation.



OSTRZEŻE

W celu spełnienia wymogów ekspozycji częstotliwości radiowej (RF), RT System 2 jednostki muszą być zainstalowane tak, że minimalna odległość 20 cm jest utrzymywane między znajdować się w położeniu i ciała wszystkich osób przez cały czas podczas normalnej pracy.

FCC equipment authorization has been granted as follows:

- ◆ The 5Mbps Line Interface Unit has been granted FCC equipment authorization.
- ◆ The 5Mbps Wireless Remote Unit has been granted FCC equipment authorization.

A.2 Industry Canada Compliance

The Wireless Remote Unit has been granted Industry Canada (IC) approval and certification per RSS-210 Issue 8 and RSS-102 Issue 4.

This Class A digital apparatus complies with Canadian ICES-003.

The Line Interface Unit (LIU) has been granted Industry Canada (IC) approval and certification per RSS-210 Issue 8 and RSS-102 Issue 4.

This Class A digital apparatus complies with Canadian ICES-003.

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

- ◆ This device may not cause harmful interference, and
- ◆ This device must accept any interference received, including interference that may cause undesired operation.

A.3 CE Compliance

The Wireless Remote Unit (WRU) and Line Interface Unit (LIU) comply with applicable EU directives for the Conformité Européene (CE) mark. The following mark is affixed to each unit.



Figure A-1 CE Mark

WRU and LIU Specifications

This section provides the WRU and LIU specifications. See the following sections for more information:

- ◆ "WRU Specifications" on page 145
- ◆ "LIU Specifications" on page 146

B.1 WRU Specifications

The following table provides the WRU Specifications:

Table B-1 WRU Specifications

Item	Description
Power source	3.7Vdc nominal – accessory battery voltage
Operating temperature	-40°C to +75°C
Humidity	0 to 100%
Environmental Rating	IP67
Dimensions	5.79 W x 2.83 H x 9.01 L in. (14.7 W x 7.2 H x 22.9 L cm)
Dimensions with 2 batteries	Standard – 7.71 W in. (19.58 W cm) High capacity – 9.17 W in. (26.66 W cm)
Weight	Stand-alone: 4.02 lbs. (1.83 Kg)
Weight with 2 batteries and antenna	Standard – 6.5 lbs. (2.95 Kg) High capacity – 7.71 lbs. (3.50 Kg)

B.2 LIU Specifications

The following table provides the LIU Specifications:

Table B-2 LIU Specifications

Item	Description
Maximum PoE output power	40W
Power source	11.9Vdc-18Vdc battery
Operating temperature	-40°C to +75°C
Humidity	0 to 100%
Environmental Rating	IP67
Dimensions	5.42 W x 9.44 H x 14.21 L inches (24 W x 14 H x 36 L centimeters)
Weight	13 lbs. (5.9 Kg)

Radio Specifications

This section provides the backhaul radio and antenna specifications. See the following sections for more information:

- ◆ *"Antenna Specifications" on page 147*
- ◆ *"Radio Specifications" on page 154*

C.1 Antenna Specifications

This section provides the antenna specifications. See the following sections for more information:

- ◆ *"Bullet Line Station Antenna" on page 147*
- ◆ *"Rocket Recorder Antenna" on page 150*
- ◆ *"NanoStation Recorder/Line Station Antenna" on page 153*

C.1.1 Bullet Line Station Antenna

The remote (line) station backhauls using the Ubiquiti Bullet radios support the following antennas:

- ◆ **6 dBi antenna** (65-0179) – This antenna is a UV stable, omnidirectional vented radome that can sustain extreme weather conditions such as heat, wind, and rain, and can be mounted to a mast, ceiling, or wall.
- ◆ **19 dBi directional antenna** (65-0177) – This antenna is a UV-resistant, directional flat-panel ABS plastic radome antenna with an aluminum back plate. It can be surface or pole mounted and adjusted 45 degrees up or down.



**Figure C-1 19 dBi Antenna
(65-0177)**

C. Radio Specifications

Antenna Specifications



Figure C-2 6 dBi Antenna (65-0179)

The supported line station antenna specifications are as follows:

Table C-1 Antenna Specifications, 6 dBi (65-0179)

Item	Description	Radiation Patterns
Model	T58060010006	<p style="text-align: center;">Vertical Radiation Pattern</p>
Frequency Range	5725 to 5850 MHz	
Bandwidth	125 MHz	
Gain	6 dBi	
Vertical Beamwidth	25°	
VSWR	-/≠ 1.5	
Impedance	50 Ohms	
Polarization	Vertical	

Table C-1 Antenna Specifications, 6 dBi (65-0179) (cont.)

Item	Description	Radiation Patterns
Maximum Power	100 Watts	<p>Horizontal Radiation Pattern</p>
Connector	N-Style Jack	
Height	10.6"	
Weight	0.5 lbs	
Horizontal Beamwidth	360°	
Rated Wind Velocity	135 mph	
Operating Temperature	-22°F to 158 °F -30 to 70 °C	

Table C-2 Antenna Specifications, 13 dBi (65-0177)

Parameter	Min	Typ	Max
Frequency Range	5150 MHz		5825 MHz
Gain		19 dBi	
Horizontal Beamwidth		16 Deg	
Vertical Beamwidth		16 Deg	
Front to Back	30 dB		
Cross Polarization	25 dB		
VSWR			
• 5150-5350MHz	2.0:1		
• 5470-5825MHz	1.5:1		
Impedance		50 OHM	
Input Power			100W
Operating Temperature	-40 °F -40 °C		158 °F 70 °C
Pole Size	1 in 25 mm		2.5 in 64 mm

C. Radio Specifications

Antenna Specifications

Table C-2 Antenna Specifications, 13 dBi (65-0177) (cont.)

Parameter	Min	Typ	Max
Weight		17.6 oz 0.5 kg	
Dimension (L x W x Thick)		7.5 x 7.5 x 0.8 in 190 x 190 x 20 mm	
Bracket Tilt		45 Deg	
Radiation Pattern			

Table C-3 Antenna Wind Loading, 13 dBi (65-0177)

Parameter	Area	100 mph 161 kph	125 mph 201 kph
Wind Loading	56 sq in 0.04 sq m	14 lbs 6.4 kg	22 lbs 10 kg

C.1.2 Rocket Recorder Antenna

The recorder station backhaul using the Ubiquiti Rocket radio supports a 13 dBi antenna. This antenna is a 2x2 Dual Polarity MIMO Omnidirectional Antenna that provides 360 degree coverage.



Figure C-3 13 dBi Antenna (65-0178)

The supported recorder antenna specifications are as follows:

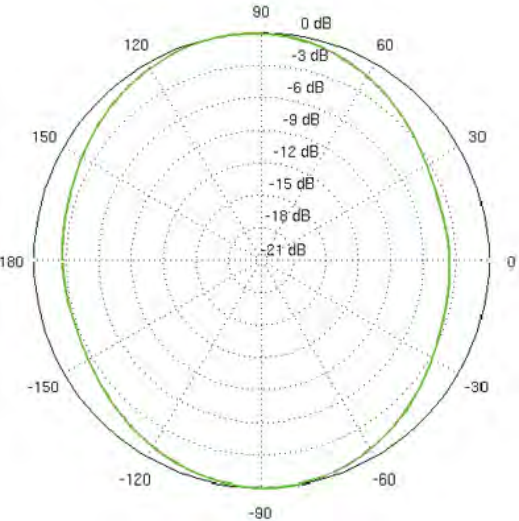
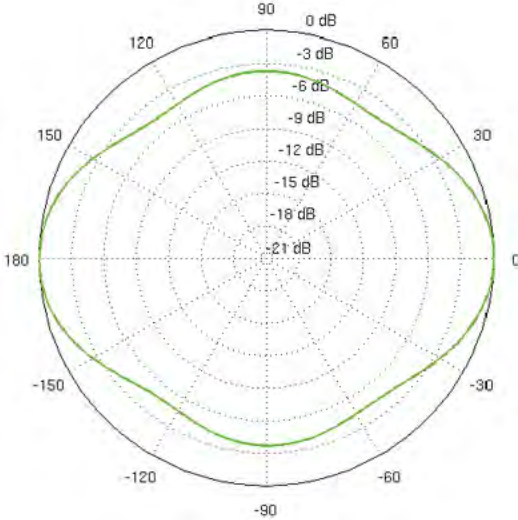
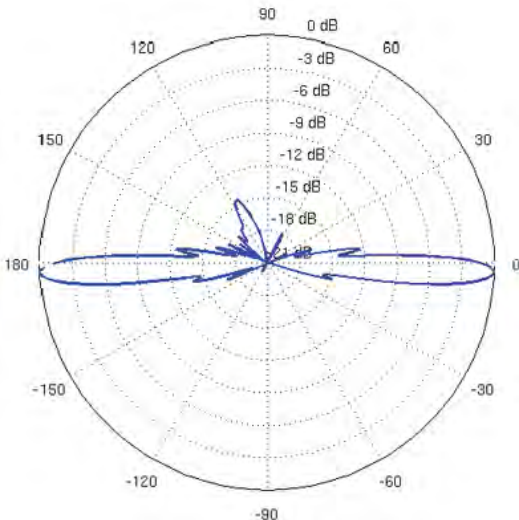
Table C-4 Antenna Specifications, 13 dBi (65-0178)

Item	Description	Radiation Patterns
Frequency Range	5.45 to 5.85 GHz	
Gain	13 dBi	
Elevation Beamwidth	7 deg	
Max VSWR	1.5:1	
Downtilt	2 deg	
Dimensions L x W x H	6.2 x 3.8 x 32.8 in 158 x 98 x 834 mm	
Weight (including pole mount)	1 lb 13 oz 820 g	
Wind Survivability	125 mph 201 kph	

C. Radio Specifications

Antenna Specifications

Table C-4 Antenna Specifications, 13 dBi (65-0178) (cont.)

Item	Description	Radiation Patterns
Wind Loading	10 lb @ 100 mph 4.5 kg @ 161 kph	<p data-bbox="889 415 1214 457"><i>Horizontal Azimuth</i></p>  <p data-bbox="326 1077 602 1119"><i>Vertical Azimuth</i></p>  <p data-bbox="915 1083 1203 1125"><i>Vertical Elevation</i></p> 
Polarization	Dual Linear	
Cross-pol Isolation	25 Db min	
ETSI Specification	EN 302 326 DN2	
Mounting	Universal pole mount	

C.1.3 NanoStation Recorder/Line Station Antenna

The recorder or line station backhaul using the Ubiquiti NanoStation M5 radios do not use an external antenna; the NanoStation M5 has an integrated 14 dBi dual-polarity antenna.

The NanoStation integrated antenna specifications are as follows:

Table C-5 NanoStation Integrated Antenna Specifications

Item	Description	Radiation Patterns
Model	NSM5/+locoM5 integrated	<p>Return Loss</p> <p>Legend: V-pol (blue), H-pol (red)</p> <p>Y-axis: dB (-15, -25)</p> <p>X-axis: GHz (5.2, 5.4, 5.6, 5.8)</p>
Frequency Range	5745 to 5825 MHz (US) 5170 to 5875 MHz (INTL)	
Cross Pol Isolation	20 dB Minimum	
Gain	13 dBi	
Beamwidth	45° (H-pol) 45° (V-pol) 45° (Elevation)	
Max VSWR	1.4:1	
Polarization	Dual Linear	
Maximum Power	5.5 Watts	
Maximum Power	5.5 Watts	
Connector	N-Style Jack	
Height	10.6"	<p>Vertical Azimuth</p> <p>Scale: 0, 30, 60, 90, 120, 150, 180</p> <p>dB levels: -5dB, -15</p>
Weight	0.5 lbs	
Horizontal Beamwidth	360°	
Rated Wind Velocity	135 mph	
Operating Temperature	-22°F to 158 °F -30 to 70 °C	

C. Radio Specifications

Radio Specifications

Table C-5 NanoStation Integrated Antenna Specifications (cont.)

