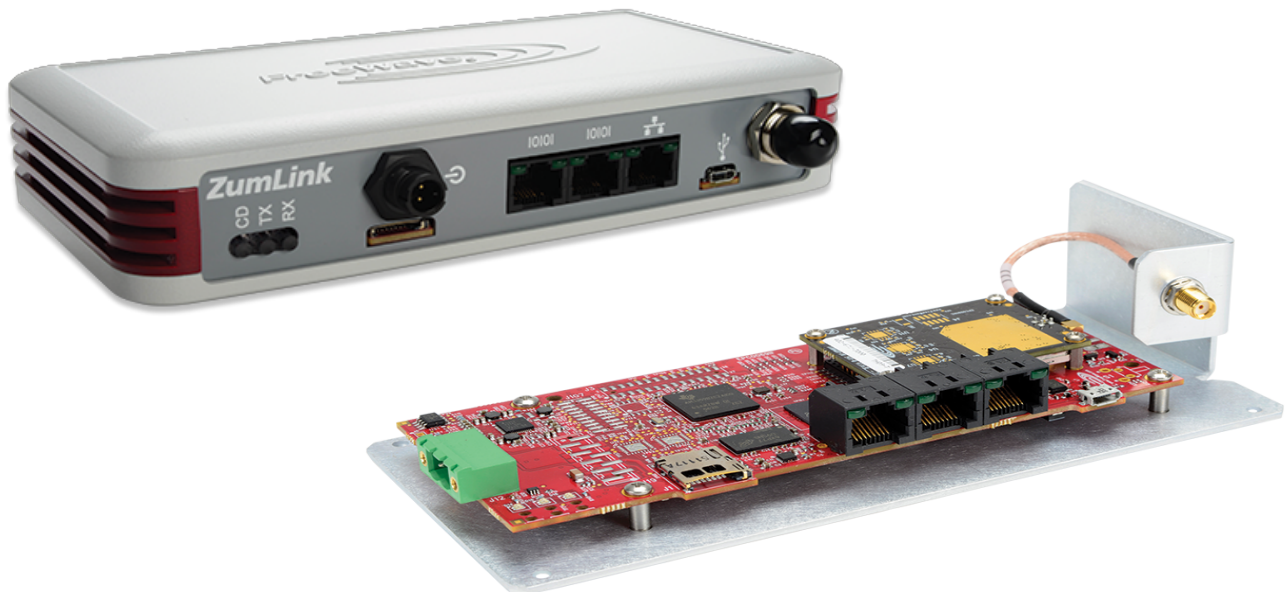# FREEWAVE

ZumLink™

Covers Models: Z9-P and Z9-PE

Firmware 1.0.7.0

User & Reference Manual

Part Number: LUM0076AA

Revision: Apr-2018

Safety Information

The products described in this manual can fail in a variety of modes due to misuse, age, or malfunction and is not designed or intended for used in systems requiring fail-safe performance, including life safety systems. Systems with the products must be designed to prevent personal injury and property damage during product operation and in the event of product failure.

Warning! **Do not** remove or insert any of the cables while the unit is powered on unless the area is known to be free of ignition concentrations of flammable gasses or vapors.

Warranty Information

FreeWave Technologies, Inc. warrants the FreeWave® ZumLink Z9-P / Z9-PE (Product) that you have purchased against defects in materials and manufacturing for a period of two years from the date of shipment, depending on model number. In the event of a Product failure due to materials or workmanship, FreeWave will, at its discretion, repair or replace the Product. For evaluation of Warranty coverage, return the Product to FreeWave upon receiving a Return Material Authorization (RMA). The replacement product will remain under warranty for 90 days or the remainder of the original product warranty period, whichever is longer.

IN NO EVENT WILL FREEWAVE TECHNOLOGIES, INC., ITS SUPPLIERS, OR ITS LICENSORS BE LIABLE FOR ANY DAMAGES ARISING FROM THE USE OF OR INABILITY TO USE THIS PRODUCT. THIS INCLUDES BUSINESS INTERRUPTION, LOSS OF BUSINESS INFORMATION, INABILITY TO ACCESS OR SEND COMMUNICATION OR DATA, PERSONAL INJURY OR DAMAGE, OR OTHER LOSS WHICH MAY ARISE FROM THE USE OF THIS PRODUCT. THE WARRANTY IS EXCLUSIVE AND ALL OTHER WARRANTIES EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE ARE EXPRESSLY DISCLAIMED.

FreeWave's Warranty does **not apply** in the following circumstances:

1. If Product repair, adjustments, or parts replacements are required due to accident, neglect, or undue physical, electrical, or electromagnetic stress.
2. If Product is used outside of FreeWave specifications as stated in the Product's data sheet.
3. If Product has been modified, repaired, or altered by Customer unless FreeWave specifically authorized such alterations in each instance in writing.

Warning! The Z9-P is sold as a multi-board solution, assembled at the FreeWave factory. Separation of the individual boards voids the FreeWave warranty.

Warning! The ZumLink Z9-PE is sold as a fully enclosed device, assembled at the FreeWave factory. Opening the ZumLink Z9-PE device voids the FreeWave warranty.

Table of Contents

Preface

Contact FreeWave Technical Support

For up-to-date troubleshooting information, check the **Support** page at www.freewave.com.

FreeWave provides technical support Monday through Friday, 8:00 AM to 5:00 PM Mountain Time (GMT -7).

- Call toll-free at 1.866.923.6168.
- In Colorado, call 303.381.9200.
- Contact us through e-mail at moreinfo@freewave.com.

Other ZumLink Information

> Use the FreeWave http://support.freewave.com/ website to download the latest version of these documents.
> Registration is required to use this login.

Document	Description	FreeWave Part Number
User Manual	The User Manual provides detailed information about installation, setup and connection, and configuration procedures, and safety information for the ZumLink device.	LUM0076AA
Quick Start Guide	The Quick Start Guide provides the out-of-the-box setup of the ZumLink device.	QSG0029AA

Document Styles

This document uses these styles:

- Parameter setting text appears as: **[Page=radioSettings]**
- File names appear as: **configuration.cfg**.
- File paths appear as: **C:\Program Files (x86)\FreeWave Technologies**.
- User-entered text appears as: **xxxxxxxxx**.

Caution: Indicates a situation that **MAY** cause damage to personnel, the radio, data, or network.

Example: Provides example information of the related text.

FREEWAVE Recommends: Identifies FreeWave recommendation information.

Important!: Provides crucial information relevant to the text or procedure.

Note: Emphasis of specific information relevant to the text or procedure.

Provides time saving or informative suggestions about using the product.

Warning! Indicates a situation that **WILL** cause damage to personnel, the radio, data, or network.

1. ZumLink Overview

Thank you for purchasing the FreeWave ZumLink Z9-P / PE.

ZumLink is the latest generation of radios offered by FreeWave and consists of enclosed and board level radios.

- Z9-PE is an enclosed 900MHz Ethernet radio.

The Z9-P / Z9-PE 900MHz Series:

- Operates in the unlicensed 900MHz ISM band (902-928 MHz).
- Provides a maximum of 30dBm transmit output power.
- Is FCC compliant as both a Frequency Hopping Spread Spectrum (FHSS) and a Digital Modulating (DM) radio.
- Has one Ethernet port, two serial ports, and one micro USB port.

Note: The frequency hopping capability is available at all bandwidths and the single channel (DM) operation is available for bandwidths of at least 500 kHz.

1.1. Communication Method

ZumLink uses LBT (Listen Before Talk) CSMA (Carrier Sense Multiple Access), where there are no assigned slots. The radios transmit when the channel is clear.

FreeWave's traditional protocol has a Master Time Slot and a Slave Time Slot within a frame.

- The Master transmits in its slot and listens in the Slave slot.
- The Slave transmits its slot and listens in the Master slot.

2. Equipment

2.1. Included Equipment

Included Equipment	
Qty	**Description**
1	Z9-P / Z9-PE wireless device.
1	Power Cable w/ flying leads
	• Z9-P FreeWave Part Number: ASC2402PT
	• Z9-PE FreeWave Part Number: ASC0003ZL
1	Quick Start Guide

> **Note**: See the Available Accessories (on page 236).

2.2. User-supplied Equipment

- DC power source
- Power cable
- USB to micro-USB cable
- Ethernet cable
- FCC approved antenna **

> **Note**: **See Approved Antennas (on page 110) for detailed information.
> Approved antennas can be purchased directly from FreeWave.

3. Installation

- Power Setup (on page 17)
- Connections and Installation (on page 17)

3.1. Power Setup

- The Z9-P / Z9-PE is approved to operate with an input voltage range of +6 to +30VDC.
- See the Technical Specifications (on page 256) for additional information.

FREEWAVE Recommends: All input power supply wires should be at least **20AWG** wires.
A dedicated power supply line is preferred.
The power supply used MUST provide more current than the amount of current drain listed in the specifications for the product and voltage. (at least 355 mA at 12V)

STOP **Warning!** Use electrostatic discharge (ESD) protectors to protect the radio from electric shock and provide filtered conditioned power with over-voltage protection.

3.2. Connections and Installation

Note: The images in this procedure are for Windows® 7 and/or Firefox®.
The dialog boxes and windows appear differently on each computer.

3.2.1. Z9-PE Connections
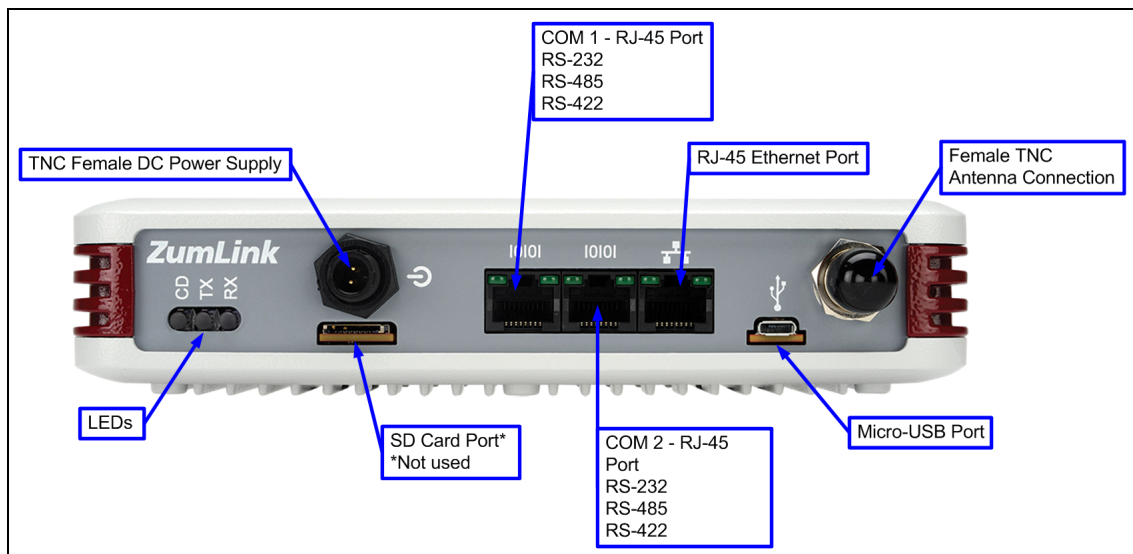
Figure 1: Z9-PE Connections

Procedure

1. Install an FCC-approved antenna.
2. Connect the antenna feed line to the ZumLink.

Warning! Only FCC approved antennas may be used. See Approved Antennas (on page 110). The antenna must be professionally installed on a fixed, mounted, and permanent outdoor structure to satisfy RF exposure requirements.

Any antenna placed outdoors must be properly grounded.

Use extreme caution when installing antennas and follow all instructions included with the antenna.

Tip   If installing a directional antenna, preset the antenna's direction appropriately.

3. Connect the ZumLink to a power supply.

The ZumLink requires a continuous +6 to +30VDC power source that can supply at least 0.8 Amps.

FREEWAVE Recommends: All input power supply wires should be at least **20AWG** wires. A dedicated power supply line is preferred.

The power supply used MUST provide more current than the amount of current drain listed in the specifications for the product and voltage.

The LED lights blink to show startup.

Note: See LEDs (on page 261) for more information.

4. Connect the USB cable to the computer and the micro-USB end to the interface board.

Figure 2 is an example of the Z9-PE connected to a laptop.

Power:
Using the supplied Power Cable, connect DC power here.

Antenna/Attenuator/RF Cable:
Connect the Antenna or attenuator and RF cable here.

Data Packets:
Connect a standard Ethernet cable here and the other end to a computer Ethernet port to pass data packets.

Z9-P Configuration:
Connect the Micro-USB end of a USB cable here and the USB end to a computer USB port to configure the Z9-PE.

Figure 2: Z9-PE Connected to Laptop

The **AutoPlay** ZumLink, **AutoPlay FreeWave Drivers**, and ZumLink windows open.

Important!: The USB does NOT power the ZumLink. It only provides a configuration interface.
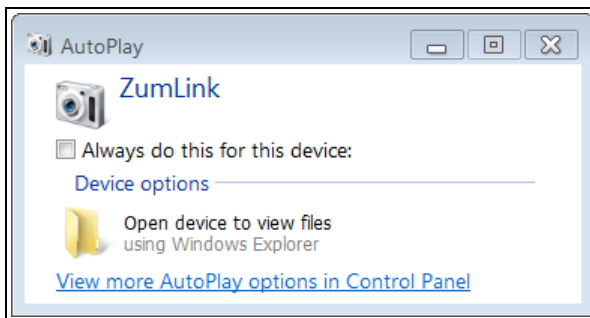
Figure 3: AutoPlay ZumLink window
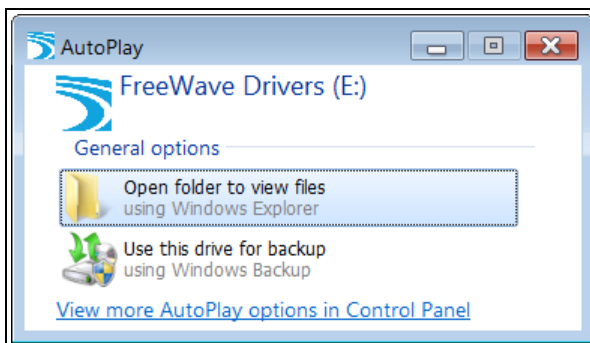
Figure 4: AutoPlay FreeWave Drivers window
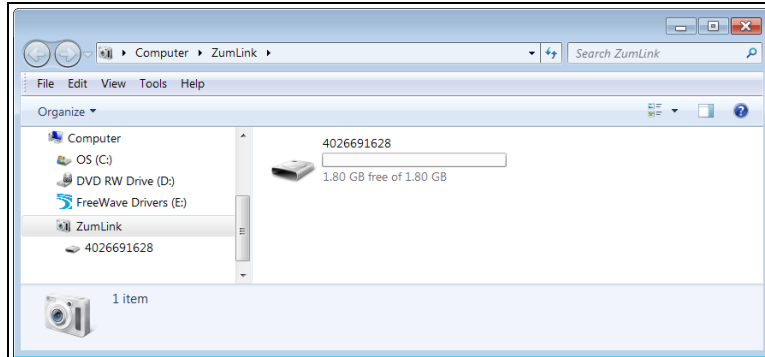
Figure 5: ZumLink window

5. Use the Ethernet port for data communications.
6. Optional: Upgrade the ZumLink to the latest firmware using either of these procedures:
   - Drag and Drop Firmware Upgrade (on page 62)
   - Web Interface Firmware Upgrade (on page 67)

> ⚠️ **Caution**: Firmware v1.0.7.0 is **NOT a required** upgrade. **ONLY** upgrade the ZumLink firmware if the user values the new features and fixes within a firmware version.