Item	Description	Radiation Patterns
	Vertical Elevation	Horizontal Azimuth
	Horizontal Elevation	

The table contains three radiation pattern plots. The top-left plot, titled 'Vertical Elevation', shows a blue curve with a main lobe centered at 0 degrees and side lobes extending to approximately +/- 45 degrees. The top-right plot, titled 'Horizontal Azimuth', shows a green curve with a main lobe centered at 0 degrees and side lobes extending to approximately +/- 45 degrees. The bottom-left plot, titled 'Horizontal Elevation', shows a blue curve with a main lobe centered at 0 degrees and side lobes extending to approximately +/- 45 degrees. All plots use a polar coordinate system with dB values on the radial axis and degrees on the angular axis.

C.2 Radio Specifications

This section provides radio specifications. The following radios are used in the backhaul:

- ◆ **Bullet** – 2.4 GHz High Power 802.11N Outdoor Radio System
See “Bullet Line Station Radios” on page 155

- ◆ **Rocket** – 900 MHz High Power 2x2 MIMO AirMax TDMA BaseStation
See *"Rocket Recorder Radios"* on page 157
- ◆ **NanoStation M5** – 5.8 GHz, High power, 2x2 MIMO AirMax TDMA PoE station with integrated 14 dBi dual-polarity antenna.
See *"NanoStation Recorder/Line Station Radios"* on page 158

C.2.1 Bullet Line Station Radios

The specifications for the Ubiquiti Bullet line station radio are as follows:

Table C–6 Bullet Line Station Radio Specifications (56-0019 US, 56-0024 Intl)

Item	Description
System Information	
Processor Specs	Atheros MIPS 24KC, 400 MHz
Memory Information	32 MB SDRAM, 8 MB Flash
Networking Interface	(1) 10/100 Ethernet Port
Regulatory / Compliance Information	
Wireless Approvals	FCC Part 15.247, IC RS210, CE
RoHS Compliance	Yes
Physical / Electrical / Environmental	
Dimensions (length x width)	7.5 x 1.8 in 190 x 46 mm
Weight	6.9 oz 196 g
Enclosure Characteristics	Powder Coated Aluminum
Antenna Connector	N-Type Connector (male)
Power Supply	24V, 0.5A PoE Adapter (included)
Power Method	Passive Power over Ethernet (pairs 4, 5+; 7, 8 return)
Max. Power Consumption	6 Watts
Operating Temperature	-40 to 176 °F -40 to 80 °C
Operating Humidity	5 to 95% Condensing
Shock and Vibration	ETSI300-019-1.4
Software Information	
Modes	Station, Access Point, AP Repeater
Services	SNMP, DHCP, NAT
Utilities	Site Survey with Preferred SSID, Antenna Alignment Tool, Discovery Utility

C. Radio Specifications

Radio Specifications

Table C–6 Bullet Line Station Radio Specifications (56-0019 US, 56-0024 Intl) (cont.)

Item	Description
Security	WEP/WPA/WPA2
QoS	802.11e / WMM Support
Statistical Reporting	Ethernet Activity, Uptime, Packet Success/Errors
Operating Frequency	5725 to 5850 (USA) 5170 to 5825 (International)
Output Power	25 dBm
Range Performance	31+ mi 50+ km (Outdoor - Antenna Dependent)

The power specifications for the Ubiquiti Bullet line station radio are as follows:

Table C–7 Bullet Line Station Radio Power Specifications (56-0019 US, 56-0024 Intl)

TX Power Specifications				RX Power Specifications			
11a	Data Rate	Avg. TX	Tolerance	11a	Data Rate	Sensitivity	Tolerance
	1-24 Mbps	25 dBm	+/-2 dB		24 Mbps	-83 dBm	+/-2 dB
	36 Mbps	23 dBm	+/-2 dB		36 Mbps	-80 dBm	+/-2 dB
	48 Mbps	21 dBm	+/-2 dB		48 Mbps	-77 dBm	+/-2 dB
	54 Mbps	20 dBm	+/-2 dB		54 Mbps	-75 dBm	+/-2 dB
11n / airMAX	MCS0	25 dBm	+/-2 dB	11n / airMAX	MCS0	-96 dBm	+/-2 dB
	MCS1	25 dBm	+/-2 dB		MCS1	-95 dBm	+/-2 dB
	MCS2	25 dBm	+/-2 dB		MCS2	-92 dBm	+/-2 dB
	MCS3	25 dBm	+/-2 dB		MCS3	-90 dBm	+/-2 dB
	MCS4	24 dBm	+/-2 dB		MCS4	-86 dBm	+/-2 dB
	MCS5	22 dBm	+/-2 dB		MCS5	-83 dBm	+/-2 dB
	MCS6	20 dBm	+/-2 dB		MCS6	-77 dBm	+/-2 dB
	MCS7	19 dBm	+/-2 dB		MCS7	-74 dBm	+/-2 dB

C.2.2 Rocket Recorder Radios

The specifications for the Ubiquiti Rocket recorder radio are as follows:

Table C–8 Rocket Recorder Radio Specifications (15-0052 US, 15-0054 Intl)

Item	Description
System Information	
Processor Specs	Atheros MIPS 24KC, 400MHz
Memory Information	64MB SDRAM, 8MB Flash
Networking Interface	2 X 10/100 BASE-TX (Cat. 5, RJ-45) Ethernet
Regulatory / Compliance Information	
Wireless Approvals	FCC Part 15.247, IC RS210, CE
RoHS Compliance	YES
Physical / Electrical / Environmental	
Dimensions (length, width, height)	6.7 x 3.1 x 1.2 in 17 x 8 x 3cm
Weight	1.6 lb 0.5kg
Enclosure Characteristics	Outdoor UV Stabilized Plastic
RF Connector	2x RP-SMA and 1x SMA (Waterproof)
Mounting Kit	Pole Mounting Kit included
Power Supply	24V, 1A POE Supply included
Power Method	Passive Power over Ethernet (pairs 4, 5+; 7, 8 return)
Max Power Consumption	8 Watts
Operating Temperature	-22 to 167 °F -30 to 75 °C
Operating Humidity	5 to 95% Condensing
Shock and Vibration	ETSI300-019-1.4
Operating Frequency	5745 to 5825 (USA) 5470 to 5825 (International)
Output Power	27 dBm
Range Performance	up to 9.3 miles up to 15 km

C. Radio Specifications

Radio Specifications

The power specifications for the Ubiquiti Rocket radio are as follows:

Table C-9 Rocket Recorder Radio Power Specifications (15-0052 US, 15-0054 Intl)

TX Power Specifications				RX Power Specifications			
	Data Rate	Avg. TX	Tolerance		Data Rate	Ave. TX	Tolerance
11a	6-24 Mbps	27 dBm	+/- 2 dB	11a	6-24 Mbps	-94 dBm min	+/- 2 dB
	36 Mbps	25 dBm	+/- 2 dB		36 Mbps	-80 dBm	+/- 2 dB
	48 Mbps	23 dBm	+/- 2 dB		48 Mbps	-77 dBm	+/- 2 dB
	54 Mbps	22 dBm	+/- 2 dB		54 Mbps	-75 dBm	+/- 2 dB
11n / airMAX	MCS0	27 dBm	+/- 2 dB	11n / airMAX	MCS0	-96 dBm	+/- 2 dB
	MCS1	27 dBm	+/- 2 dB		MCS1	-95 dBm	+/- 2 dB
	MCS2	27 dBm	+/- 2 dB		MCS2	-92 dBm	+/- 2 dB
	MCS3	27 dBm	+/- 2 dB		MCS3	-90 dBm	+/- 2 dB
	MCS4	26 dBm	+/- 2 dB		MCS4	-86 dBm	+/- 2 dB
	MCS5	24 dBm	+/- 2 dB		MCS5	-83 dBm	+/- 2 dB
	MCS6	22 dBm	+/- 2 dB		MCS6	-77 dBm	+/- 2 dB
	MCS7	21 dBm	+/- 2 dB		MCS7	-74 dBm	+/- 2 dB
	MCS8	27 dBm	+/- 2 dB		MCS8	-95 dBm	+/- 2 dB
	MCS9	27 dBm	+/- 2 dB		MCS9	-93 dBm	+/- 2 dB
	MCS10	27 dBm	+/- 2 dB		MCS10	-90 dBm	+/- 2 dB
	MCS11	27 dBm	+/- 2 dB		MCS11	-87 dBm	+/- 2 dB
	MCS12	26 dBm	+/- 2 dB		MCS12	-84 dBm	+/- 2 dB
	MCS13	24 dBm	+/- 2 dB		MCS13	-79 dBm	+/- 2 dB
	MCS14	22 dBm	+/- 2 dB		MCS14	-78 dBm	+/- 2 dB
MCS15	21 dBm	+/- 2 dB	MCS15	-75 dBm	+/- 2 dB		

C.2.3 NanoStation Recorder/Line Station Radios

The specifications for the Ubiquiti NanoStation™ radio are as follows:

Table C-10 NanoStation Radio Specifications (56-0035 US, 56-0032 Intl)

Item	Description
System Information	
Processor Specs	Atheros MIPS 24KC, 400MHz
Memory Information	32MB SDRAM, 8MB Flash
Networking Interface	1 X 10/100 BASE-TX (Cat. 5, RJ-45) Ethernet
Regulatory / Compliance Information	

Table C–10 NanoStation Radio Specifications (56-0035 US, 56-0032 Intl) (cont.)

Item	Description
Wireless Approvals	FCC Part 15.247, IC RS210, CE
RoHS Compliance	YES
Physical / Electrical / Environmental	
Dimensions (length, width, height)	6.42 x 1.22 x 3.15 in 163 x 31 x 80mm
Weight	0.40 lb 0.18kg
Enclosure Characteristics	Outdoor UV Stabilized Plastic
Mounting Kit	Pole Mounting Kit included
Power Supply	24V, 0.5A POE Supply included
Power Method	Passive Power over Ethernet (pairs 4, 5+; 7, 8 return)
Max Power Consumption	5.5 Watts
Operating Temperature	-22 to 167 °F -30 to 75 °C
Operating Humidity	5 to 95% Condensing
Shock and Vibration	ETSI300-019-1.4
Operating Frequency	5745 to 5825 (USA) 5170 to 5875 (International)
Output Power	27 dBm
Range Performance	31+ mile 50+ km

The power specifications for the Ubiquiti NanoStation M5 radio are as follows:

Table C–11 NanoStation Radio Power Specifications (56-0035 US, 56-0032 Intl)

TX Power Specifications				RX Power Specifications			
	Data Rate	Avg. TX	Tolerance		Data Rate	Ave. TX	Tolerance
11a	6-24Mbps	23 dBm	+/-2 dB	11a	6-24Mbps	-83 dBm min	+/-2 dB
	36 Mbps	21 dBm	+/-2 dB		36 Mbps	-80 dBm	+/-2 dB
	48 Mbps	19 dBm	+/-2 dB		48 Mbps	-77 dBm	+/-2 dB
	54 Mbps	18 dBm	+/-2 dB		54 Mbps	-75 dBm	+/-2 dB

C. Radio Specifications

Radio Specifications

Table C–11 NanoStation Radio Power Specifications (56-0035 US, 56-0032 Intl) (cont.)