4. Configuration

4.1. Drag and Drop Configuration

> ⚠️ **Caution**: This procedure requires the Windows® Explorer file extension to be visible.
> See the Microsoft® topic Show or Hide File Name Extensions to view the extensions.

> **Important!**: Windows® 7 or later is required to use the USB Drag and Drop.

> **Note**: The images in this procedure are for Windows® 7 and/or Firefox®.
> The dialog boxes and windows appear differently on each computer.

Procedure

1. Connect the USB cable to the computer and the micro-USB end to the interface board.
   The **AutoPlay** ZumLink, **AutoPlay FreeWave Drivers**, and ZumLink windows open.

Figure 6: AutoPlay ZumLink window
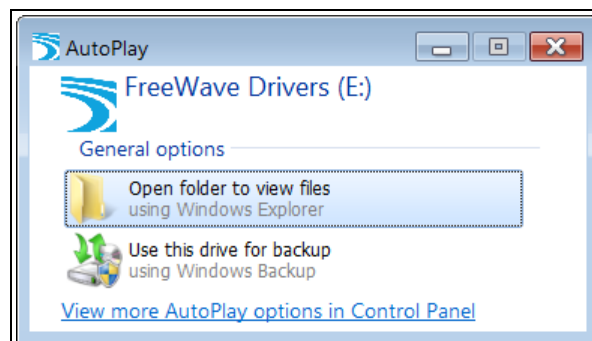
Figure 7: AutoPlay FreeWave Drivers window
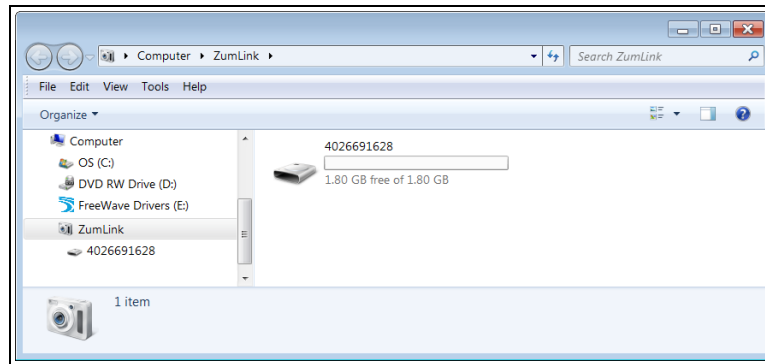
Figure 8: ZumLink window

2. Close the **AutoPlay** windows.
3. In the ZumLink window, double-click the connected ZumLink.
   The files of the ZumLink appear in the window.
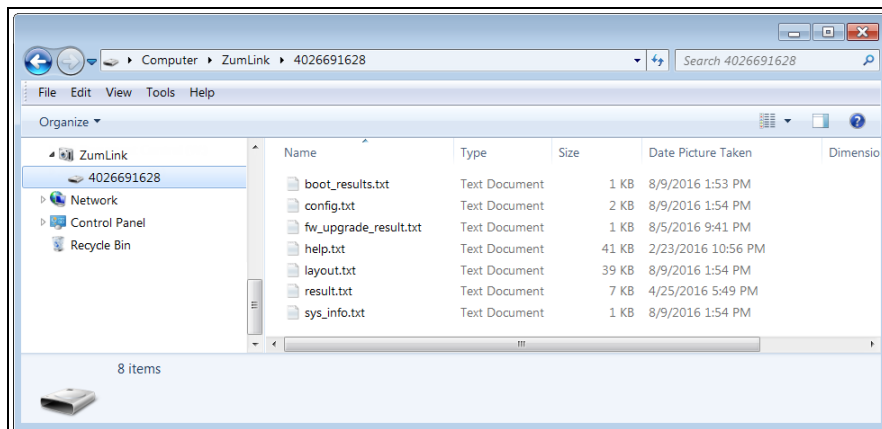
Figure 9: Opened ZumLink window showing the ZumLink files

4. Select the **config.txt** file and copy it to the clipboard (press <Ctrl+C>).
5. Leave the ZumLink window open - it is used later in the procedures.
6. Open a Windows® Explorer window and create a designated folder for changed configuration files.

   Example: **C:\ZumLink Config File**.

7. Paste (press <Ctrl+V>) the copied **config.txt** file into the designated folder.

   Important!: The **txt** file must be copied to a separate location on the computer to edit. The file CANNOT be changed directly in the ZumLink folder.
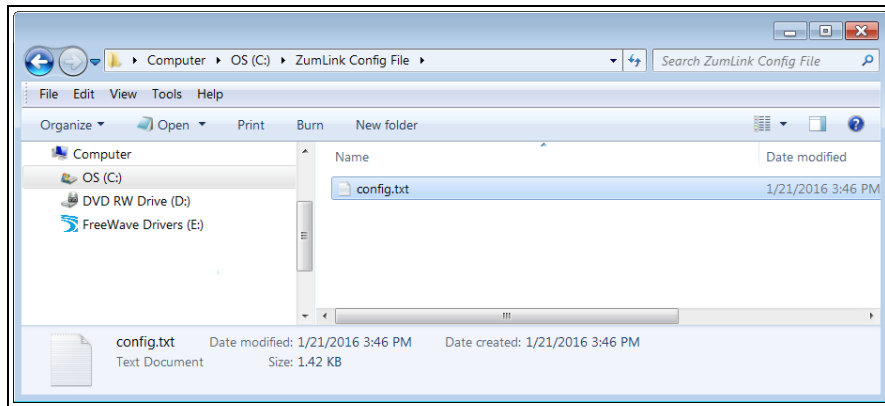
Figure 10: Copied config.txt file in the designated configuration folder.

8. Double-click the **config.txt** to open it in the default text editor.

> **Note**: This example uses Notepad®.

9. Click the Notepad® **File** menu and click **Save As**.
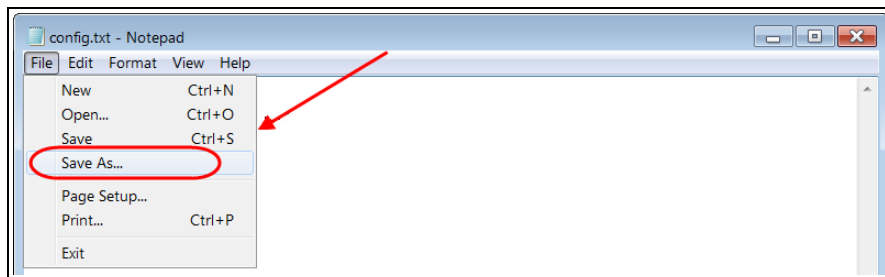
Figure 11: Notepad® window - File > Save As menu.

The **Save As** dialog box opens.

10. In the **File Name** text box, enter a file name with either the **.cfg** or **.cfg.txt** extension.

> **Note**: The file name used in this example is for illustration purposes only.
> Any name can be used. NO SPACES are allowed in the file name.

> ⚠️ **Caution**: A **.cfg** file extension is required for Windows® 7.
> A **.cfg.txt** file extension may be required for some versions of Windows® 8 and
> Windows® 10.
> Failure to save the file with the correct extension type results in the file **NOT** being able
> to integrate with the ZumLink **config.txt** file when copied to the ZumLink window.

11. Click the **Save as type** list box arrow and select **All Files**.
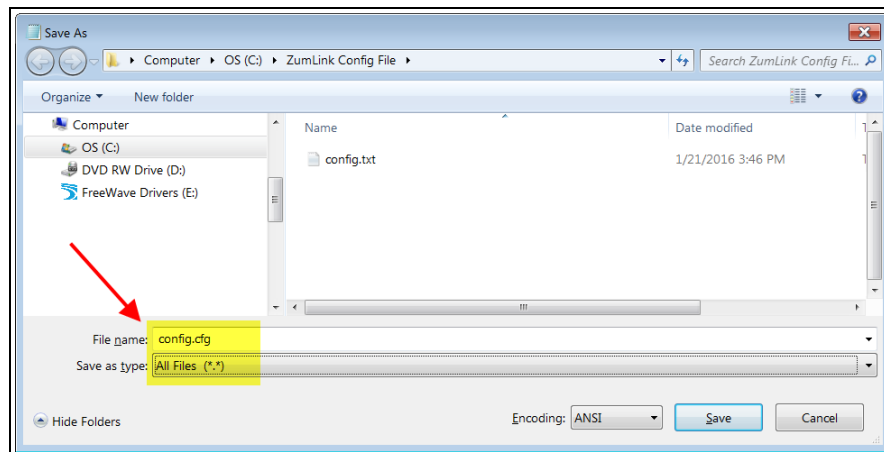
Figure 12: Save As dialog box with All Files (*.*) selected.

12. Click [Save].

   The dialog box closes and the text editor returns with the new **.cfg** or **.cfg.txt** file open.

13. As applicable, change these general settings:
   - [Page=systemInfo]
     - systemInfo.deviceName
     - systemInfo.deviceId

   > **Note**: See systemInfo for detailed information about these settings.

   - [Page=radioSettings]
     - radioSettings.txPower
     - radioSettings.rfDataRate***
     - radioSettings.radioMode
     - radioSettings.networkId***
     - radioSettings.nodeId**
     - radioSettings.radioFrequency***
     - radioSettings.radioHoppingMode***
     - radioSettings.beaconInterval
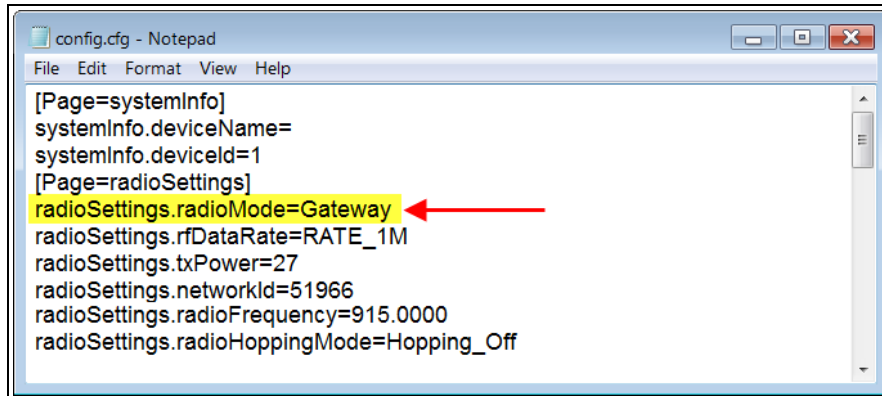
   > **Note**: See radioSettings for detailed information about these settings.

   Each radio with the same **networkId must have a UNIQUE **nodeId**.

   ***These are the Golden Settings and they MUST match between all radios with the same networkId.

> **Important!**: With **radioHoppingMode** enabled, only one radio can be designated as a Gateway or Gateway-Repeater. All other radios MUST be designated as Endpoints or Endpoint-Repeaters. For detailed information, see radioSettings in the Settings and Descriptions section.

> **Example**: For illustration, the **radioSettings.radioMode** was changed from **Endpoint** to **Gateway**.

Figure 13: Notepad® with the .cfg file open.

14. Press <Ctrl+S> or, on the **File** menu, click **Save** to save the updated file.
15. Close the text editor.
16. Locate and open the ZumLink window so it is side-by-side with the changed configuration file window.
17. Open the Windows® Explorer designated folder for changed configuration files.
18. Select the changed **.cfg** or **.cfg.txt** file.
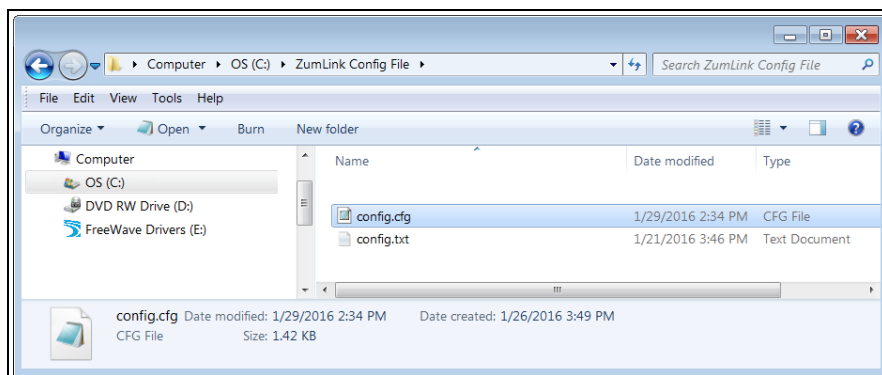
Figure 14: Select the changed .cfg or .cfg.txt file.