TX Power Specifications				RX Power Specifications			
11n / airMAX	MCS0	23 dBm	+/- 2 dB	11n / airMAX	MCS0	-96 dBm	+/- 2 dB
	MCS1	23 dBm	+/- 2 dB		MCS1	-95 dBm	+/- 2 dB
	MCS2	23 dBm	+/- 2 dB		MCS2	-92 dBm	+/- 2 dB
	MCS3	23 dBm	+/- 2 dB		MCS3	-90 dBm	+/- 2 dB
	MCS4	22 dBm	+/- 2 dB		MCS4	-86 dBm	+/- 2 dB
	MCS5	20 dBm	+/- 2 dB		MCS5	-83 dBm	+/- 2 dB
	MCS6	18 dBm	+/- 2 dB		MCS6	-77 dBm	+/- 2 dB
	MCS7	17 dBm	+/- 2 dB		MCS7	-74 dBm	+/- 2 dB
	MCS8	23 dBm	+/- 2 dB		MCS8	-95 dBm	+/- 2 dB
	MCS9	23 dBm	+/- 2 dB		MCS9	-93 dBm	+/- 2 dB
	MCS10	23 dBm	+/- 2 dB		MCS10	-90 dBm	+/- 2 dB
	MCS11	23 dBm	+/- 2 dB		MCS11	-87 dBm	+/- 2 dB
	MCS12	22 dBm	+/- 2 dB		MCS12	-84 dBm	+/- 2 dB
	MCS13	20 dBm	+/- 2 dB		MCS13	-79 dBm	+/- 2 dB
	MCS14	18 dBm	+/- 2 dB		MCS14	-78 dBm	+/- 2 dB
MCS15	17 dBm	+/- 2 dB	MCS15	-75 dBm	+/- 2 dB		

LED Indicators

This chapter provides the possible LED status and error indicators for WRUs and LIUs.

The WRU has three possible states; undeployed, deploying, and deployed.

When tilting the WRU to deploy, re-acquire GPS, or check status, tilt the WRU geophone down until the LEDs light, and then return the WRU to the horizontal position as shown in the following figure:



Figure D-1 WRU Down-Tilt Action

When tilting the WRU to undeploy, tilt the WRU geophone up until the LEDs light, and then return the WRU to the horizontal position as shown in the following figure:



Figure D-2 WRU Up-Tilt Action

D.1 WRU Undeployed

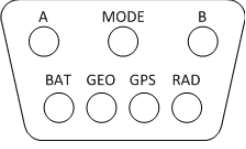
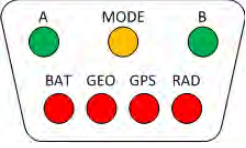
When the WRU is undeployed, all of the LEDs are off. A vertical tilt has the following effect:

- ◆ **Geophone Down** – WRU deployment
- ◆ **Geophone Up** – No effect; nothing happens

D. LED Indicators

WRU Undeployed

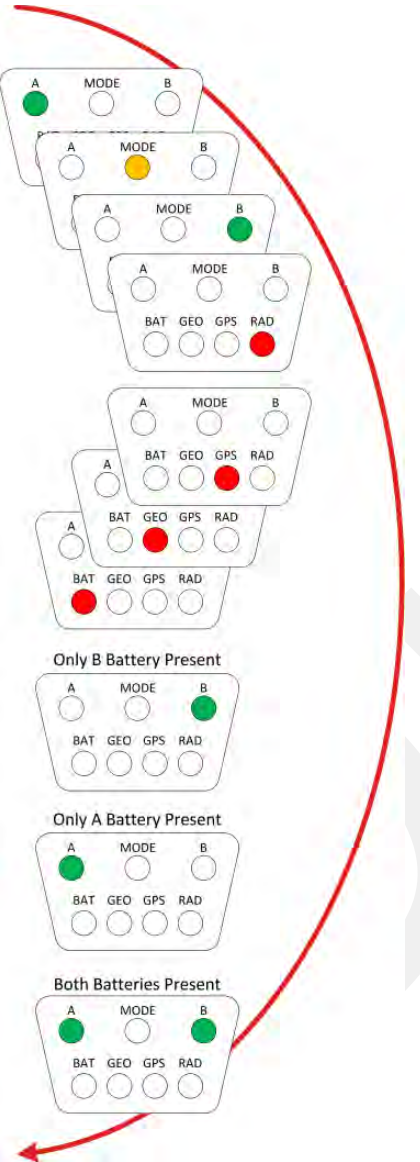
Table D-1 WRU LED Indications, Undeployed

LED Indicators	Summary	Description
	<p>Undeployed Dead batteries</p>	<p>If no LEDs are on (lit up) on an undeployed WRU, it can be one of the following scenarios:</p> <ul style="list-style-type: none"> • Unit undeployed • Batteries dead <p>When you do a tilt test (geophone down) on an undeployed WRU with no LEDs on, the following may occur:</p> <ul style="list-style-type: none"> • An Undeployed WRU deploys and begins the self tests • A WRU with dead batteries will continue to display no lit LEDs • A WRU is defective if no LEDs turn on after battery replacement. <p>NOTE: Battery state is shown in the RT System 2 user interface tables. For example, the Ground Equipment Table.</p>
	<p>Geo down tilt detected Deploy</p>	<p>Tilt the WRU with the geophone pointing down.</p> <p>After a few seconds, all of the LEDs light up solid.</p> <p>Place the WRU flat on the ground to within five seconds to begin the deployment process:</p> <ul style="list-style-type: none"> • Battery fuse self-test • Battery test • THD test • Geophone test • GPS fix • Radio test

After removing both batteries from an undeployed WRU, and then replacing BAT A, BAT B, or both, when the first battery is connected, the WRU goes through the power on LED sequence and then remains in the undeployed state.

The following table shows the LED power-on sequence for an undeployed WRU:

Table D-2 WRU LED Indications, Undeployed Power-On Sequence

LED Indicators	Summary	Description
 <p>The diagram illustrates the sequence of LED indicators for a hard reset (power on). The sequence starts with the A battery LED lit (green), followed by the MODE LED (yellow), then the B battery LED (green), then the RAD LED (red), then the GPS LED (red), then the GEO LED (red), then the BAT LED (red), then the A battery LED (green), then the B battery LED (green), and finally both A and B battery LEDs (green). A red arrow indicates the clockwise rotation of the sequence.</p>	<p>Hard reset (power on)</p>	<p>The LEDs light up in clockwise rotation starting with the A battery LED and ending with the A battery LED, B battery LED, or both.</p>

D.2 WRU Deploying

When the WRU begins deploying, the following tests are executed:

D. LED Indicators

WRU Deploying

- ◆ BAT A and BAT B connected
 - Battery fuse test
 - Battery test
 - THD test
 - Geophone Test
 - GPS test
 - Radio Test
- ◆ BAT A *or* BAT B connected
 - Battery test
 - THD test
 - Geophone Test
 - GPS test
 - Radio Test

The following table shows the possible LED indicators for a WRU that is deploying:

Table D-3 WRU LED Indications, Deploying Sequence

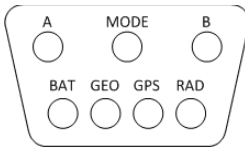
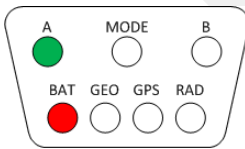
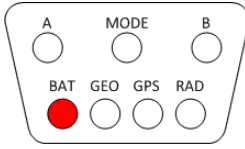
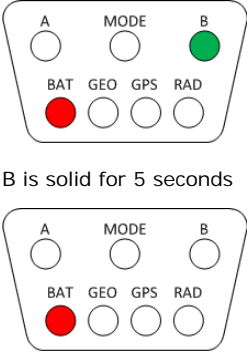
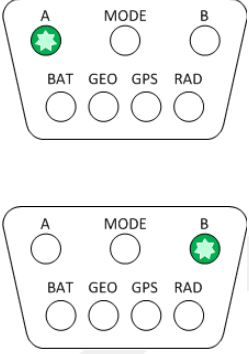
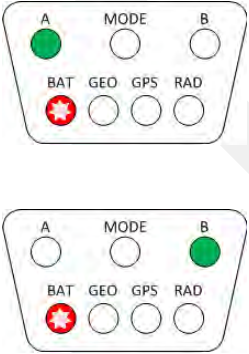
LED Indicators	Summary	Description
	Dead batteries Defective Unit	<p>If no LEDs are on (lit up) during the deploying state, it can be one of the following scenarios:</p> <ul style="list-style-type: none"> • Batteries dead • Defective Unit <p>When you do a tilt test (geophone down) on a WRU with no LEDs on, the following may occur:</p> <ul style="list-style-type: none"> • A WRU with dead batteries will continue to display no lit LEDs • A WRU is defective if no LEDs turn on after battery replacement. <p>NOTE: Battery state is shown in the RT System 2 user interface tables. For example, the Ground Equipment Table.</p>
 <p>A is solid for 5 seconds</p>  <p>BAT remains solid</p>	Battery fuse test failure (A)	<p>When both batteries are installed, the battery fuse test is performed.</p> <p>A Solid for 5 seconds BAT Solid</p> <p>A solid BAT LED indicates that the WRU detected a bad fuse during deployment and returned to the undeployed state. When a battery fuse test fails, the WRU will not deploy.</p> <p>Both batteries must be present for the battery fuse test to execute. This allows you to deploy a WRU by removing the battery connected to the bad fuse prior to the deployment tilt action.</p>

Table D-3 WRU LED Indications, Deploying Sequence (cont.)

LED Indicators	Summary	Description
 <p>B is solid for 5 seconds</p> <p>BAT remains solid</p>	<p>Battery fuse test failure (B)</p>	<p>When both batteries are installed, the battery fuse test is performed.</p> <p>B Solid for 5 seconds BAT Solid</p> <p>A solid BAT LED indicates that the WRU detected a bad fuse during deployment and returned to the undeployed state. When a battery fuse test fails, the WRU will not deploy.</p> <p>Both batteries must be present for the battery fuse test to execute. This allows you to deploy a WRU by removing the battery connected to the bad fuse prior to the deployment tilt action.</p>
	<p>Battery test</p>	<p>If both batteries are installed and their capacities are above 9000 mAh, the following occurs:</p> <ul style="list-style-type: none"> Battery in use LED (A or B) Flashes The THD, GEO, GPS, and RAD self-tests are performed <p>NOTE: The general battery test provides a visual indication if the WRU has one or more missing, malfunctioning, or low capacity batteries and provides 45 seconds to correct the problem before proceeding to the remainder of the deployment self-tests.</p>
	<p>Battery failure</p>	<p>If one or both batteries have sub-9000mAh capacities or are not installed, the following occurs:</p> <ul style="list-style-type: none"> Solid – A and or B Flashing – BAT LED flashes for 45 seconds <p>Install one or two batteries with capacities above 9000 mAh during the 45 second window. The following occurs:</p> <ul style="list-style-type: none"> Flashing BAT LED turns off Battery in use LED (A or B) flashes for approximately 2 seconds The THD, GEO, GPS, and RAD self-tests are performed

D. LED Indicators

WRU Deploying

Table D-3 WRU LED Indications, Deploying Sequence (cont.)