19. Drag and drop the **.cfg** or **.cfg.txt** file to the ZumLink window.
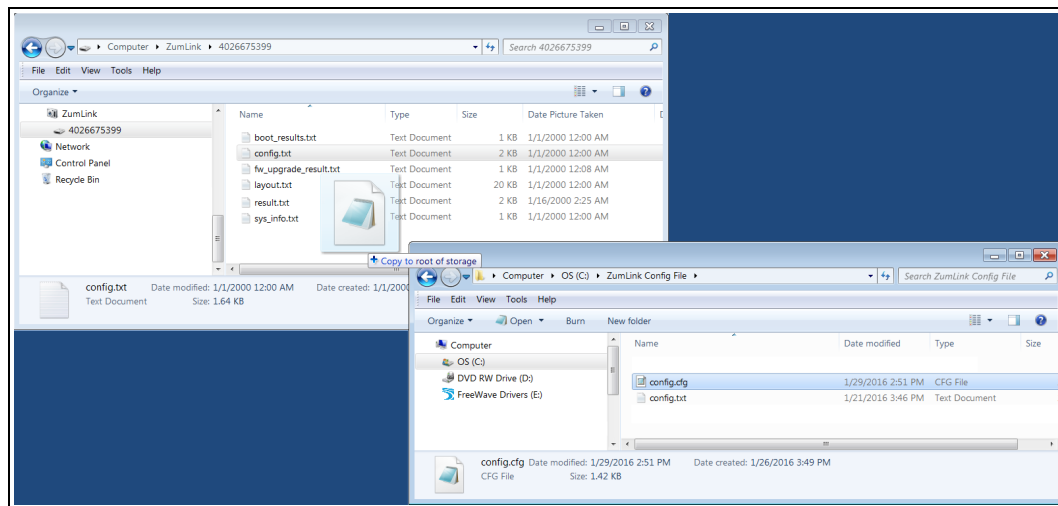
Figure 15: Drag and drop the .cfg or .cfg.txt file to the ZumLink window.

20. Wait for the **.cfg** or **.cfg.txt** file to integrate with the ZumLink **config.txt** file.

> **Note**: The more changes made in the **.cfg** or **.cfg.txt** file, the longer the ZumLink takes to process the file and update the **config.txt** file.
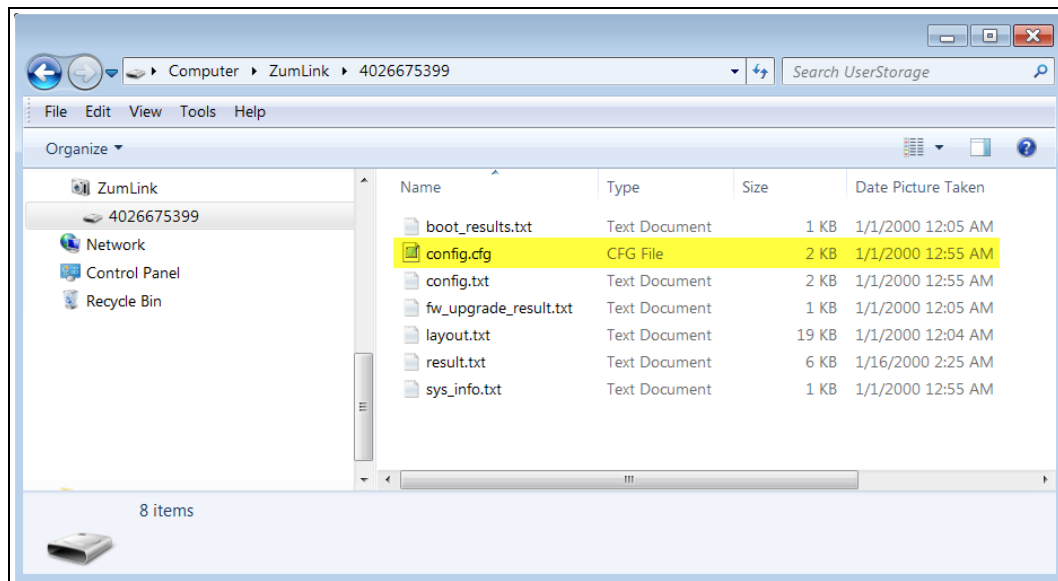
Figure 16: Changed .cfg file copied to the ZumLink window.

When the **config.txt** is updated, the changed **.cfg** or **.cfg.txt** file is removed from the list of files in the ZumLink window.

21. Double-click the **result.txt** file to verify there are **No errors Detected** with the identified changes in the file.
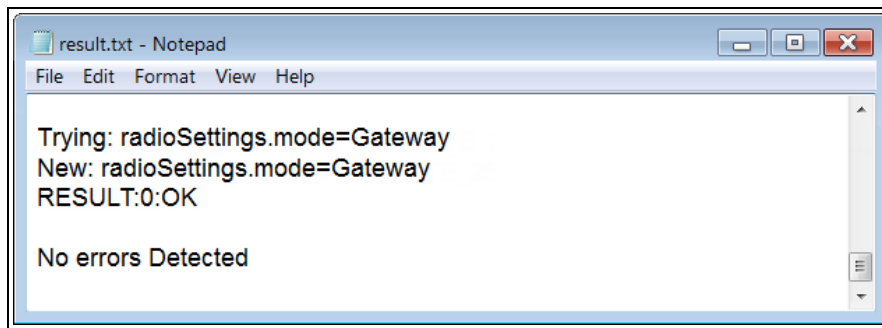
Figure 17: Opened result.txt file.

If an error was detected, the **result.txt** file will indicate that errors are present.

22. As appropriate, repeat the Drag and Drop procedure to correct any errors.

23. Optional: Double-click the **config.txt** file to view the new ZumLink configuration.

24. Optional: Complete the Change the Password (on page 57) procedure.

4.2. CLI Configuration

This procedure provides a Tera Term terminal connection to the ZumLink CLI. Other terminal emulators (e.g., HyperTerminal, PuTTY) may be used.

The basic steps are:

Note: The images in this procedure are for Windows® 7 and/or Firefox®.
The dialog boxes and windows appear differently on each computer.

4.2.1. Connect the ZumLink to the Computer

1. Connect the USB cable to the computer and the micro-USB end to the interface board. The **AutoPlay** ZumLink, **AutoPlay FreeWave Drivers**, and ZumLink windows open.
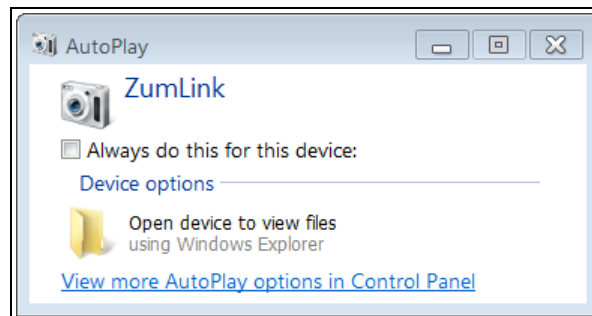

Figure 18: AutoPlay ZumLink window

Figure 19: AutoPlay FreeWave Drivers window

Figure 20: ZumLink window

Important!: The ZumLink driver installs automatically.
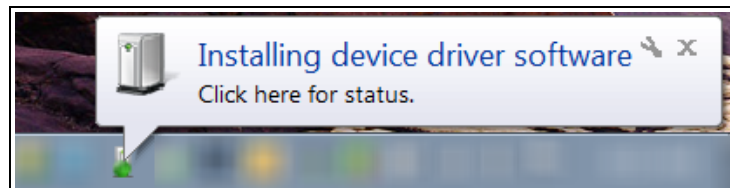
Figure 21: Installing Driver message
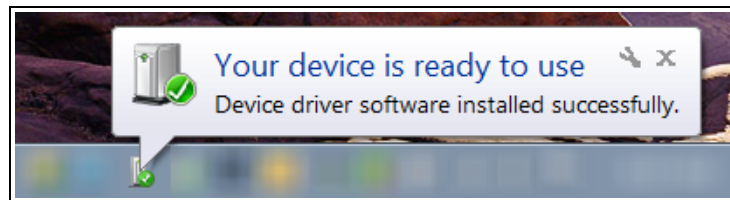
Figure 22: Driver ready to use message

Note: If the ZumLink driver does NOT automatically install, complete the Install the ZumLink Driver (on page 30) procedure.

2. Continue with Tera Term Activation and ZumLink Setup (on page 35).

4.2.2. Install the ZumLink Driver

> **Note**: Follow this procedure if the ZumLink driver does NOT automatically install.
> The images in this procedure are for Windows® 7 and/or Firefox®.
> The dialog boxes and windows appear differently on each computer.

1. In the **AutoPlayFreeWave Drivers** window, make a note of the drive letter (in this example image, it is E).
2. Click the **Windows® Start** button and right-click on **Computer**.
3. In the right-click menu, click **Properties**.

Figure 23: Right-click Properties on the menu.

The **System** window opens.

4. Click **Device Manager**.

Figure 24: Click Device Manager.

The **Device Manager** window opens.

5. Under **Other Devices**, right-click the **CDC Serial** device and select **Update Driver Software**.

Figure 25: Right-click CDC Serial and click Update Driver Software.

The **Update Driver Software - CDC Serial** dialog box opens.

6. Click **Browse my computer for driver software**.
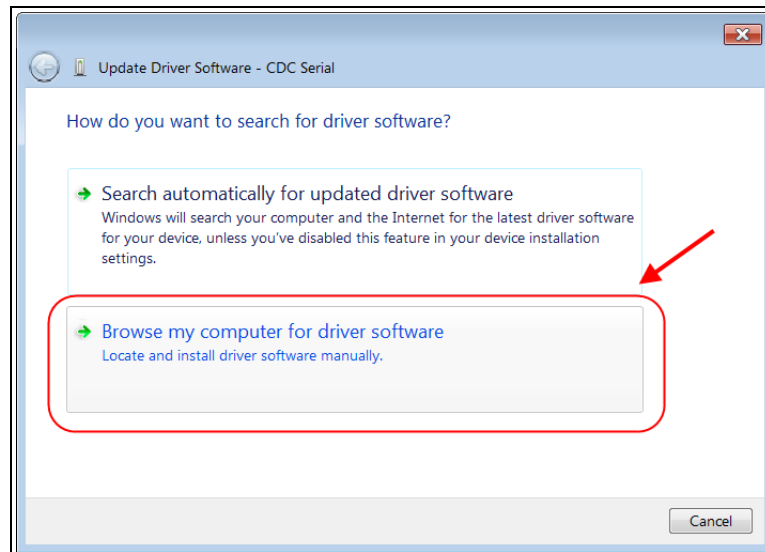
Figure 26: Update Driver Software - CDC Serial dialog box

The **Update Driver Software - CDC Serial** dialog box refreshes with the active **Browse** option.
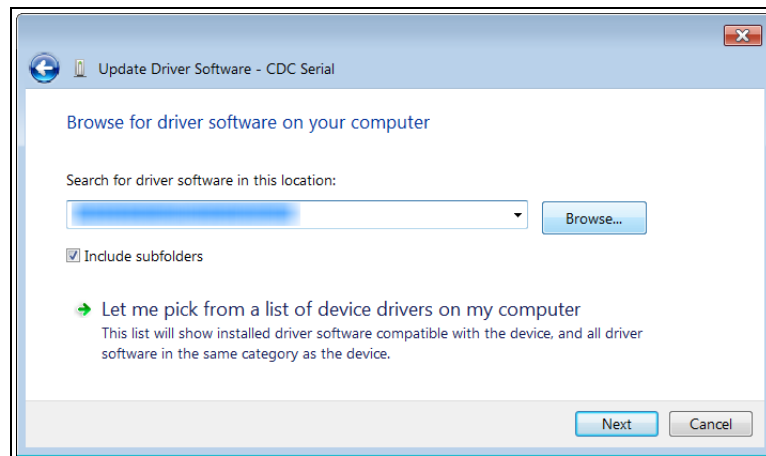
Figure 27: Update Driver Software - CDC Serial dialog box with Browse option

7. Click **Browse...** .
   The **Browse For Folder** dialog box opens.

8. Select the drive letter identified in the **Removable DiskAutoPlayFreeWave Drivers** window.

> **Note**: The driver letter shown in the image is an example only.
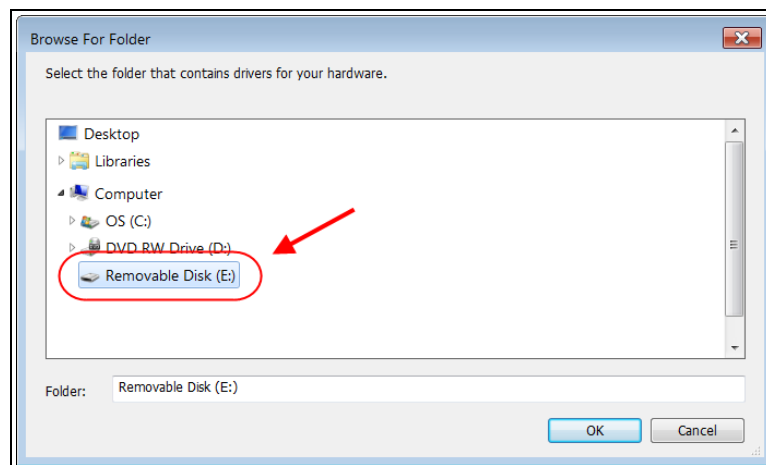
Figure 28: Browse For Folder dialog box

9. Click **OK** to save the selection and close the dialog box.
   The **Update Driver Software - CDC Serial** dialog box returns with the selected drive.
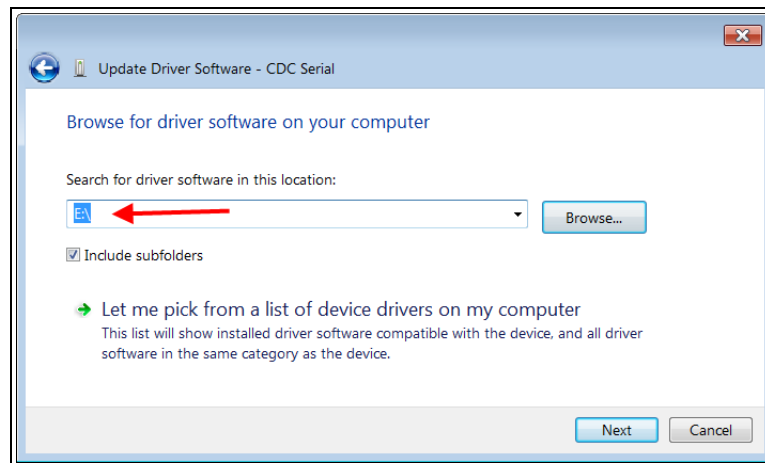
Figure 29: Update Driver Software - CDC Serial dialog box with selected drive

10. Click **Next**.
    The **Windows Security** dialog box opens.
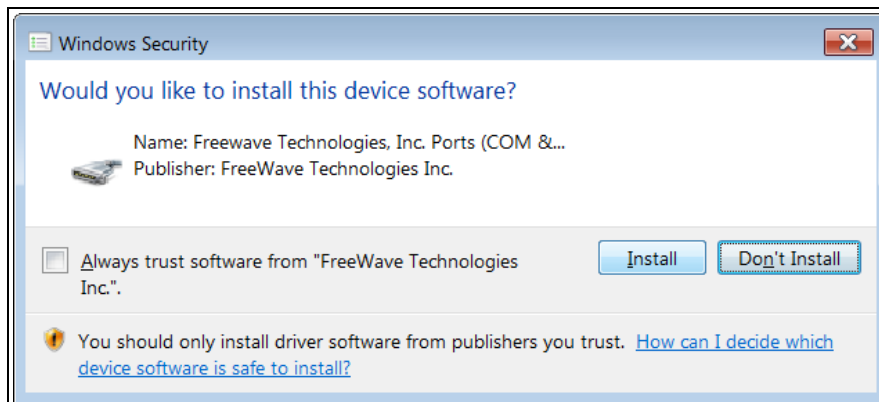
Figure 30: Windows Security dialog box

11. Click **Install**.
    The driver software is installed.
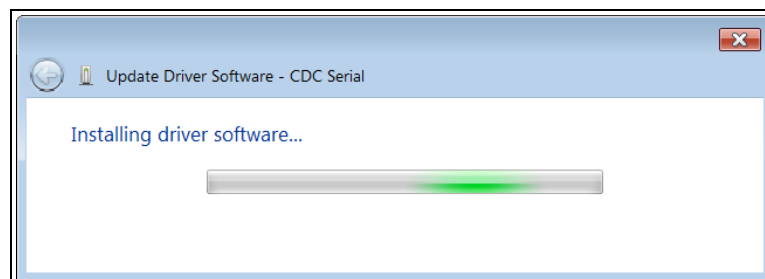
Figure 31: Installing driver software

The dialog box refreshes showing a successful driver install.
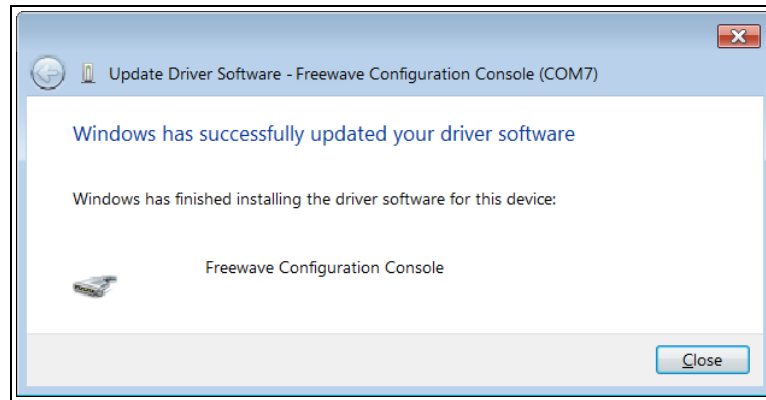
Figure 32: Successful driver installation.

12. Click **Close**.
    The **Device Manager** window returns showing the **FreeWave Configuration Console** added to the **Ports**.
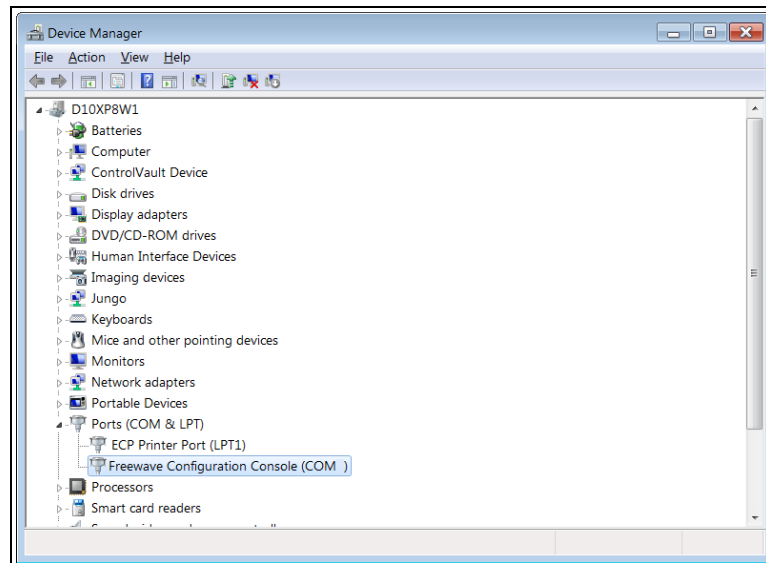
Figure 33: The Device Manager window showing the FreeWave Configuration Console device and its assigned COM Port number.

Important!: The **Port** assignment varies from computer to computer.

4.2.3. Tera Term Activation and ZumLink Setup

Note: This procedure provides a Tera Term terminal connection to the ZumLink CLI. Other terminal emulators (e.g., HyperTerminal, PuTTY) may be used.
The images in this procedure are for Windows® 7 and/or Firefox®.
The dialog boxes and windows appear differently on each computer.

1. On the computer connected to the ZumLink Z9-P / Z9-PE device, open a terminal program (e.g., Tera Term http://ttssh2.osdn.jp/).
2. In Tera Term, on the **File** menu, select **New Connection**.
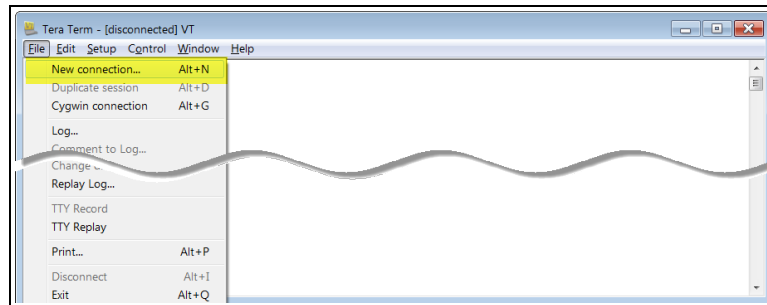
Figure 34: File menu > New Connection

The **Tera Term New Connection** dialog box opens.

3. Click the **Port** list box arrow and select the COM port the ZumLink device is connected to.
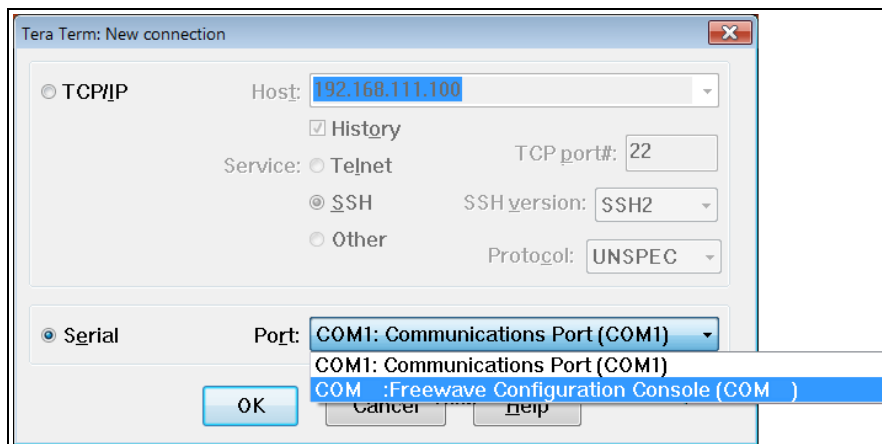
Figure 35: Select the ZumLink COM port

Important!: The **Port** assignment varies from computer to computer.

4. Click **OK** to save the changes and close the dialog box.
    The Tera Term window shows the connected COM port and Baud rate in the title bar of the window.
5. In the Tera Term window, click the **Setup** menu and select **Serial Port**.
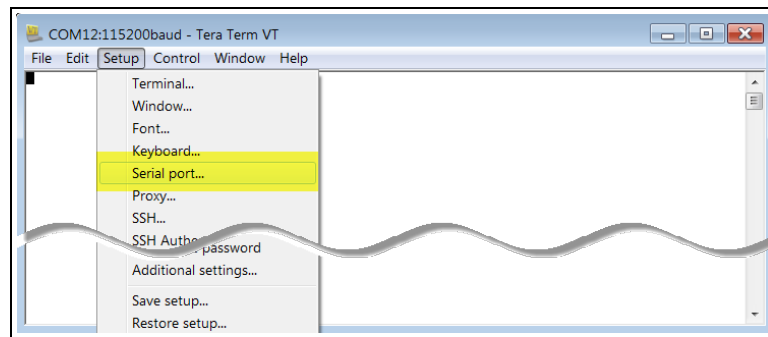
Figure 36: Serial menu > Setup Port

The **Tera Term: Serial Port Setup** dialog box opens.

> **Note**: The image shows the default ZumLink settings.
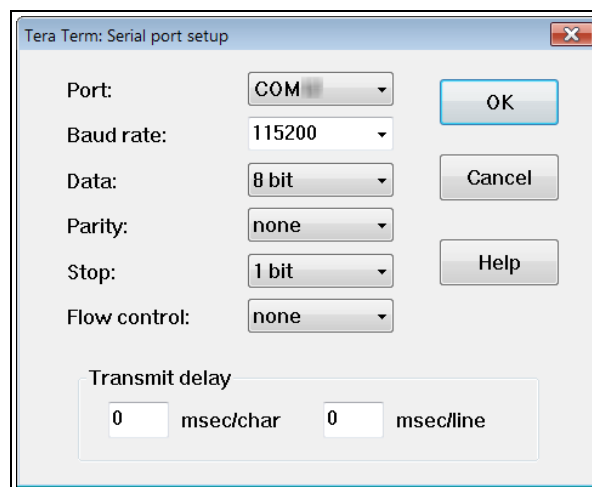
Figure 37: Tera Term: Serial Port Setup dialog box with Default Settings

6. Verify, and change if required, the Tera Term serial port settings (except the **Port** setting) of the connected ZumLink so the settings are the same as the defaults shown in Figure 37.

7. Verify the COM port settings are:
   Baud Rate / **Baudrate**: 115200
   Data / **Databits**: 8 bit
   Parity: none
   Stop / **Stopbits**: 1 bit

8. Click **OK** to save the changes and close the dialog box.

9. In the Tera Term window, press <Enter>.
   The ZumLink CLI Login returns.

10. Login using the current **username** and **password**.

> **Note**: The password does not appear when typing - it looks blank.

The **FreeWave Shell** returns.

Figure 38: The FreeWave Shell returns.

Note: The login times out after 3600 seconds. Repeat the login procedure if needed.

11. At the > prompt, type **pages** and press <Enter>.
    The available ZumLink information appears.
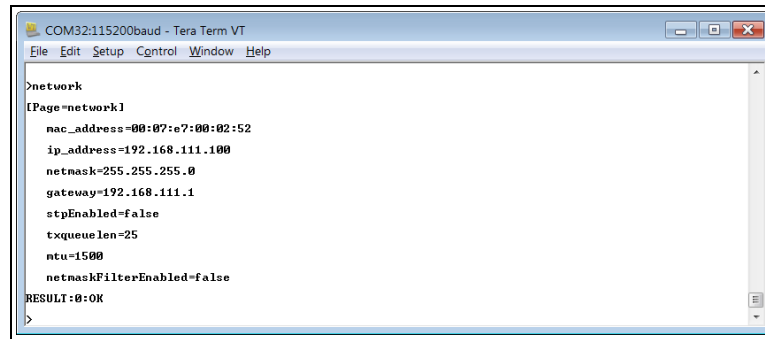
Figure 39: ZumLink Pages information

12. At the > prompt, type **network** and press <Enter>.
    The ZumLink **network** settings appear.

Figure 40: network Settings Page
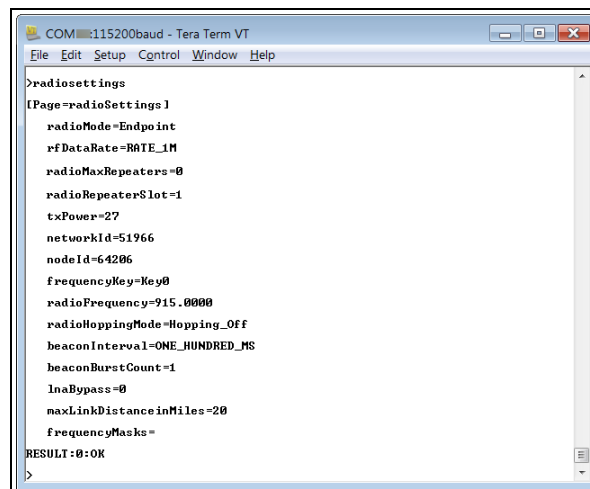
> **Note**: Steps 13 to 16 make the IP Address and nodeId unique to each radio.
> Other values may be defined as long as they are unique to each radio.

13. At the > prompt, type `ip_address=192.168.1.nnn` and press <Enter>.

> **Note**: Where **nnn** = a 3 digit number, unique to the connected radio.

14. At the > prompt, type `radiosettings` and press <Enter>.
    The ZumLink **radioSettings** appear.

> **Important!**: Figure 41 shows **ALL** available settings for the page.
> Only **radioSettings** that apply to the current **radioMode**, **HoppingMode**, and **rfDataRate** are visible in the CLI and the Web Interface and can be changed.

Figure 41: radioSettings Page

15. At the > prompt, type `nodeId=nnn` and press <Enter>.

> **Note**: Where **nnn** = a 1 to 5 digit number, unique to the connected radio.
> The **nodeId** MUST be unique on each radio within the same **networkId**.

16. At the > prompt, type `save` and press <Enter>.

17. Optional: Complete the Change the Password (on page 57) procedure.

> **Important!**: **ONLY** upgrade the ZumLink firmware if the user values the new features and fixes within a firmware version.

4.3. Web Interface Configuration

STOP **Warning!** This is a FreeWave BETA feature of the Z9-P / Z9-PE.

This procedure provides a Web Interface connection to the Z9-P / Z9-PE.

The basic steps are:

A. Connect the Z9-P / Z9-PE to the Computer (on page 40)

B. Optional: Install the ZumLink Driver (on page 42)

C. Setup the Computer IP Address Configuration (on page 47)

D. Web Interface Configuration (on page 51)

Note: The images in this procedure are for Windows® 7 and/or Firefox®.
The dialog boxes and windows appear differently on each computer.