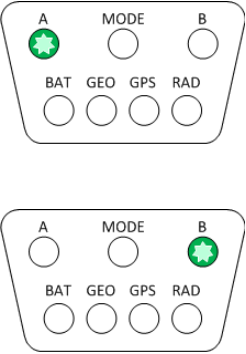
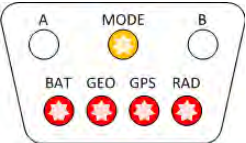
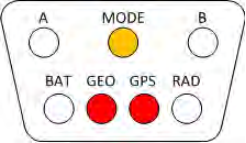
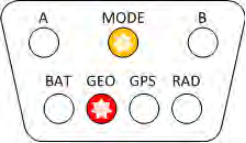
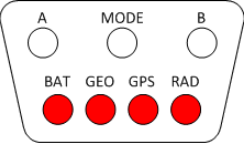
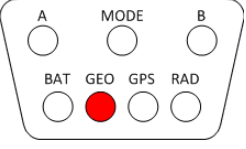
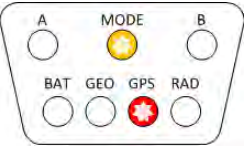
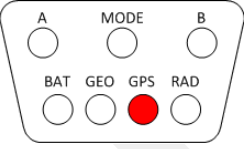
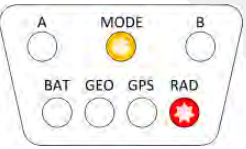
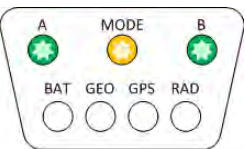
LED Indicators	Summary	Description
		<p>If no changes are made to the batteries within the 45 second window, The following occurs:</p> <ul style="list-style-type: none"> Flashing BAT LED turns off Battery in use LED (A or B) flashes for approximately 2 seconds The THD, GEO, GPS, and RAD self-tests are executed
	Self-test starting	<p>If a WRU self-test fails, the WRU will continue to the next test.</p> <p>Flashing:</p> <ul style="list-style-type: none"> MODE BAT GEO GPS RAD <p>NOTE: Error LEDs remain persistent throughout the self-discovery process and are turned off upon completion.</p>
	Continue (lay flat to move to next test)	<p>To skip a test during the self-test process, tilt the WRU geophone down until you see this triangle of LEDs. Tilt the WRU back to horizontal to continue.</p> <p>Solid:</p> <ul style="list-style-type: none"> MODE GEO GPS <p>NOTE: The GPS test cannot be skipped.</p>
	Geophone test in progress	<p>Flashing:</p> <ul style="list-style-type: none"> MODE GEO <p>NOTE: Performing a vertical geophone down tilt during the geophone test causes the WRU to go into the communications repeater mode. WRU repeaters are used to solve terrain or distance related communication problems between WRUs.</p>

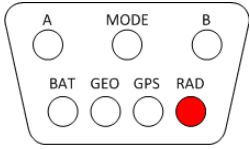
Table D-3 WRU LED Indications, Deploying Sequence (cont.)

LED Indicators	Summary	Description
	THD test failure	Solid: <ul style="list-style-type: none"> BAT GEO GPS RAD NOTE: No LEDs are affected when the THD test starts or when it passes.
	Geophone test failure	GEO Solid NOTE: For a multiple-channel geophone, tests the first channel only.
	Acquiring GPS fix	Flashing: <ul style="list-style-type: none"> MODE GPS NOTE: The WRU will attempt to get a 3-meter GPS lock for up to 15 minutes. During this time, the GPS LED flashes. The WRU will not form until the GPS lock is achieved. If the GPS lock cannot be achieved, form by serial number.
	GPS test failure	GPS Solid GPS fix not found For a multiple-channel geophone, tests the first channel only.
	Neighbor discovery in progress	Flashing: <ul style="list-style-type: none"> MODE RAD
	Neighbor discovered	Flashing: <ul style="list-style-type: none"> A MODE B

D. LED Indicators

WRU Deploying

Table D-3 WRU LED Indications, Deploying Sequence (cont.)

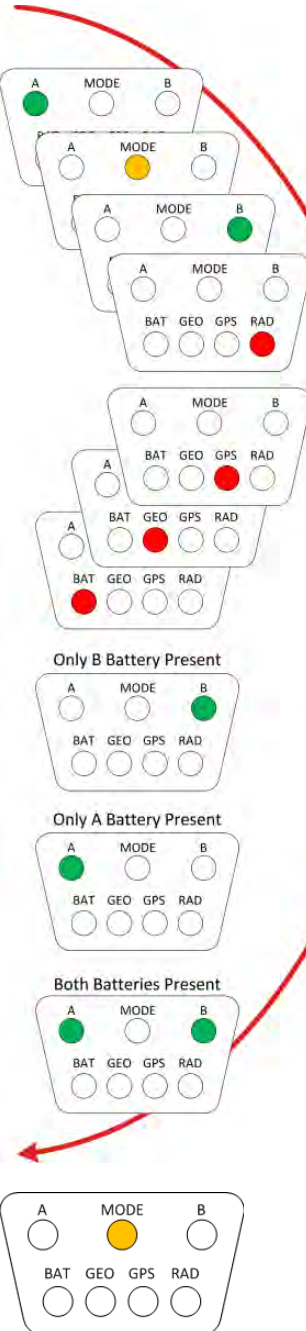
LED Indicators	Summary	Description
	No neighbor detected	RAD Solid If this is the first WRU deployed, this is the expected condition.

If power is removed from a WRU in the deploying state, the WRU stays in the deploying state and restarts the deploying process when power is restored.

After removing both batteries from a deploying WRU, and then replacing BAT A, BAT B, or both, when the first battery is connected, the WRU goes through the power on LED sequence. If both batteries are connected, the battery fuse test is executed. If only one battery is connected, the battery fuse test is skipped. The remainder of the self-tests are then executed.

The following table shows the LED power-on sequence for an deploying WRU:

Table D-4 WRU LED Indications, Deploying Power-On Sequence

LED Indicators	Summary	Description
	<p>Hard reset (power on)</p>	<p>The LEDs light up in clockwise rotation starting with the A battery LED and ending with the A battery LED, B battery LED, or both for 2 seconds.</p> <p>The A and B battery LEDs at the end of the rotation indicate that one or both batteries are above the minimum threshold of 9000mAh.</p> <p>Finally, the MODE LED lights up for approximately 5 seconds indicating that the WRU is verifying its firmware integrity.</p>

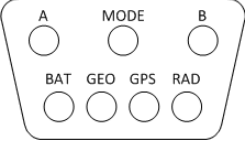
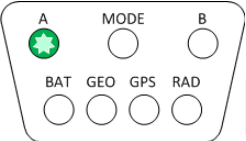
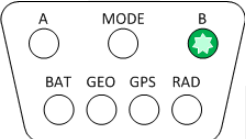
D.3 WRU Deployed

If the WRU is already deployed, a vertical tilt has the following effect:

- ◆ **Geophone Down** – If Sleeping, takes three to four seconds to wake up. If in Standby or Armed displays the battery status, deployment self-test status, and re-acquires the GPS position.
- ◆ **Geophone Up** – All lights light. If placed flat within 5 seconds, the WRU undeploys.

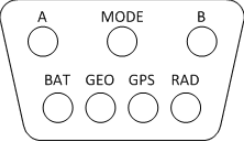
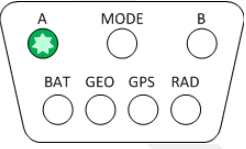
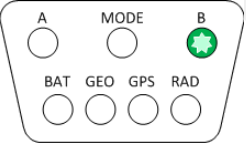
The following table shows how the LEDs light up during normal operation with no vertical tilt for a deployed WRU.

Table D–5 WRU LED Indications, Deployed WRU, No Geophone Tilt

LED Indicators	Summary	Description
	Undeployed Dead Batteries Sleeping	If no LEDs are on (lit up), it can be one of the following scenarios: <ul style="list-style-type: none"> • WRU undeployed • Batteries dead • WRU Sleeping • WRU Awake, but unformed NOTE: Battery state is shown in the RT System 2 user interface tables. For example, the Ground Equipment Table.
	Battery A in use	A Flashing: <ul style="list-style-type: none"> • Battery A in use • WRU formed or Armed
	Battery B in use	B Flashing: <ul style="list-style-type: none"> • Battery B in use • WRU formed or Armed

The following table shows how the LEDs light up during a vertical tilt (geophone down) for a deployed WRU.

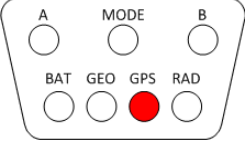
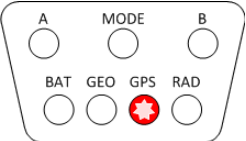
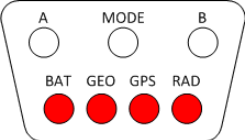
Table D-6 WRU LED Indications, Deployed WRU, Geophone Down Tilt

LED Indicators	Summary	Description
	<p>Undeployed Dead Batteries Sleeping</p>	<p>If no LEDs are on (lit up) before tilting the WRU, it can be one of the following scenarios:</p> <ul style="list-style-type: none"> • WRU undeployed • Batteries dead • WRU Sleeping • WRU Awake, but unformed <p>When you do a tilt test (geophone down) on a WRU with no LEDs on, the following may occur:</p> <ul style="list-style-type: none"> • An Undeployed WRU deploys and begins the self tests • A WRU with dead batteries will continue to display no lit LEDs • A Sleeping WRU goes back to the deployed, unformed state and displays the battery status and any self-tests that failed during deployment (BAT, THD, GEO, GPS, or RAD). • A WRU in the Awake unformed state displays the battery status and any self-tests that failed during deployment (BAT, THD, GEO, GPS, or RAD). <p>NOTE: Battery state is shown in the RT System 2 user interface tables. For example, the Ground Equipment Table.</p>
	<p>Battery A in use</p>	<p>A Flashing:</p> <ul style="list-style-type: none"> • Battery A in use • WRU formed or Armed <p>NOTE: Only when GPS position occurs at the same time the battery status is displayed.</p>
	<p>Battery B in use</p>	<p>B Flashing:</p> <ul style="list-style-type: none"> • Battery B in use • WRU formed or Armed <p>NOTE: Only when no self-test failures. Re-acquire GPS position occurs at the same time the battery status is displayed.</p>

D. LED Indicators

WRU Deployed

Table D–6 WRU LED Indications, Deployed WRU, Geophone Down Tilt (cont.)

LED Indicators	Summary	Description
	Re-acquire GPS position	<p>GPS Solid for up to 15 minutes</p> <p>The deployed WRU can be in any of the following states:</p> <ul style="list-style-type: none"> • Unformed • Formed <p>NOTE: The battery status is displayed at the same time the GPS position is re-acquiring.</p>
	GPS position acquired	<p>GPS Flashing</p> <p>The Deployed WRU is in Standby</p>
	Self test failure	<p>The LED associated with the failed self-test is solid. All four LEDs are solid only if all four self-tests failed, or the THD self-test fails.</p> <p>The LEDs are visible only during the deployment process, and when the WRU is tilted (geophone down) to check status after the WRU is deployed.</p> <p>Solid:</p> <ul style="list-style-type: none"> • BAT • GEO • GPS • RAD

The following table shows how the LEDs light up during a vertical tilt (geophone up) for a deployed WRU.

Table D–7 WRU LED Indications, Deployed WRU, Geophone Up Tilt

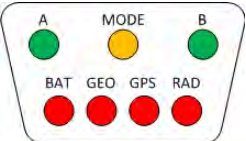
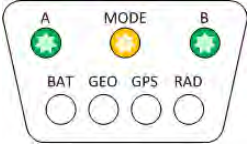
LED Indicators	Summary	Description
	Geo tilt detected Undeploy	<p>Tilt the WRU with the geophone pointing up. After a few seconds, all of the LEDs light up solid.</p> <p>Place the WRU flat on the ground within five seconds to undeploy the WRU.</p>

Table D-7 WRU LED Indications, Deployed WRU, Geophone Up Tilt (cont.)

LED Indicators	Summary	Description
	Undeploy successful	Flashing: <ul style="list-style-type: none"> • A • MODE • B

After removing both batteries from a deployed WRU, and then replacing BAT A, BAT B, or both, when the first battery is connected, the WRU goes through the power on LED sequence. The WRU transitions to the Awake, unformed state. If the WRU is not formed within 30 minutes, the WRU transitions to the Sleep state.