4.3.1. Connect the Z9-P / Z9-PE to the Computer

1. Connect the USB cable to the computer and the micro-USB end to the interface board.
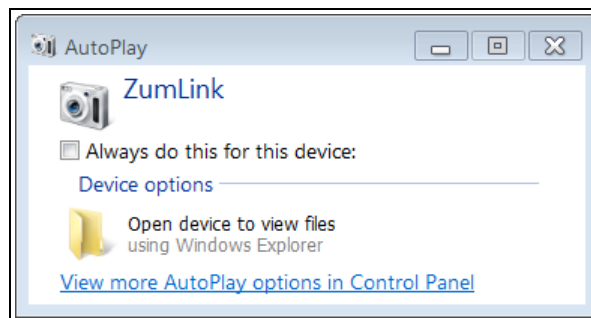   The **AutoPlay** ZumLink, **AutoPlay FreeWave Drivers**, and ZumLink windows open.
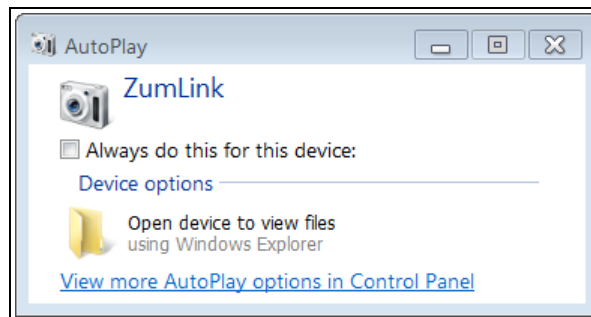
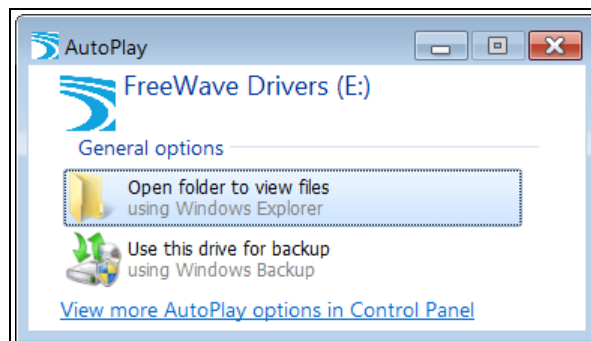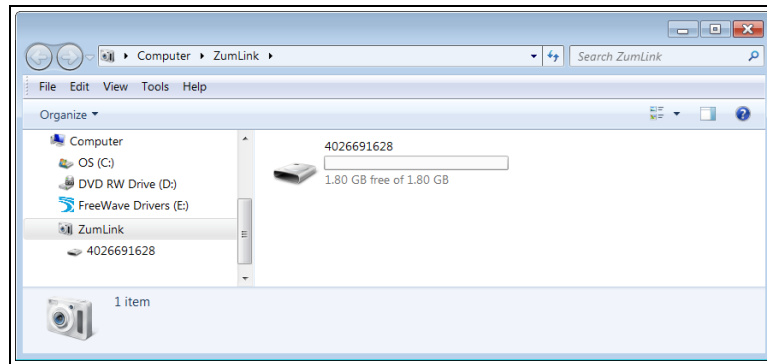**Figure 42: AutoPlay ZumLink window**
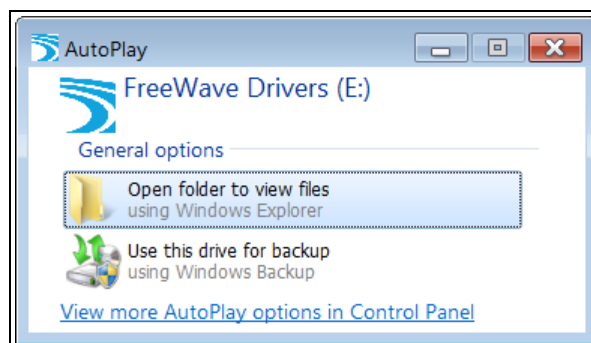
Figure 43: AutoPlay FreeWave Drivers window
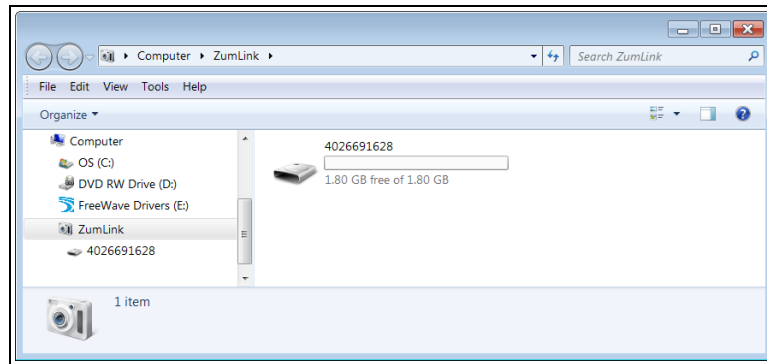
Figure 44: ZumLink window

Important!: The ZumLink driver installs automatically.
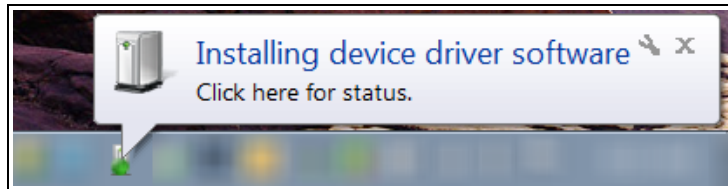
Figure 45: Installing Driver message
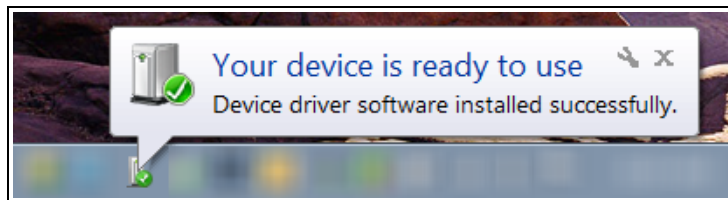
Figure 46: Driver ready to use message

Note: If the ZumLink driver does NOT automatically install, complete the Install the ZumLink Driver (on page 30) procedure.

2. Continue with Tera Term Activation and ZumLink Setup (on page 35).

4.3.2. Install the ZumLink Driver

Note: Follow this procedure if the ZumLink driver does NOT automatically install.
The images in this procedure are for Windows® 7 and/or Firefox®.
The dialog boxes and windows appear differently on each computer.

1. In the **AutoPlayFreeWave Drivers** window, make a note of the drive letter (in this example image, it is E).
2. Click the **Windows® Start** button and right-click on **Computer**.
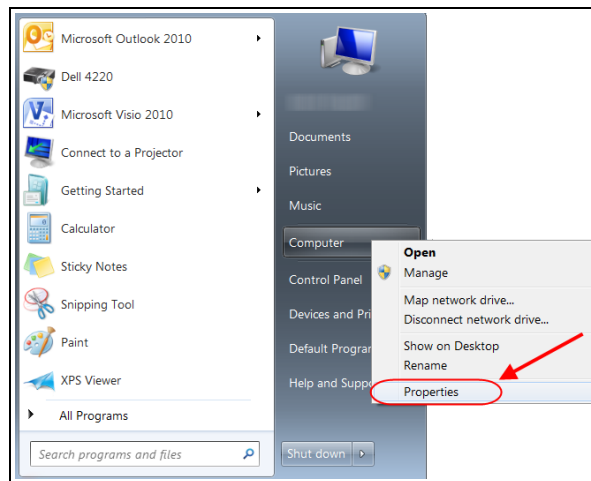3. In the right-click menu, click **Properties**.
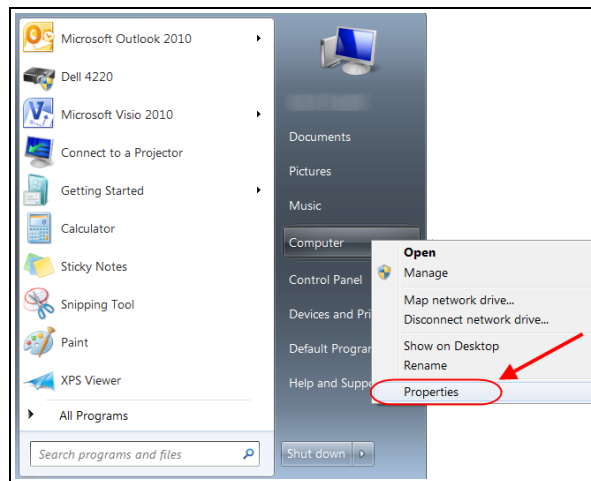
Figure 47: Right-click Properties on the menu.

The **System** window opens.
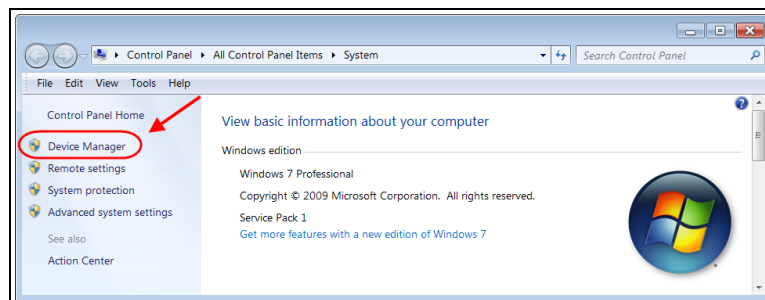4. Click **Device Manager**.
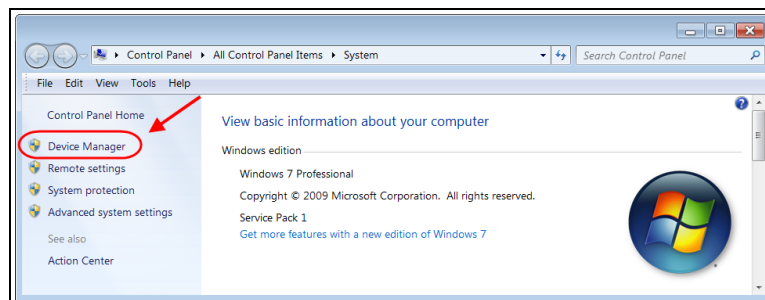
Figure 48: Click Device Manager.

The **Device Manager** window opens.
5. Under **Other Devices**, right-click the **CDC Serial** device and select **Update Driver Software**.
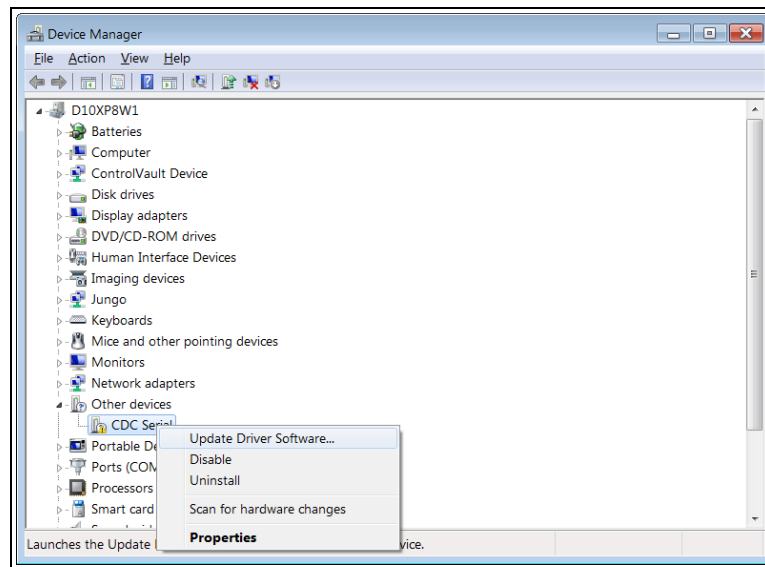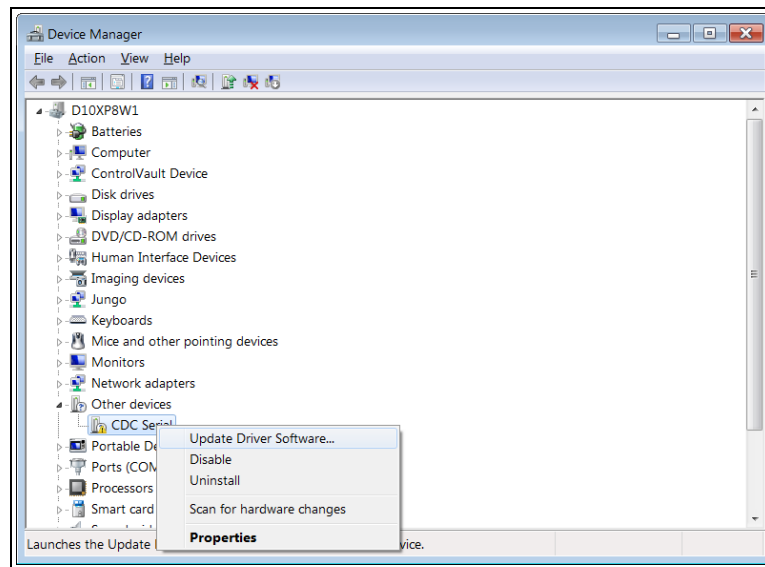
Figure 49: Right-click CDC Serial and click Update Driver Software.

The **Update Driver Software - CDC Serial** dialog box opens.

6. Click **Browse my computer for driver software**.
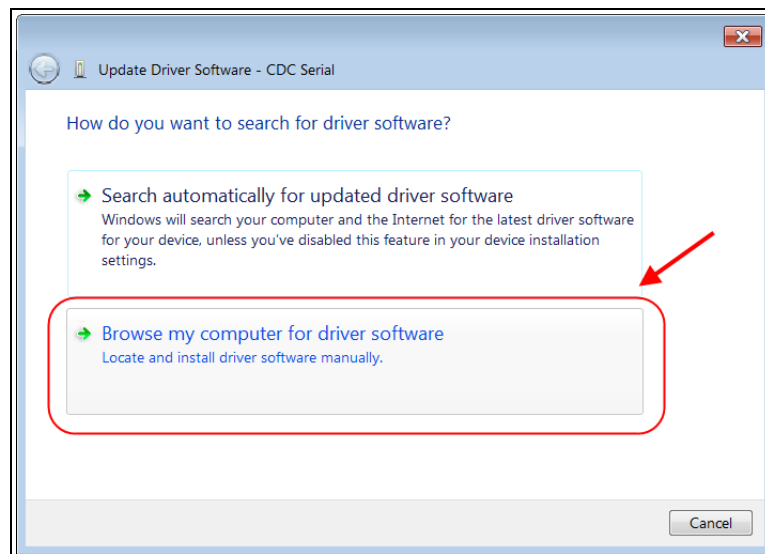
Figure 50: Update Driver Software - CDC Serial dialog box

The **Update Driver Software - CDC Serial** dialog box refreshes with the active **Browse** option.
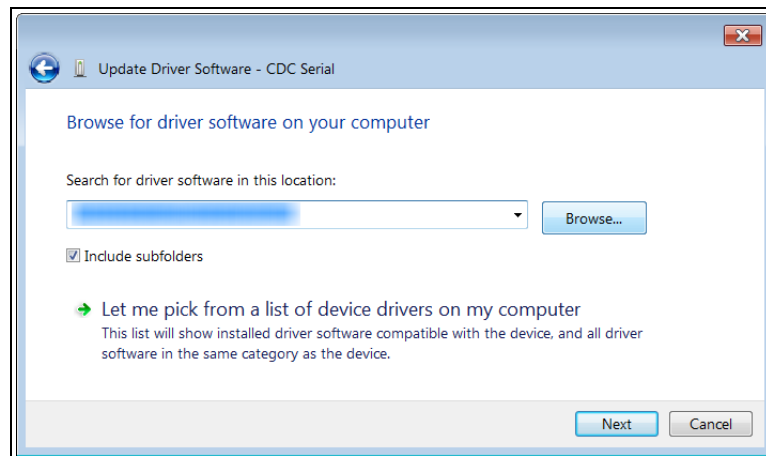
Figure 51: Update Driver Software - CDC Serial dialog box with Browse option

7. Click .
   The **Browse For Folder** dialog box opens.

8. Select the drive letter identified in the **Removable DiskAutoPlayFreeWave Drivers** window.

> **Note**: The driver letter shown in the image is an example only.
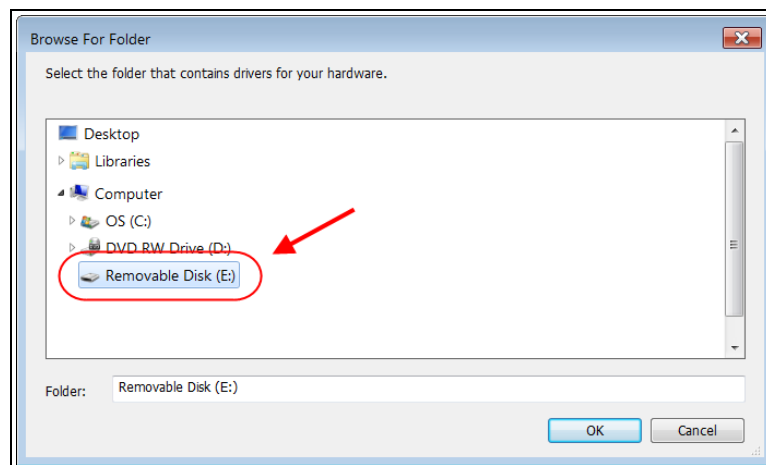
Figure 52: Browse For Folder dialog box

9. Click **OK** to save the selection and close the dialog box.
   The **Update Driver Software - CDC Serial** dialog box returns with the selected drive.
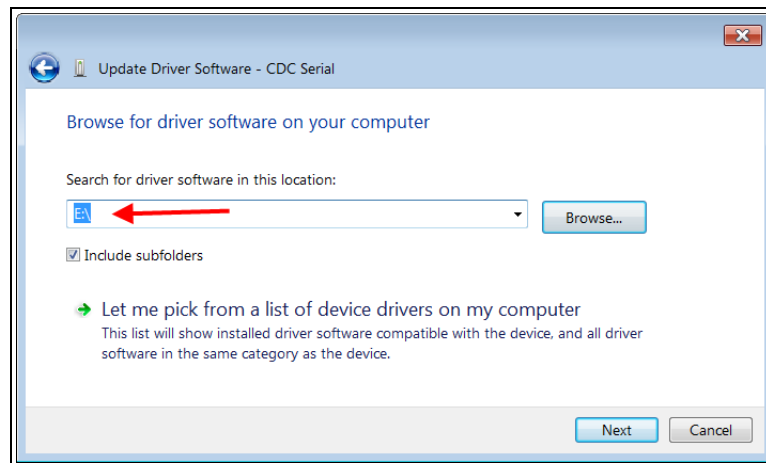
Figure 53: Update Driver Software - CDC Serial dialog box with selected drive

10. Click **Next**.
    The **Windows Security** dialog box opens.
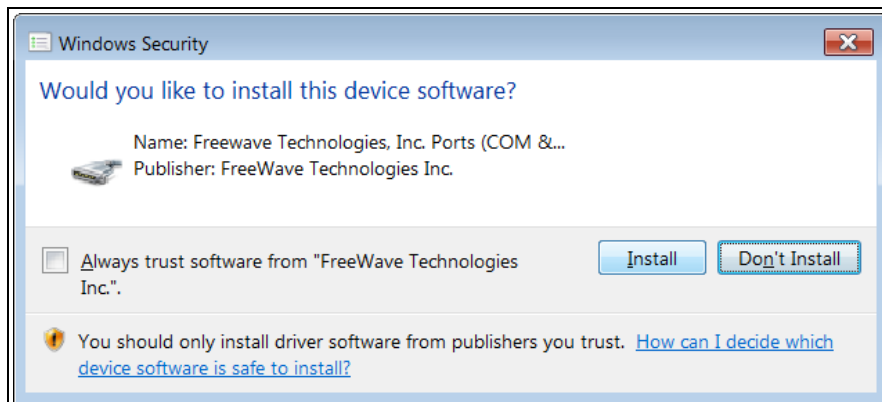
Figure 54: Windows Security dialog box

11. Click **Install**.
    The driver software is installed.
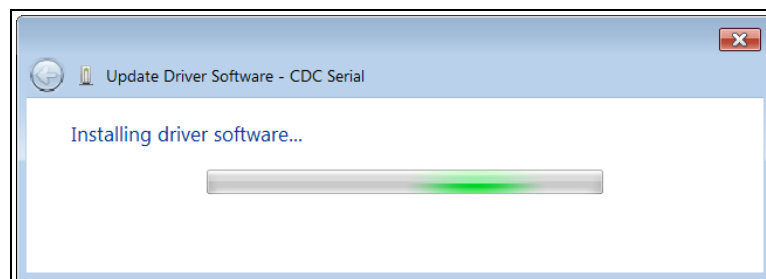
Figure 55: Installing driver software

The dialog box refreshes showing a successful driver install.
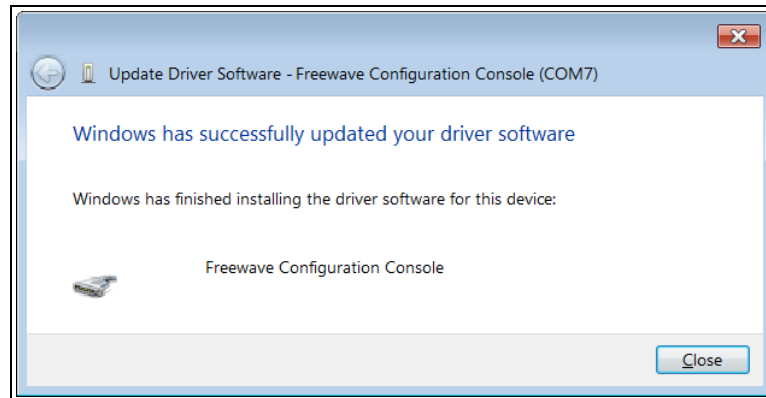
Figure 56: Successful driver installation.

12. Click **Close**.
    The **Device Manager** window returns showing the **FreeWave Configuration Console** added to the **Ports**.
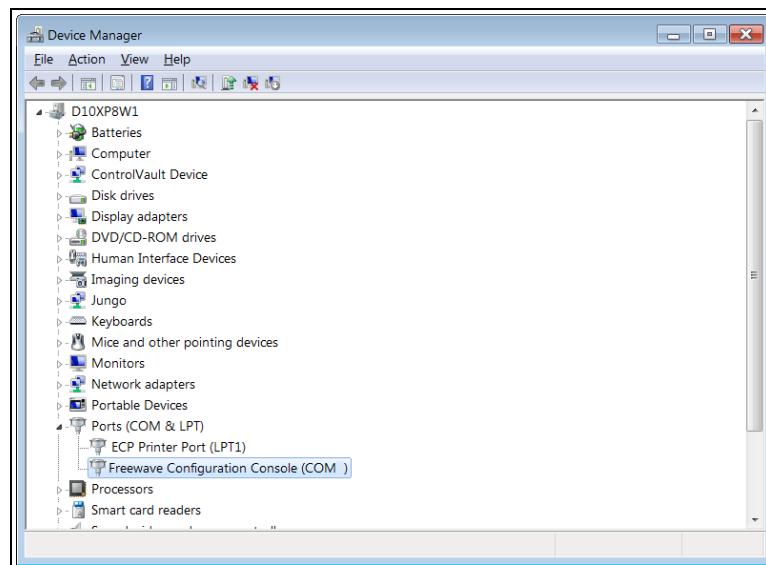
Figure 57: The Device Manager window showing the FreeWave Configuration Console device and its assigned COM Port number.

Important!: The **Port** assignment varies from computer to computer.

4.3.3. Setup the Computer IP Address Configuration

> **Note**: The images in this procedure are for Windows® 7 and/or Firefox®.
> The dialog boxes and windows appear differently on each computer.

1. On the computer, click the Windows® **Start** button and select **Control Panel**.
2. View the **Control Panel** window by **Category** and click **Network and Internet > View Network Status and Tasks**.
3. Click the **Change Adapter Settings** link.
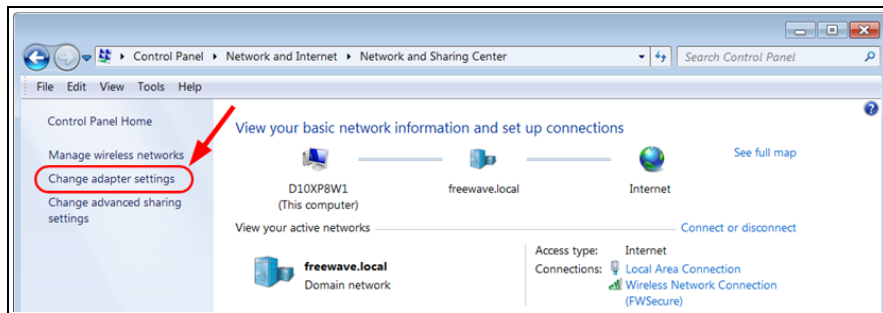
Figure 58: Change Adapter Settings Link

4. Double-click the **Local Area Connection** link.
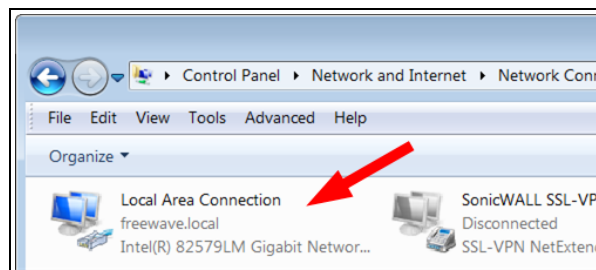
Figure 59: Local Area Connection Link

The **Local Area Connection Status** dialog box opens.
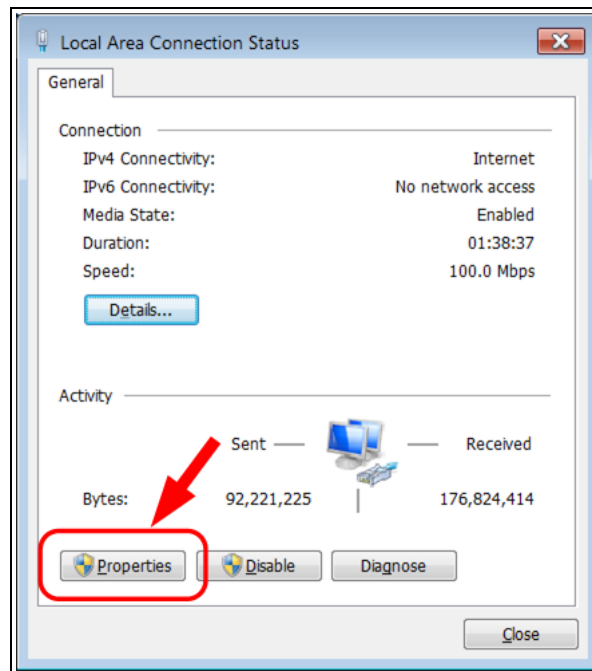
Figure 60: Local Area Connection Status dialog box

5. Click **Properties**.
   The **Local Area Connection Properties** dialog box opens.
6. Select the **Internet Protocol Version 4 (TCP/IPv4)** option.
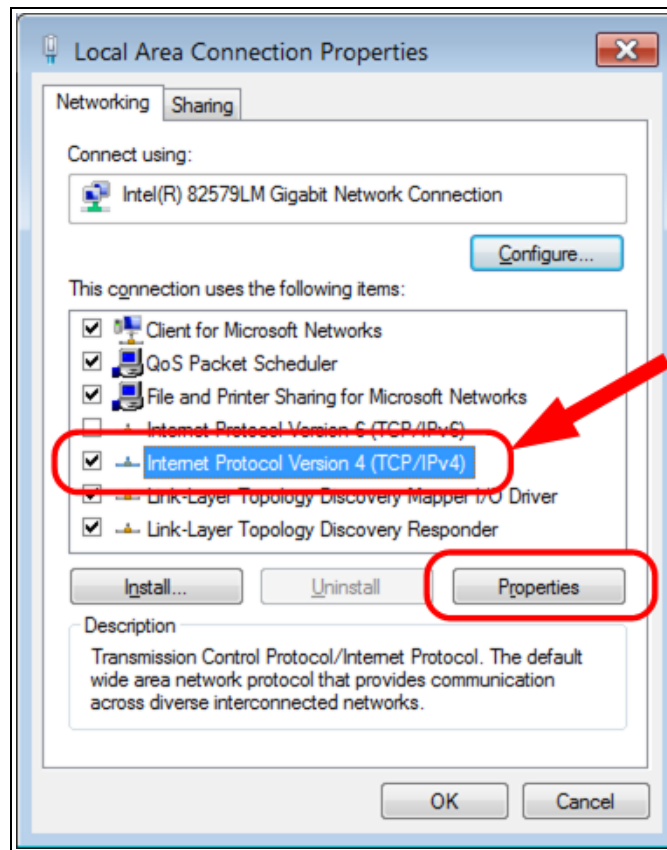
Figure 61: Local Area Connection Properties dialog box

7. Click **Properties**.
   The **Internet Protocol Version 4 (TCP/IPv4) Properties** dialog box opens.

8. **IMPORTANT**: Make a note of the current settings (to reverse this procedure later).