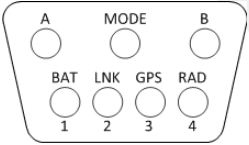
D.4 LIU Power-On

The LIU LEDs function independently from each other, and there can be a number of combinations of LEDs that are on, off, or flashing. The following list shows the LEDs used to indicate status:

- ◆ **Battery** – A, B, BAT
- ◆ **Power, Mode** – MODE
- ◆ **Discipline** – MODE
- ◆ **Check Link Status** – MODE, 1, 2, 3, and 4
- ◆ **Connection to Central** – LNK
- ◆ **GPS Lock** – GPS
- ◆ **Radio connection, communication with neighbor** – RAD

The following table shows the LED power-on sequence for an LIU:

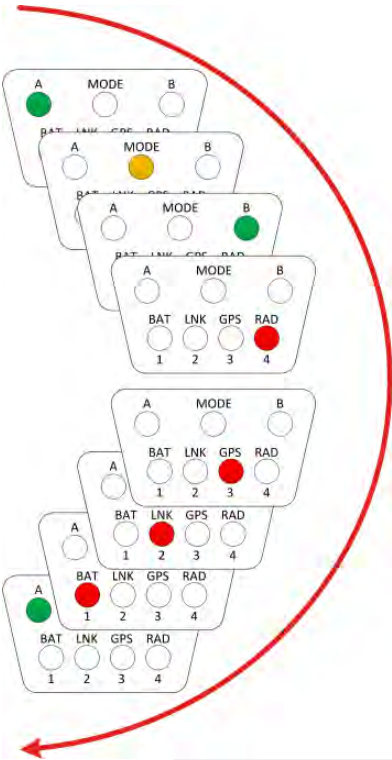
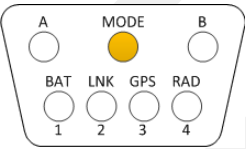
Table D-8 LIU LED Indications, Power-On Sequence

LED Indicators	Summary	Description
	Off	No lights

D. LED Indicators

LIU Normal Operation

Table D-8 LIU LED Indications, Power-On Sequence (cont.)

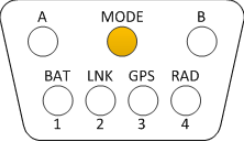
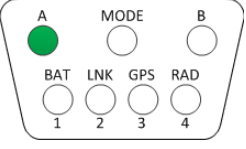
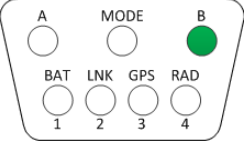
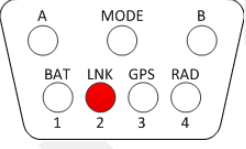
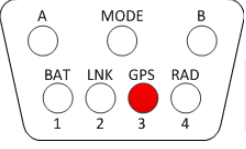
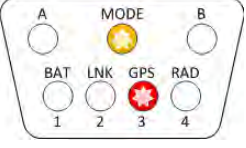
LED Indicators	Summary	Description
	<p>Hard Reset LIU</p>	<p>The LEDs light up in clockwise rotation starting and ending with the A battery LED in the following cases:</p> <ul style="list-style-type: none"> • When the batteries are attached • Anytime the unit resets itself • In between updating firmware applications
	<p>The unit is verifying the integrity of the firmware.</p>	<p>MODE Solid for approximately 5 seconds</p>

D.5 LIU Normal Operation

The following tables describe the possible Normal Mode LIU Status Indications:

- ◆ "LIU LED Status Indications, Normal Mode" on page 175
- ◆ "LIU LED Error Indications, Normal Mode" on page 177

Table D-9 LIU LED Status Indications, Normal Mode

LED Indicators	Summary	Description
	<p>On, Disciplined to GPS</p> <p>Checking firmware</p>	<p>MODE solid</p> <p>The MODE LED indicates that the integrity of the downloaded firmware is being verified.</p>
	<p>Battery A in use</p>	<p>A solid</p> <p>Indicates Battery A in use powering LIU. Battery Voltage is above depleted threshold.</p>
	<p>Battery B in use</p>	<p>B solid</p> <p>Indicates Battery B in use powering LIU. Battery Voltage is above depleted threshold.</p>
	<p>LIU connected to Central</p>	<p>LNK solid</p>
	<p>GPS lock</p>	<p>GPS solid</p>
	<p>GPS disciplined</p>	<p>Flashing:</p> <ul style="list-style-type: none"> GPS flashes in the 1 s rhythm of the PPS MODE flashes in the 1 s rhythm of the PPS

D. LED Indicators

LIU Normal Operation

Table D-9 LIU LED Status Indications, Normal Mode (cont.)

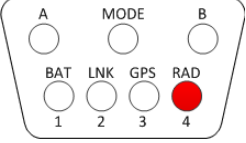
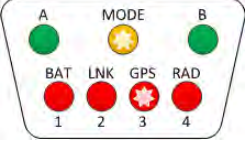
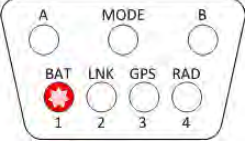
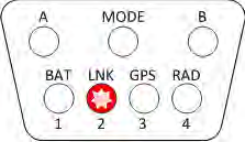
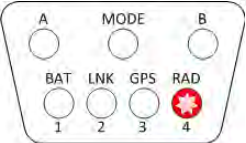
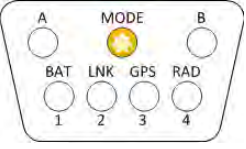
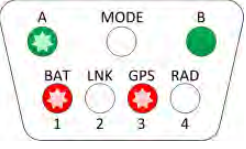
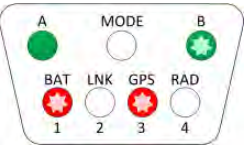
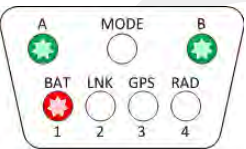
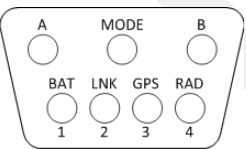
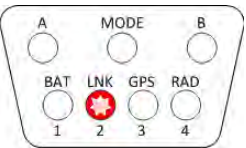
LED Indicators	Summary	Description
	Formed	RAD solid
	Normal	Solid: <ul style="list-style-type: none"> A/B BAT LNK (connected) RAD (formed) Flashing: <ul style="list-style-type: none"> MODE GPS LNK (disconnected)
	Main (ARM) processor is upgrading its own firmware	BAT flashing
	Main (ARM) processor is upgrading the Power Control (XMEGA) processor firmware	LNK flashing
	Main (ARM) processor is upgrading the Radio processor firmware	RAD flashing

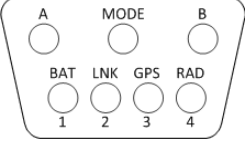
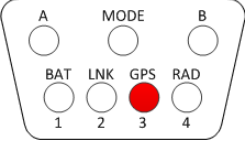
Table D-10 LIU LED Error Indications, Normal Mode

LED Indicators	Summary	Description
	<p>On, no GPS discipline</p>	<p>MODE flashing every 1 second</p>
	<p>Single battery failure Battery B in use Battery A below threshold or disconnected</p>	<p>A: <ul style="list-style-type: none"> Off, or 4 long flashes, then off (On 4.5s, off 2s) or GPS PPS flash B Solid BAT: <ul style="list-style-type: none"> 4 long flashes, then off (On 4.5s, off 2s) </p>
	<p>Single battery failure Battery A in use Battery B below threshold or disconnected</p>	<p>A Solid B: <ul style="list-style-type: none"> Off, or 4 long flashes, then off (On 4.5s, off 2s) or GPS PPS flash BAT: <ul style="list-style-type: none"> 4 long flashes, then off (On 4.5s, off 2s) </p>
	<p>Both batteries below threshold -OR- One below threshold and one disconnected</p>	<p>A & B: <ul style="list-style-type: none"> Off, or 4 long flashes, then off (On 4.5s, off 2s) or GPS PPS flashes BAT: <ul style="list-style-type: none"> 4 long flashes, then off (On 4.5s, off 2s) </p>
	<p>No IP Address acquired</p>	<p>LNK off</p>
	<p>LIU has IP Address, but no communications with Central</p>	<p>LNK flashing</p>

D. LED Indicators

Firmware Upgrade

Table D–10 LIU LED Error Indications, Normal Mode (cont.)

LED Indicators	Summary	Description
	No GPS lock	GPS off No GPS or less than 3 satellites
	GPS lock, not disciplined	GPS on GPS lock, but not disciplined

D.6 Firmware Upgrade

The following table describes the possible WRU and LIU LED indications during firmware upgrade:

Table D–11 WRU and LIU LED Status Indications, Firmware Upgrade

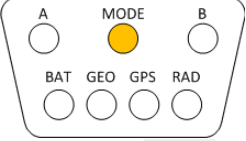
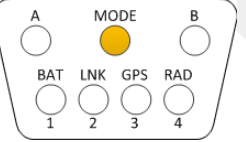
LED Indicators	Summary	Description
 	Firmware upgrade	MODE Solid for approximately 5 seconds During firmware upgrade, the MODE LED indicates that each processor's new firmware is being verified.

Table D-11 WRU and LIU LED Status Indications, Firmware Upgrade (cont.)

LED Indicators	Summary	Description
	<p>Firmware upgrade</p>	<p>BAT Flashing</p> <p>The main processor is saving the new firmware for all processors to non-volatile memory.</p>
	<p>The power control processor's firmware is being upgraded</p>	<p>GEO/LNK Flashing for approximately 15 seconds</p>
	<p>The Radio processor's firmware is being upgraded</p>	<p>RAD Flashing for approximately 1-2 seconds</p>

Weighted Base

This section describes the mast that uses weights to maintain stability.

E.1 Specifications

Tripod Weight = 50 lbs (22.73 kg)

Minimum mast height = 53" (includes 6" for mounting)

Base size = 48" (1.2m) x 48" (1.2m)

Supports up to 12 – 16" x 8" blocks

Pre-galvanized steel frame

Accepts up to 2.5" mast (not included)



Figure E-1 Weighted Mast

E.2 Hardware Supplied

The following hardware is supplied with the tripod mast:

- ◆ 4 - Bolt, Carriage 1/4 - 20 x 3/4"
- ◆ 12 - Bolt, Carriage 1/4 - 20 x 5/8"
- ◆ 4 - Bolt, 1/4 - 20 x 3/4" Hex Head
- ◆ 4 - Bolt, 1/4 - 20 x 1/2" Hex Head
- ◆ 24-Nut, 1/4 - 20
- ◆ 24 - Lock washer, 1/4 Int. tooth

E.3 Assembly Instructions

This section provides instructions and illustrations for assembly of the tripod.