9. Select the **Use the following IP address** option button.

10. In the **IP Address** text box, enter an IP Address that is **in the same subnet range but a DIFFERENT IP Address** than the Z9-P / Z9-PE.

> **Example**: Enter an **IP Address** from **192.168.111.1** to **192.168.111.254** (but NOT **192.168.111.100**) and the **Subnet Mask** to **255.255.255.0**.

> **Note**: The default ZumLink IP Address is **192.168.111.100**. The default subnet mask is **255.255.255.0**.

Figure 62: Local Area Connection Properties dialog box

> **Note**: An IP Address is NOT required in the **Default Gateway** text box.

11. Click to save the changes and close the dialog box.
12. Click **Close** twice to close the **Local Area Connection Properties** and **Local Area Connection Status** dialog boxes.

4.3.4. Web Interface Configuration

1. Open a web browser.
2. In the URL address bar, enter the IP address of the attached Z9-P / Z9-PE with `/config` afterword.

> **Note**: If this is the first time the radio is accessed, enter the default Z9-P / Z9-PE IP Address of `192.168.111.100`.
> If the IP Address was changed, enter that IP Address.

> **Example**: For the first time, enter `192.168.111.100/config`.

The **Authentication Required** (Login) dialog box opens.
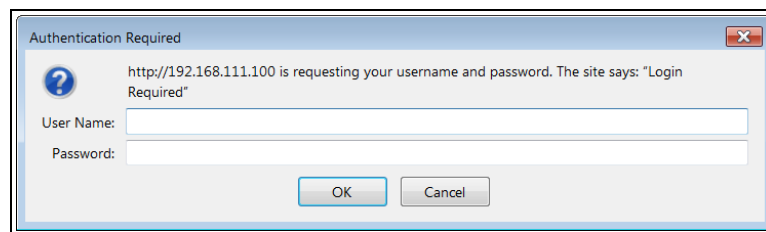
Figure 63: Authentication Required (Login) dialog box

3. Enter `admin` in both the **User Name** and **Password** text boxes and click **OK**.

> **Note**: If the **User Name** or **Password** were changed, enter the applicable information.

The **Login** dialog box closes and the **System Info** window opens.
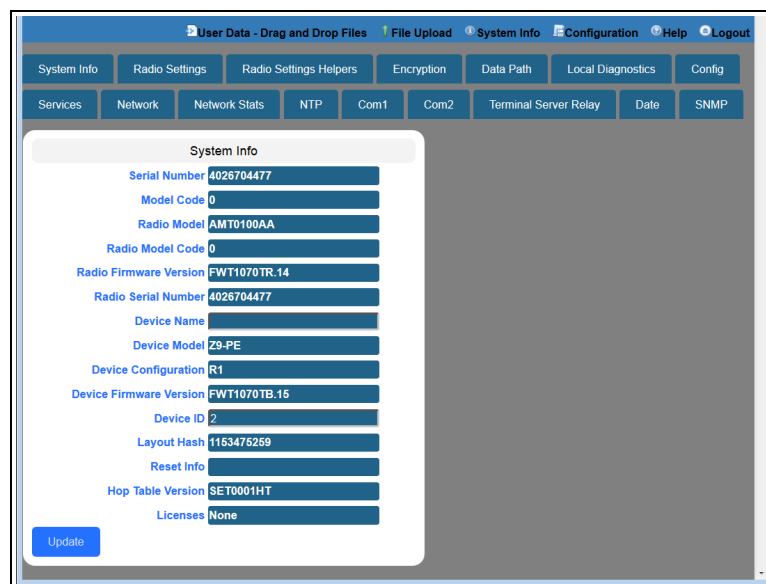
Figure 64: System Info window

4. Click either the **COM1** or **COM2** button.
   The appropriate COM window opens.
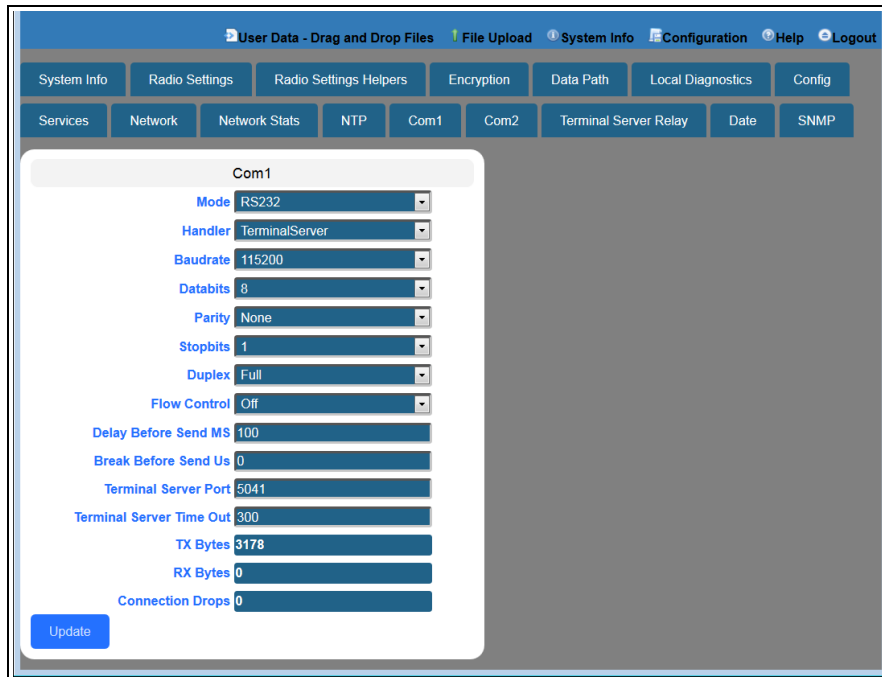
Figure 65: COM1 window

5. Verify the COM port settings are:
   Baud Rate / **Baudrate**: 115200
   Data / **Databits**: 8 bit
   Parity: none
   Stop / **Stopbits**: 1 bit

   Note: The settings for COM1 are the same for COM2 except for the **TerminalServerPort**.

6. Click the **Network** button.
   The **Network** window opens.

Figure 66: Network window

> **Note**: Steps 7 to 10 make the IP Address and nodeId unique to each radio.
> Other values may be defined as long as they are unique to each radio.

7. In the **IP Address** text box, enter the new IP Address and click **Update**.

8. Click the **Update** button to save the changed information.

9. Click the **Radio Settings** button.
   The **Radio Settings** window opens.

Figure 67: Radio Settings window

> **Important!**: Only **radioSettings** that apply to the current **radioMode**, **HoppingMode**, and **rfDataRate** are visible in the CLI and the Web Interface and can be changed.

10. In the **Node ID** text box, enter the same unique 3 digit number **used in the last octet** of the IP Address entered in Step 9 and click **Update**.

11. Click the **Update** button to save the changed information.

12. Optional: Complete the Change the Password (on page 57) procedure.

> **Note**: Go to http://support.freewave.com/ to login and download the latest firmware for the ZumLink.. Registration is required to use this login.

5. Creating a Basic ZumLink Gateway and Endpoint Network

Note: The setting changes described in this procedure can be changed using the Drag and Drop Configuration (on page 21), the CLI Configuration (on page 28), or the Web Interface Configuration (on page 40).

Figure 68 shows a basic network setup for the ZumLink device.

Z9-PE Gateway   **Z9-PE Endpoint**
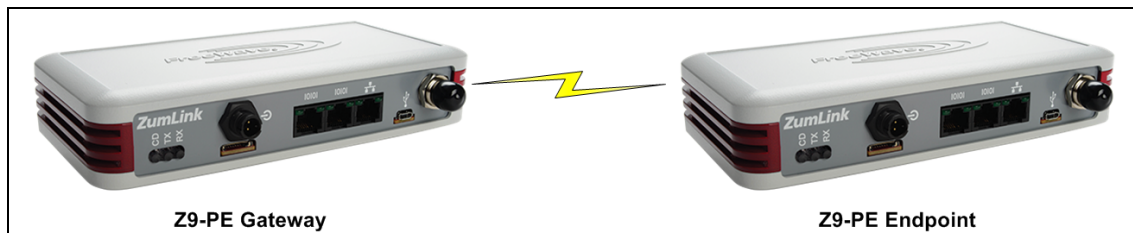
Figure 68: A Basic ZumLink Network

Procedure

Note: This example procedure is specific for CLI configuration.

1. Connect and apply power to the ZumLink devices in the network.
2. Optional: Upgrade the devices using one of these procedures:

⚠ **Caution**: Firmware v1.0.7.0 is **NOT a required** upgrade. **ONLY** upgrade the ZumLink firmware if the user values the new features and fixes within a firmware version.

- Drag and Drop Firmware Upgrade (on page 62)
- Web Interface Firmware Upgrade (on page 67)

3. Complete the CLI Configuration (on page 28) procedure.

4. Select one radio and, at the > prompt, type `radioSettings.radioMode=Gateway`.

5. At the > prompt, type a setting between `10 and 30` for the **radioSettings.txPower**.

   > **Example**: `txPower=30` or `radioSettings.txPower=30`.

   > Entering **txpower=0** or **radiosettings.txpower=0** changes the power to minimum or 10.

   > **Note**: See radioSettings for detailed information.

6. For the other radio in the network, at the > prompt, type `radioSettings.radioMode=Endpoint`.

7. Verify the `radioSettings.networkId=` setting is the same on ALL radios in the network.

8. At the > prompt, type `nodeId=nnn` and press <Enter>.

   > **Note**: Where **nnn** = a 1 to 5 digit number, unique to the connected radio.
   > The **nodeId** MUST be unique on each radio within the same **networkId**.

   > Optional: For **Endpoints** in the network, use the command:
   > `radioSettings.nodeId=0`.
   > This allows the Endpoint to **automatically** set the **nodeId** to a predetermined unique number from 2 through 65533.

   > **Important!**: The Gateway **radioSettings.nodeId** defaults to 1 and CANNOT be changed.

9. At the > prompt, type `save` and press <Enter>.
   A solid green CD LED indicates that the radios are linked.

   > **Note**: See LEDs (on page 261) for additional information.

10. Type **logout** and press <Enter> to exit the FreeWave Shell.

6. Change the Password

> **Important!**: The ZumLink password is changed through the CLI.

1. Login using the current **username** and **password**.
2. Use this command format to change the password:
   `system.password=[oldpassword],[newpassword],[newpassword]` and press <Enter>.

   > **Example**: The default password is `admin`.
   > The CLI to change this is:
   > `system.password=admin,NewPasswrd123,NewPasswrd123`.

   > **Note**: An error message appears when there is an error in typing the new password command.

7. Firmware Upgrade

Important!: The **Download the Upgrade File** procedure must be completed first.

7.1. Download the Upgrade File

⚠️ **Caution**: Firmware v1.0.7.0 is **NOT a required** upgrade. **ONLY** upgrade the ZumLink firmware if the user values the new features and fixes within a firmware version.

Note: The images in this procedure are for Windows® 7 and/or Firefox®.
The dialog boxes and windows appear differently on each computer.

1. Click http://support.freewave.com/.
   The **Login** window opens.

   Important!: Registration is required to use this login.
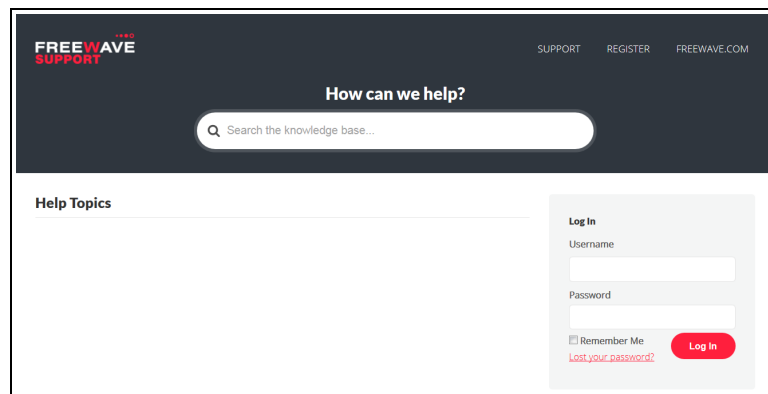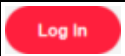
Figure 69: FreeWave Login window

2. Enter the **User Name** and **Password**.

3. Click ⬤ Log In .
   A successful Login message briefly appears.

   The **Help Topics** window opens.
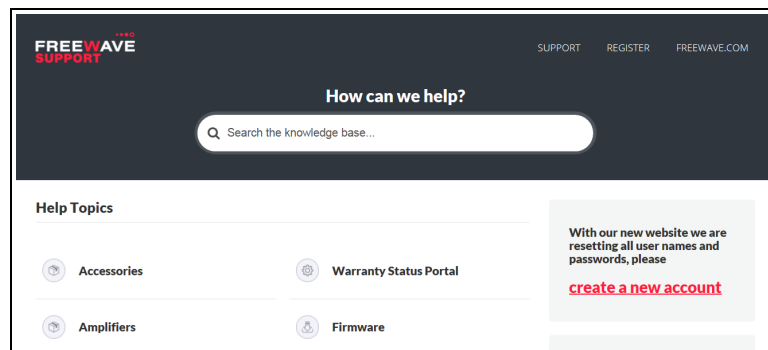
Figure 70: Help Topics window

4. Click the **Firmware** link.
   The **Firmware** window opens.
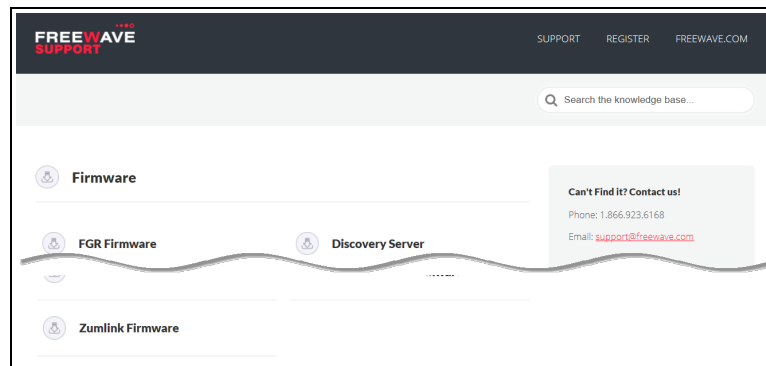
Figure 71: Firmware window