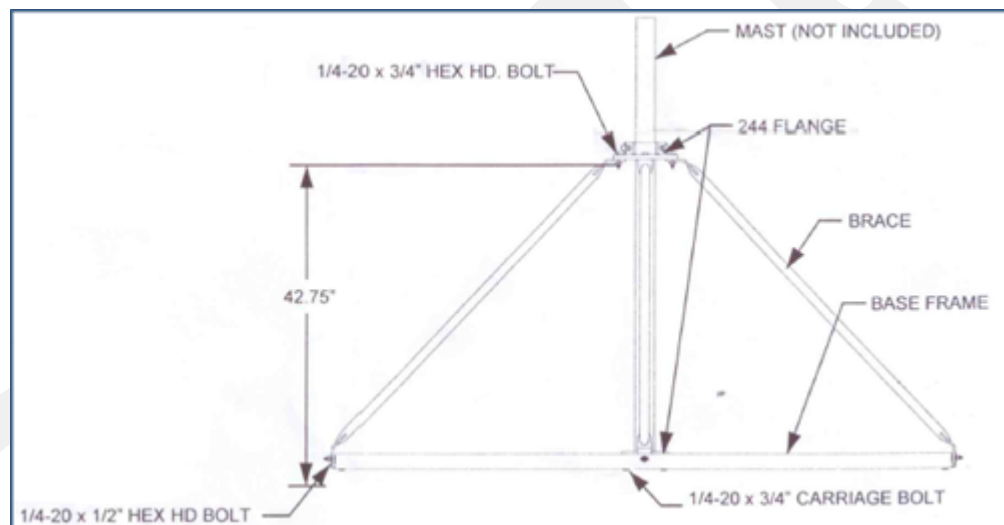


Figure E-2 Tripod Assembly, Front View

To assemble the tripod:

- 1 Assemble one 244 Flange to the Center Support Plate using four 1/4-20 x 3/4" carriage Bolts, Lock washers and Hex Nuts. Make sure to assemble the Bolts with the Heads on the underside of the frame. Hex Nut should be on the top side of the frame.
- 2 Assemble Base Frame and Center Support Plate using twelve 1/4-20 x 5/8" carriage Bolts, Lock washers and Hex Nuts. Make sure to assemble the Bolts with the Heads on the underside of the frame. Hex Nut should be on the top side of the frame.
- 3 Assemble the four (4) Braces to the upper support flange using four 1/4-20x3/4 Hex Head Bolts, Lock washers and Nuts.
- 4 Assemble the other end of the braces to the base frame using the four (4) 1/4-20 x 1/2" Hex Head Bolts, Lock washers, and Nuts.
- 5 Insert Bolts into upper and lower flange.
- 6 Slide the mast (not included) into position and tighten securely and weigh.

Wade Antenna Ltd., Ontario, Canada

Using a Compass

This chapter describes how to use a sighting compass. A sighting compass has the same features as a baseplate compass, but adds a vertical mirror that allows you to view the compass dial and the landmark at the same time.

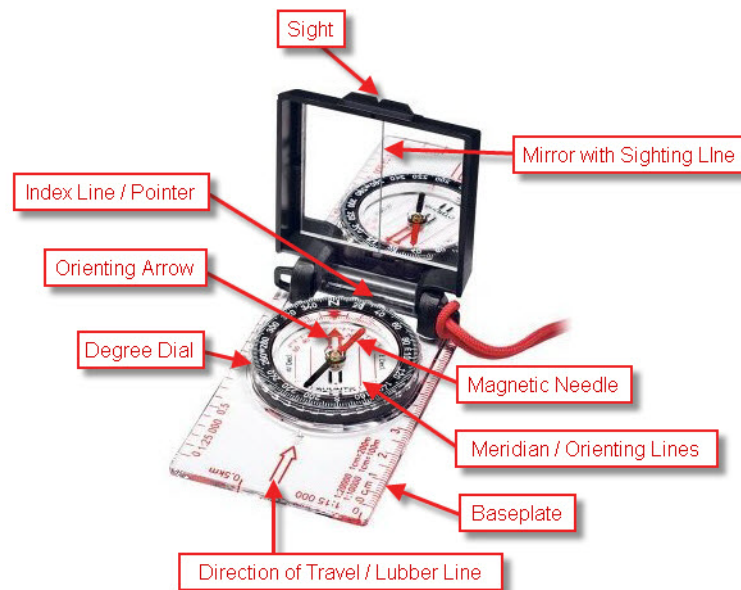


Figure F–1 Sighting Compass (70-0067)

For an in-depth description of using a compass with a map and setting the declination on a compass see the following links:

- ◆ <http://www.compassdude.com/default.shtml>
- ◆ <http://www.compassdude.com/compass-declination.shtml>
- ◆ <http://www.rei.com/learn/expert-advice/navigation-basics.html>
- ◆ <http://www.thecompassstore.com/howtouseyour.html>

A compass needle points to the magnetic north pole which is not the same as true or geographic north. The difference between magnetic and true north is called magnetic declination. The declination value depends on your actual location on the Earth. Over time, as the Earth's magnetic field shifts, the declination values also shift.

Maps are drawn with true north at the top edge. When using a compass to navigate or locate objects, you must adjust the readings to account for the angular difference between true north (★) and magnetic north (MN). The declination value is marked on topographical maps as shown in the following figure:

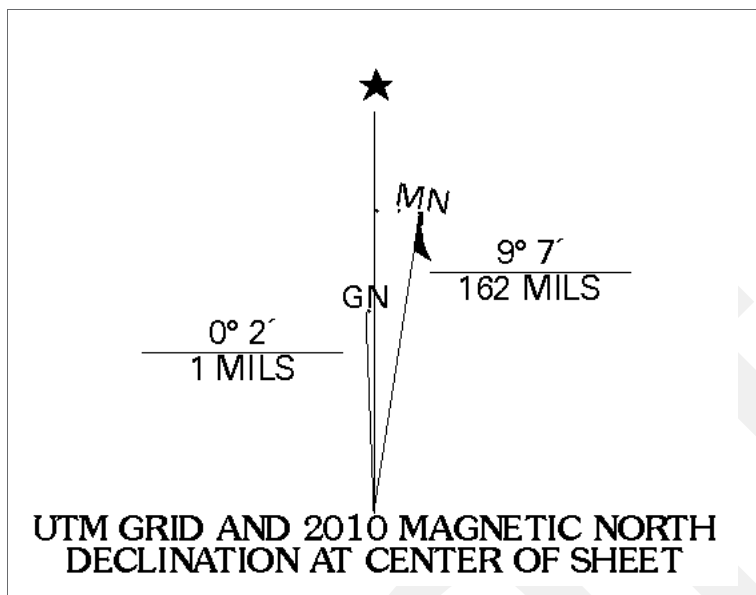


Figure F-2 Declination Indication on Map

However, because of the dynamic nature of the Earth's magnetic field, old maps are inaccurate. To obtain the most recent declination values, enter your map location at the following link:

<http://www.ngdc.noaa.gov/geomag-web/#declination>

CAUTION

Placing magnetic objects near a compass can cause an incorrect reading (deviation). Examples include:

- *Objects that contain steel and iron such as pocket knives, belt buckles, vehicles, railroad tracks, and ore deposits in the Earth*
- *Objects that use magnets such as stereo speakers*
- *Electrical current in cables and overhead lines*

To locate an object using a map and a compass:

- 1** Place the long edge of the compass baseplate on the map, connecting the desired start and end points. For example, the start point could be where you are standing [A], and the end point [B] is where you want to locate the backhaul mast. The Direction of Travel arrow should point towards the end point (mast location).
- 2** While holding the compass on the map, turn the Degree Dial until the Meridian / Orienting Lines are parallel with the Meridian lines on the map. This is the same as turning the Degree Dial until the Orienting Arrow points to north on the map.



U.S. DE
U

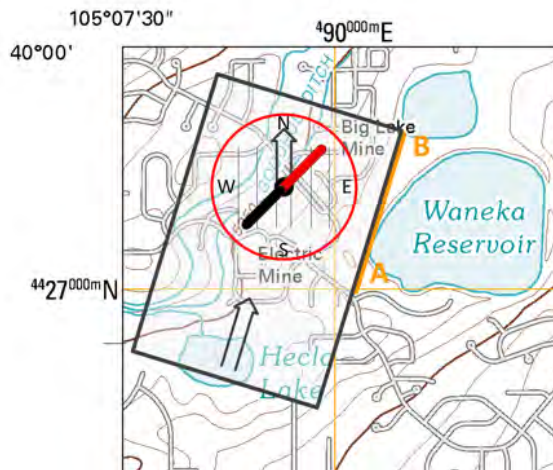


Figure F-3 *Compass and Map*

3 Adjust for declination.

- If you have an adjustable compass – Move the Orienting Arrow to the right or left by the declination number. When you align the magnetic needle with the Orienting Arrow, the declination is accounted for.
- If you do not have an adjustable compass – Mark the declination on your compass with a piece of tape. Align the magnetic needle with the tape mark.
- Adjust the Orienting Arrow to the left or right. For example:
 - ▶ For a declination of 0, no adjustment is necessary.
 - ▶ For a declination of 9 (9 degrees East), move the Orienting Arrow (or place a tape mark) to the right 9 degrees.
 - ▶ For a declination of -9 (9 degrees West), move the Orienting Arrow (or place a tape mark) to the left 9 degrees.

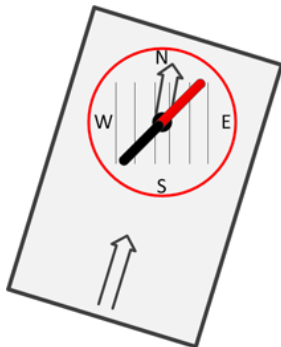


Figure F-4 *Compass Adjusted for Declination*

- 4 Pick up the compass and adjust the cover so the angle of the cover to the base is between 45 and 70 degrees.
- 5 Hold the base of the compass in the palm of your hand. Keep the compass level. Turn your entire body and the compass until the red end of the Magnetic Needle is aligned with the red end (north end) of Orienting Arrow.

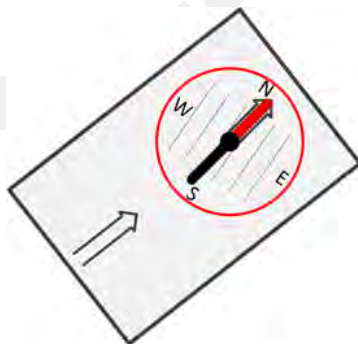


Figure F-5 *Compass Adjusted for Declination*

- 6 While holding the compass at eye level, keep the compass level and align your destination with the sight notch on the top of the case.
- 7 Ensure that the sighting line in the mirror passes through the center of the compass wheel.

Rope Knot

This chapter shows how to tie a taut-line hitch knot. This loop knot can be adjusted to loosen or tighten a line, yet holds under a load. This knot is commonly used to secure tent lines and loads on vehicles. It is the recommended knot for securing the RT System 2 guy rope mast.

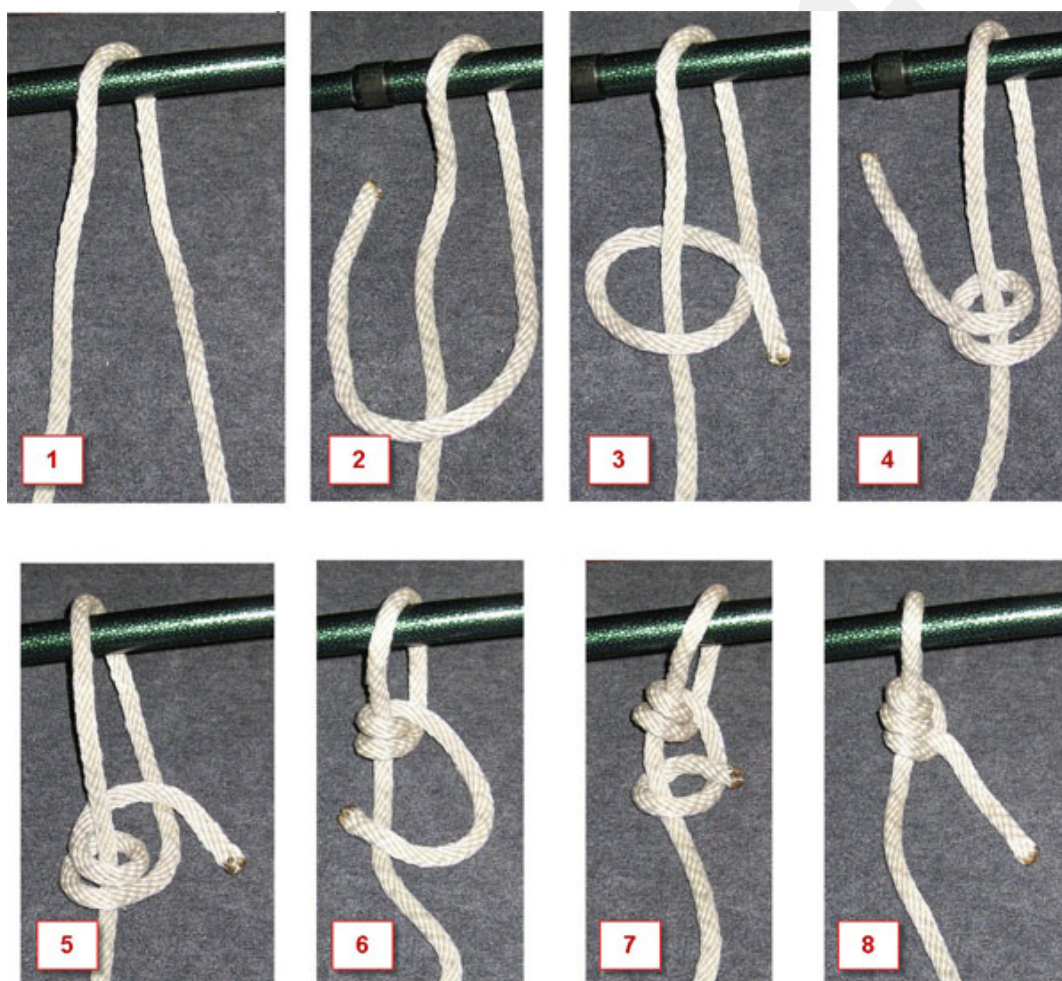


Figure G-1 Tying the Taut-line Hitch Knot

The following link provides a short video example:

http://www.sailingcourse.com/videos/taut_line_hitch.htm

Country Codes

This chapter provides a quick-reference to the ISO 3166 country codes.

Table H-1 ISO 3166 Country Codes

Name	Code
Afghanistan	004
Åland Islands	248
Albania	008
Algeria	012
American Samoa	016
Andorra	020
Angola	024
Anguilla	660
Antarctica	010
Antigua and Barbuda	028
Argentina	032
Armenia	051
Aruba	533
Australia	036
Austria	040
Azerbaijan	031
Bahamas (the)	044
Bahrain	048
Bangladesh	050
Barbados	052
Belarus	112
Belgium	056
Belize	084
Benin	204
Bermuda	060
Bhutan	064

Table H-1 ISO 3166 Country Codes

Name	Code
Bolivia, Plurinational State of	068
Bonaire, Sint Eustatius and Saba	535
Bosnia and Herzegovina	070
Botswana	072
Bouvet Island	074
Brazil	076
British Indian Ocean Territory (the)	086
Brunei Darussalam	096
Bulgaria	100
Burkina Faso	854
Burundi	108
Cambodia	116
Cameroon	120
Canada	124
Cape Verde	132
Cayman Islands (the)	136
Central African Republic (the)	140
Chad	148
Chile	152
China	156
Christmas Island	162
Cocos (Keeling) Islands (the)	166
Colombia	170
Comoros	174
Congo	178

H. Country Codes

Table H-1 ISO 3166 Country Codes

Name	Code
Congo (the Democratic Republic of the)	180
Cook Islands (the)	184
Costa Rica	188
Côte d'Ivoire	384
Croatia	191
Cuba	192
Curaçao	531
Cyprus	196
Czech Republic (the)	203
Denmark	208
Djibouti	262
Dominica	212
Dominican Republic (the)	214
Ecuador	218
Egypt	818
El Salvador	222
Equatorial Guinea	226
Eritrea	232
Estonia	233
Ethiopia	231
Falkland Islands (the) [Malvinas]	238
Faroe Islands (the)	234
Fiji	242
Finland	246
France	250
French Guiana	254
French Polynesia	258
French Southern Territories (the)	260
Gabon	266
Gambia (The)	270

Table H-1 ISO 3166 Country Codes

Name	Code
Georgia	268
Germany	276
Ghana	288
Gibraltar	292
Greece	300
Greenland	304
Grenada	308
Guadeloupe	312
Guam	316
Guatemala	320
Guernsey	831
Guinea	324
Guinea-Bissau	624
Guyana	328
Haiti	332
Heard Island and McDonald Islands	334
Holy See (the) [Vatican City State]	336
Honduras	340
Hong Kong	344
Hungary	348
Iceland	352
India	356
Indonesia	360
Iran (the Islamic Republic of)	364
Iraq	368
Ireland	372
Isle of Man	833
Israel	376
Italy	380
Jamaica	388

Table H-1 ISO 3166 Country Codes

Name	Code
Japan	392
Jersey	832
Jordan	400
Kazakhstan	398
Kenya	404
Kiribati	296
Korea (the Democratic People's Republic of)	408
Korea (the Republic of)	410
Kuwait	414
Kyrgyzstan	417
Lao People's Democratic Republic (the)	418
Latvia	428
Lebanon	422
Lesotho	426
Liberia	430
Libya	434
Liechtenstein	438
Lithuania	440
Luxembourg	442
Macao	446
Macedonia (the former Yugoslav Republic of)	807
Madagascar	450
Malawi	454
Malaysia	458
Maldives	462
Mali	466
Malta	470
Marshall Islands (the)	584
Martinique	474
Mauritania	478

Table H-1 ISO 3166 Country Codes

Name	Code
Mauritius	480
Mayotte	175
Mexico	484
Micronesia (the Federated States of)	583
Moldova (the Republic of)	498
Monaco	492
Mongolia	496
Montenegro	499
Montserrat	500
Morocco	504
Mozambique	508
Myanmar	104
Namibia	516
Nauru	520
Nepal	524
Netherlands (the)	528
New Caledonia	540
New Zealand	554
Nicaragua	558
Niger (the)	562
Nigeria	566
Niue	570
Norfolk Island	574
Northern Mariana Islands (the)	580
Norway	578
Oman	512
Pakistan	586
Palau	585
Palestine, State of	275
Panama	591

H. Country Codes

Table H-1 ISO 3166 Country Codes

Name	Code
Papua New Guinea	598
Paraguay	600
Peru	604
Philippines (the)	608
Pitcairn	612
Poland	616
Portugal	620
Puerto Rico	630
Qatar	634
Réunion	638
Romania	642
Russian Federation (the)	643
Rwanda	646
Saint Barthélemy	652
Saint Helena, Ascension and Tristan da Cunha	654
Saint Kitts and Nevis	659
Saint Lucia	662
Saint Martin (French part)	663
Saint Pierre and Miquelon	666
Saint Vincent and the Grenadines	670
Samoa	882
San Marino	674
Sao Tome and Principe	678
Saudi Arabia	682
Senegal	686
Serbia	688
Seychelles	690
Sierra Leone	694
Singapore	702

Table H-1 ISO 3166 Country Codes

Name	Code
Sint Maarten (Dutch part)	534
Slovakia	703
Slovenia	705
Solomon Islands (the)	090
Somalia	706
South Africa	710
South Georgia and the South Sandwich Islands	239
South Sudan	728
Spain	724
Sri Lanka	144
Sudan (the)	729
Suriname	740
Svalbard and Jan Mayen	744
Swaziland	748
Sweden	752
Switzerland	756
Syrian Arab Republic (the)	760
Taiwan (Province of China)	158
Tajikistan	762
Tanzania, United Republic of	834
Thailand	764
Timor-Leste	626
Togo	768
Tokelau	772
Tonga	776
Trinidad and Tobago	780
Tunisia	788
Turkey	792
Turkmenistan	795

Table H-1 ISO 3166 Country Codes

Name	Code
Turks and Caicos Islands (the)	796
Tuvalu	798
Uganda	800
Ukraine	804
United Arab Emirates (the)	784
United Kingdom (the)	826
United States (the)	840
United States Minor Outlying Islands (the)	581
Uruguay	858
Uzbekistan	860
Vanuatu	548
Venezuela, Bolivarian Republic of	862
Viet Nam	704
Virgin Islands (British)	092
Virgin Islands (U.S.)	850
Wallis and Futuna	876
Western Sahara*	732
Yemen	887
Zambia	894
Zimbabwe	716

Ce chapitre fournit des informations sur le suivant :

- ◆ *“Batteries” sur la page 192*
- ◆ *“l’information juridique” sur la page 198*

I.1 Batteries

Ce chapitre fournit des informations sur les batteries utilisées dans le système RT System 2 de Wireless Seismic, Inc.

I.1.1 Batteries au lithium-ion

Cette section fournit des informations sur les caractéristiques, l'utilisation et la manipulation des batteries au lithium-ion. Reportez-vous aux sections suivantes pour en savoir plus:

- *“Spécifications” on page 192*
- *“Directives en matière de manipulation et de sécurité” on page 193*
- *“Transport” on page 194*
- *“Entreposage” on page 196*

I.1.1.1 Spécifications

Le RT System 2 utilise une ou deux batteries au lithium-ion intelligentes et personnalisées, dotées d'un circuit de charge autonome qui protège les batteries contre les surcharges, décharges, courts-circuits ou changements extrêmes de température.

Le tableau suivant indique les spécifications des batteries:

Tableau I–1 Spécifications des batteries au lithium-ion

Élément	Description	Valeur
Tension	Nominale	3,7 V c.c.
	Arrêt	2,8 V c.c.
	Charge complète (90 %)	4,1 V c.c.
	Tension de charge excessive	4,28 V c.c.
	Tension de décharge excessive	2,80 V c.c.
Courant	Courant de charge maximum	2 A
	Consommation, mode actif	4,2 mA maximum
	Consommation, mode veille	66 µA maximum
Charge complète (90 %) mAh	Environ 12 000 mAh à la tension nominale	

Tableau I-1 Spécifications des batteries au lithium-ion (cont.)

Élément	Description	Valeur
Charge complète (90 %) mWh	Environ 44 400 mWh à la tension nominale	
Capacité		48,8 wattheures
Connecteur	5 broches	
DEL	Une DEL qui indique l'état de charge lors de la connexion à la station de charge, de la manière suivante :	<ul style="list-style-type: none"> • Vert : chargé • Rouge : en train de charger • Orange : phase transitionnelle entre l'état de chargement et l'état chargé, ou dépassement des limites de la température de charge
Étiquette	Une étiquette indiquant le numéro de série sous forme de code à barres	
Température	Fonctionnement	De -40°C à +85°C
	Chargement	De -5°C à +45°C
	Entreposage à température ambiante	<ul style="list-style-type: none"> • De -20°C à +45°C durant une période maximum d'un mois • De -20°C à +35°C durant 6 mois maximum ; passé ce délai, les blocs-batteries doivent être rechargés à plus de 50 % de leur capacité

I.1.1.2 Directives en matière de manipulation et de sécurité

Respecter les directives suivantes en matière de manipulation et de sécurité :

- ♦ Si un bloc-batterie présente une fuite de liquides, ne pas toucher les liquides. Jeter le bloc-batterie en cas de fuite. En cas de contact oculaire avec du liquide, ne pas se frotter les yeux. Rincer immédiatement les yeux avec de l'eau pendant au moins 15 minutes, en soulevant les paupières supérieures et inférieures jusqu'à ce qu'il n'y ait plus de trace de liquide. Consulter un médecin.
- ♦ Ne pas démonter, écraser ou percer une batterie
- ♦ Ne pas court-circuiter les contacts externes d'une batterie
- ♦ Ne pas jeter une batterie dans le feu ou l'eau
- ♦ Ne pas exposer une batterie à des températures supérieures à 60 °C (140 °F)
- ♦ Maintenir la batterie à l'écart des enfants
- ♦ Éviter d'exposer la batterie à des vibrations ou chocs excessifs
- ♦ Ne pas utiliser une batterie endommagée
- ♦ Les blocs-batteries au lithium-ion DOIVENT être entièrement déchargés avant leur élimination

- ◆ Bien qu'il puisse exister des restrictions locales ou nationales, les batteries au lithium-ion sont considérées comme des « déchets universels non dangereux » par le gouvernement fédéral. Il existe des restrictions qui s'appliquent à ceux qui gèrent de grandes quantités de déchets universels ; celles-ci définissent l'étiquetage, le confinement, etc. Dans la mesure du possible, les batteries doivent être déchargées avant de les jeter. Les conducteurs/contacts de batterie doivent être fixés de manière à éviter un court-circuit accidentel. Chaque bloc-batterie doit être placé dans un sac en plastique.
- ◆ Le recyclage est encouragé lorsqu'il est réalisable. Les batteries contiennent des matériaux recyclables et sont acceptées par plusieurs entreprises de recyclage de batteries. Reportez-vous à l'un des éléments suivants pour obtenir plus d'informations sur le recyclage et l'élimination :
 - <http://www.swe.com>
 - <http://www.rbr.org>
 - <http://www.call2recycle.org>
 - 1-800-8-BATTERY
 - 1-877-2-RECYCLE

I.1.1.3 Transport

Aux États-Unis, les expéditions de grandes quantités de batterie au lithium-ion (plus de 24 piles ou 12 batteries par colis) sont réglementées comme des matières dangereuses (classe 9) par le gouvernement fédéral et sont soumises aux règlements décrits ci-après :

- ◆ Code of Federal Regulations, Title 49 Transportation.
http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?sid=92868a82add6feba6afa796572133179&c=ecfr&tpl=/ecfrbrowse/Title49/49tab_02.tpl
- ◆ International Air Transport Association (IATA)
http://www.iata.org/whatwedo/cargo/dangerous_goods/pages/lithium_batteries.aspx

Les batteries ne peuvent être expédiées par voie terrestre que si toutes les conditions suivantes sont satisfaites :

- ◆ La boîte utilisée satisfait le test de chute de 1,2 m (boîte classée « UN ») de boîte d'emballage
- ◆ Les bornes de bloc-batterie sont protégées pour éviter un court-circuit
- ◆ Le poids brut ne dépasse pas 30 kg (66 livres)
- ◆ L'emballage extérieur porte l'étiquette requise en vigueur. La figure suivante en montre un exemple.



Exemple I-1 Example Battery Shipping Label

Les batteries ne peuvent être expédiées par voie aérienne que si toutes les conditions suivantes sont satisfaites :

- ◆ La boîte utilisée satisfait le test de chute de 1,2 m (boîte classée « UN ») de boîte d'emballage
- ◆ Les bornes de bloc-batterie sont protégées pour éviter un court-circuit
- ◆ Le poids brut de chaque colis ne dépasse pas 10 kg (22 livres)
- ◆ L'emballage extérieur porte l'étiquette requise en vigueur. La figure précédente en montre un exemple (*"Example Battery Shipping Label" on page 195*).

AVERTISSEMENT

Les informations contenues dans le présent document ont pour but de fournir une connaissance générale des règlements s'appliquant aux batteries. Elles ne sont pas exhaustives, et les conditions mentionnées dans ce document peuvent avoir changées. Rien dans le présent chapitre ou dans le Guide de déploiement ne constitue un avis juridique ou est destiné à répondre aux problèmes juridiques, de conformité, ou réglementaires spécifiques qui peuvent survenir dans des circonstances particulières. Le présent chapitre et le Guide de déploiement ne sont pas destinés à remplacer les règlements officiels en vigueur concernant l'emballage et l'expédition de matières dangereuses ou un conseil juridique indépendant sur ces questions. Vous êtes seul responsable du respect de toutes les lois, règlements et autres exigences. Veuillez vous reporter à une copie officielle de la version en vigueur de ces documents pour obtenir les dernières informations.

I.1.1.4 Entreposage

Un entreposage et un entretien adéquats des batteries au lithium-ion est indispensable pour optimiser leur durée de vie utile et éviter une défaillance catastrophique. Respecter les précautions suivantes en matière d'entreposage :

- ◆ Retirer les batteries de l'unité distante sans fil avant l'entreposage
- ◆ Température d'entreposage recommandée des batteries au lithium-ion :
 - De -20°C à +45°C durant une période maximum d'un mois
 - De -20°C à +35°C durant 6 mois maximum ; passé ce délai, les blocs-batteries doivent être rechargés à plus de 50 % de leur capacité
 - L'entreposage à basses températures ralentit la décharge naturelle et la perte de capacité au fil du temps. Entreposer les batteries à 25°C ou moins si possible
- ◆ Niveaux de charge d'entreposage recommandés :
 - Charger (ou décharger) les batteries à un niveau de charge de 30 % à 50 % avant de les entreposer. Des niveaux de charge inférieurs ou supérieurs peuvent réduire la durée de vie des batteries.
 - Ne jamais entreposer des batteries entièrement déchargées, sauf en cas d'élimination.
 - Un chargement périodique est nécessaire pour maintenir une charge de 30 % à 50 % en cas d'entreposage de longue durée
- ◆ Entreposer les batteries dans un endroit bien aéré
- ◆ Ne pas laisser les batteries inutilisées pendant de longues durées, qu'elles soient dans le produit ou placées en entreposage. Si une batterie n'a pas été utilisée pendant 6 mois, vérifier l'état de charge et charger ou éliminer la batterie, le cas échéant.
- ◆ Vérifier régulièrement l'état de charge de la batterie
- ◆ Envisager le remplacement de la batterie par une nouvelle en cas de constat d'une des conditions suivantes :
 - L'autonomie de la batterie descend en dessous d'environ 80 % de son autonomie initiale
 - Le temps de charge de la batterie augmente sensiblement

I.1.2 Chargement des batteries au lithium-ion

Cette section décrit les précautions de chargement et présente le chargeur de batterie.

I.1.2.1 Précautions de chargement

Respecter les précautions de chargement suivantes :

- ◆ Avant de la charger, inspecter la batterie pour détecter les signes éventuels de dommages sur le boîtier ou les connecteurs susceptibles de créer un court-circuit.
- ◆ La batterie peut être chargée dans la plage de température de 0°C à +45°C. En cas de chargement de la batterie en dehors de cette plage, la batterie peut devenir très chaude ou se rompre.
- ◆ Être absolument sûr de l'utilisation d'une source de 5 V lors du chargement de la batterie.
- ◆ Prendre soin de charger les batteries sur une surface ininflammable.
- ◆ Ne pas charger les batteries à proximité d'objets ou de liquides inflammables.
- ◆ Conserver un extincteur à poudre chimique de classe C à proximité.
- ◆ Ne pas continuer de recharger la batterie si elle ne se recharge pas dans le temps de chargement spécifié.
- ◆ NE JAMAIS laisser une batterie au lithium-ion sans surveillance lorsqu'elle est en train de charger.

I.1.2.2 Chargeur de batterie

Le chargeur de batterie au lithium-ion est conçu pour fonctionner à partir d'une ligne de service simple 120 V c.a., 10 A.

Le bloc d'alimentation servant à charger le bloc-batterie fournit une tension régulée de 5 V c.c.



Exemple I-2 Chargeur de batterie



*Exemple I-3 Étiquette avec
numéro de série et voyant
DEL*

**PRUDENCE**

Le risque d'explosion si la batterie est remplacée par un type incorrect. Débarrassez-vous utilisées batteries selon les instructions.

I.2 l'information juridique

I.2.1 Conformité avec les règles et règlements de la FCC

La Federal Communications Commission (FCC) réglemente l'utilisation d'antennes dans l'article suivant : Code of Federal Regulations – Title 47, Part 15 – Radio Frequency Devices, Subpart C – Intentional Radiators, Section 15.203 Antenna Requirement.

**REMARQUE**

Cet équipement a été testé et jugé conforme aux limites fixées pour un appareil numérique de classe A, conformément à la partie 15 des règles de la FCC. Ces limites sont conçues pour fournir une protection raisonnable contre les interférences nuisibles lorsque l'équipement est utilisé dans un environnement commercial. Cet équipement génère, utilise et peut émettre l'énergie des fréquences radio et, s'il n'est pas installé et utilisé conformément au mode d'emploi, peut causer des interférences nuisibles avec les communications radio. Le fonctionnement de cet équipement dans une zone résidentielle est susceptible de provoquer des interférences nuisibles, auquel cas l'utilisateur devra corriger les interférences à ses propres frais.

Lorsqu'il est utilisé comme prévu, le RT System 2 respecte les conditions de l'article 15.203 de la FCC de la manière suivante :

Lorsqu'il est utilisé comme prévu, le RT System 2 respecte les conditions de l'article 15.203 de la FCC et d'Industrie Canada CNR-Gen 7.1.2 de la manière suivante :

- ◆ Les antennes du RT System 2 doivent être installées et manipulées par des professionnels spécifiquement désignés pour cela.
- ◆ Les changements ou modifications non expressément approuvés par Wireless Seismic, Inc. peuvent annuler l'autorisation de l'utilisateur d'utiliser l'équipement.
- ◆ Le RT System 2 doit être utilisé uniquement avec les antennes fournies (*Tableau I-2*) branchées à l'unité distante sans fil ou à la station de base à l'aide d'un connecteur mâle de type N intégré.

Tableau I-2 Spécifications des antennes

Modèle	Fréquence (MHz)	Gain	Largeur de bande verticale	Poids	Dimensions (Longueur x Diamètre)
WSI 65-0204 (antenna-normal)	2400	5.5 dBi	25°	0.4 lbs .2 kg	32 x 0,6 po 810.5 x 15 mm
WSI 65-0091 (extension-normal)	2400	0 dBi	N/A	0.6 lbs 0.3 kg	30 x 0,7 po 762 x 18,5 mm

AVERTISSEMENT

Afin de se conformer aux normes de la matière d'exposition aux radiofréquences (RF), les unités RT System 2 doivent être installées de manière à garder en permanence une distance minimale de 20 cm entre la ou les antennes et le corps de toute personne en mode de fonctionnement normal.

L'autorisation d'équipement de FCC a été accordée comme suit :

- ◆ Le 5Mbps unité d'interface de ligne a reçu l'autorisation d'équipement.
- ◆ Le 5Mbps unité lointaine sans fil a reçu l'autorisation d'équipement.

I.2.2 Industrie Canada Conformité

L'unité distante sans fil a reçu l'approbation et la certification d'Industrie Canada (IC) par rapport à CNR-210 8^e édition et CNR-102 4^e édition :

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

L'unité d'interface de ligne a reçu l'approbation et la certification d'Industrie Canada (IC) par rapport à CNR-210 8^e édition et CNR-102 4^e édition :

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

Cet appareil est conforme avec l'industrie Canada licence exemptes des normes. Son fonctionnement est soumis aux deux conditions suivantes :

- ◆ Ce dispositif ne peut causer des interférences, et
- ◆ Ce dispositif doit accepter toute interférence, y compris les interférences qui peuvent causer un mauvais fonctionnement du dispositif.

I.2.3 Acquiescement de CE

L'Unité Lointaine Sans fil (WRU) et l'Unité d'Interface de Ligne (LIU) se plie aux directives d'UE applicables pour le Conformité Européene (CE) la marque. La marque suivante est attachée à chaque unité.



Exemple I-4 Marque de CE

Numerics

12 V DC 36
19 dBi directional antenna 147
5.8 GHz band 35
56-0032 INTL 68
56-0035 US 68
6 dBi antenna 147
65-0091 18
90-0026 10
90-0028 10
90-0032 10
90-0039 10

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Acquiring GPS fix 167
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