5. Click the **ZumLink Firmware** link.
   The available firmware/software appears in the window.
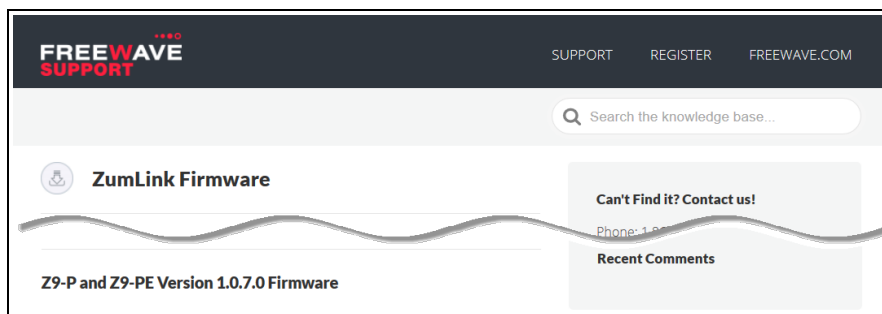
Figure 72: ZumLink Firmware window

6. Click the firmware/software link.
   The **Firmware Upgrade** window opens.
7. Select and click the attachment.
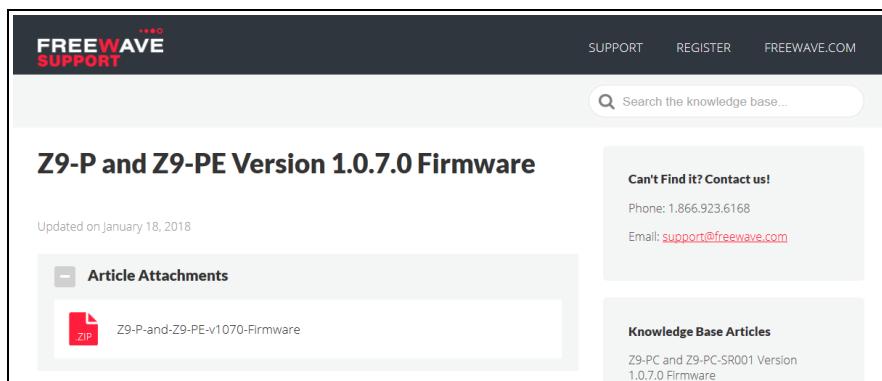
Figure 73: Z9-P / Z9-PE Firmware Upgrade window with selected attachment.

The **Opening** dialog box opens.
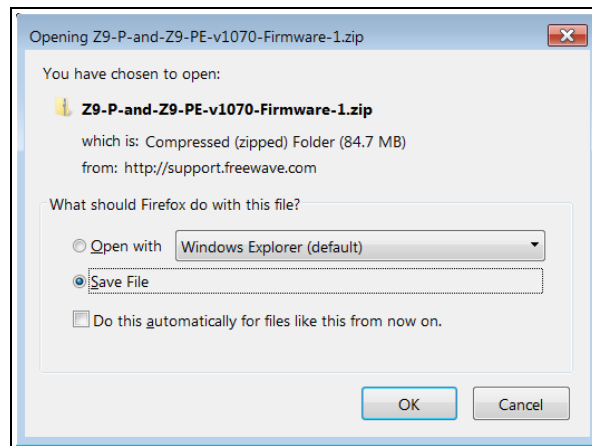
Figure 74: Z9-P / Z9-PE Opening dialog box

8. Click **OK**.
   The **Enter name of file to save to** dialog box opens.
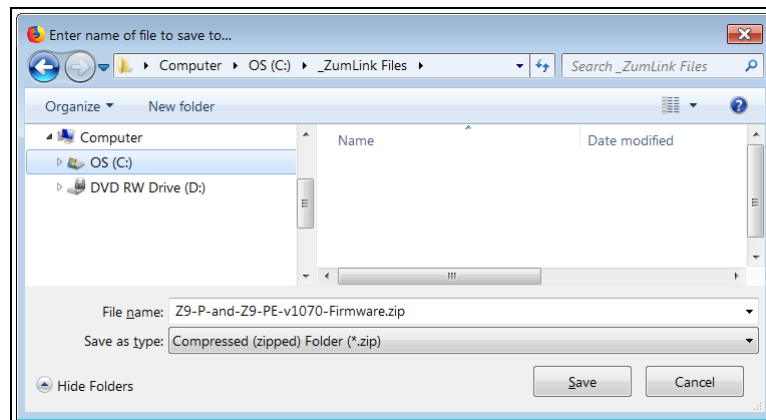
Figure 75: Enter name of file to save to dialog box

9. Search for and select a location to save the **.zip** file to and click **Save**.
   The **Enter name of file to save to** dialog box closes.

10. Open a Windows® Explorer window and find the location where the **.zip** file was saved.

11. Double-click the **.zip** file.

12. Extract the files from the **.zip** file into the parent location.

> **Note**: The files include the **.pkg** and **.fcf** files used in the upgrade process.

13. Continue with:

   - Drag and Drop Firmware Upgrade (on page 62)
   - Web Interface Firmware Upgrade (on page 67)

7.2. Drag and Drop Firmware Upgrade

> ⚠️ **Caution**: Firmware v1.0.7.0 is **NOT a required** upgrade. **ONLY** upgrade the ZumLink firmware if the user values the new features and fixes within a firmware version.

This procedure describes using drag and drop to upgrade the Z9-P / Z9-PE firmware.

> **Note**: Alternatively, use the Web Interface Firmware Upgrade (on page 67) to upgrade the Z9-P / Z9-PE.

> ⚠️ **Caution**: This procedure requires the Windows® Explorer file extension to be visible. See the Microsoft® topic Show or Hide File Name Extensions to view the extensions.

Procedure

> **Note**: This procedure shows Firefox® dialog boxes.
> Other browsers will have different dialog boxes and procedures.

1. Verify the Download the Upgrade File (on page 59) procedure is complete.
2. Connect the USB cable to the computer and the micro-USB end to the interface board. The **AutoPlay** ZumLink, **AutoPlay FreeWave Drivers**, and ZumLink windows open.
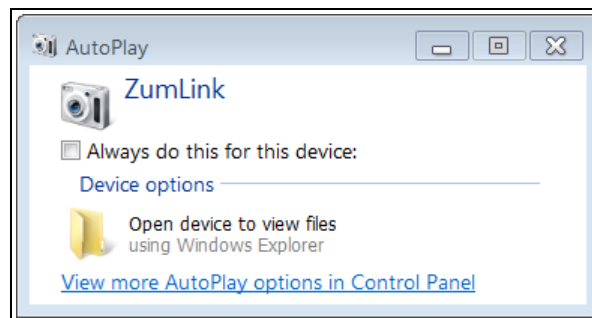
Figure 76: AutoPlay ZumLink window
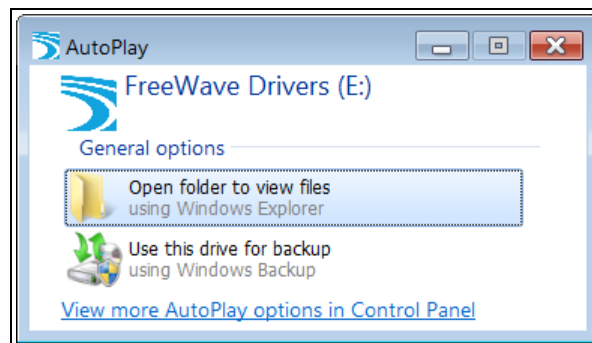
Figure 77: AutoPlay FreeWave Drivers window
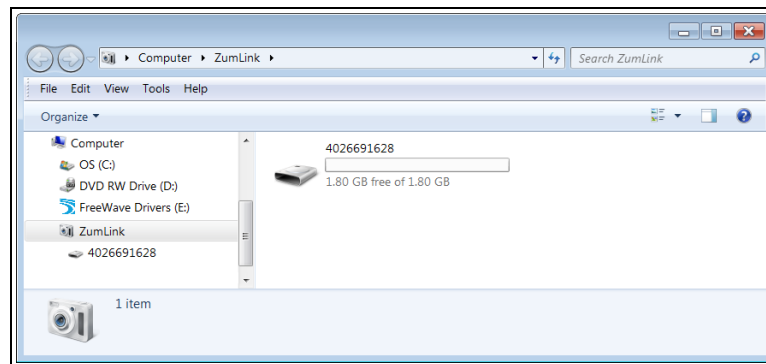
Figure 78: ZumLink window

3. In the ZumLink window, double-click the connected ZumLink.
   The files of the ZumLink appear in the window.
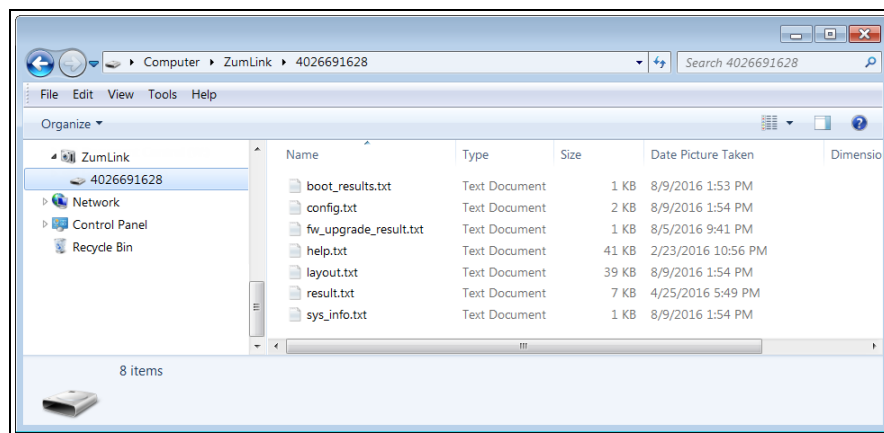
Figure 79: Opened ZumLink window showing the ZumLink files

4. Optional: Select, copy, and paste the **config.txt** file to a secure location.

> **Note**: This is to backup the current **config.txt** before the upgrade process in case the old **config.txt** file needs to be restored.

5. Locate and select the downloaded ZumLink upgrade **.pkg** file.

> ⚠ **Caution**: A **.pkg** or **.fcf** file extension is required for Windows® 7.
> A **.pkg.txt** or **.fcf.txt** file extension may be required for some versions of Windows® 8, Windows® 8.1, and Windows® 10.
> Failure to save the file with the correct extension type results in the file **NOT** being able to integrate with the ZumLink when copied to the ZumLink window.

6. If using some versions of Windows® 8, Windows® 8.1, or Windows® 10, change the extension of the **.pkg** file to **.pkg.txt** and select that file.

v1.0.7.0 Upgrade Notes for Z9-P / Z9-PE

> **Important!**: Inside the downloaded **Z9-P-and-Z9-PE-v1070-Firmware.zip** file, there are **TWO .pkg** files.
> The **CORRECT .pkg** file to use depends on the ZumLink version you're upgrading from.

- When upgrading **from v1.0.4.2 or LATER** firmware, use the file named:
  - **1_Device_Firmware_v1_0_7_0_____when_upgrading_from_v1042_or_later.pkg**.
- When upgrading from a version **EARLIER than v1.0.4.2**, use the file named:
  - **1_Device_Firmware_v1_0_7_0_____when_upgrading_from_a_version_earlier_than_v10402.pkg**.
- For all firmware versions, use the **.fcf** file for the second part of the upgrade.

Figure 80: Selected .pkg file

7. Drag and drop the **.pkg** or **.pkg.txt** file on to the ZumLink window.
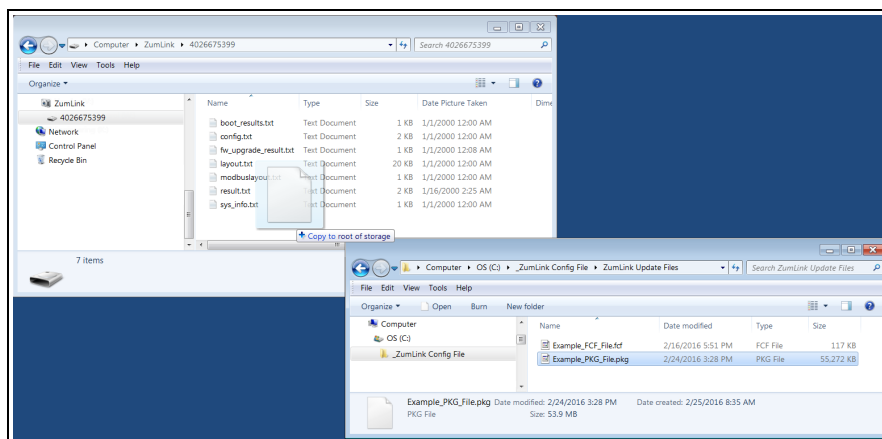
Figure 81: Drag and Drop the .pkg or .pkg.txt file to the ZumLink window

The **.pkg** or **.pkg.txt** file will disappear after approximately 6-10 minutes.

8. Wait a few minutes for the **AutoPlay** and ZumLink windows to close.
   The ZumLink automatically reboots.

Warning! **DO NOT** remove power from the Z9-P / Z9-PE during or immediately after this process!

Wait until the Home window (on page 116) Web Interface is accessible before removing power from the ZumLink device (approximately 6-8 minutes).

If power was removed prematurely during the upgrade process, the Web Interface pages may not be accessible.

Reinstall the **.pkg** file and **WAIT for the file upgrade process to complete**.

Tip The LEDs (on page 261) indicated the upgrade process.

The **AutoPlay** and ZumLink windows re-open when the **.pkg** or **.pkg.txt** upgrade file has been applied.

9. In the ZumLink window, double-click the connected ZumLink.
   The files of the ZumLink appear in the window.

10. Locate and select the downloaded ZumLink upgrade **.fcf** file.

Note: If required for some versions of Windows® 8, Windows® 8.1, or Windows® 10, change the extension of the **.fcf** file to **.fcf.txt** and select that file.
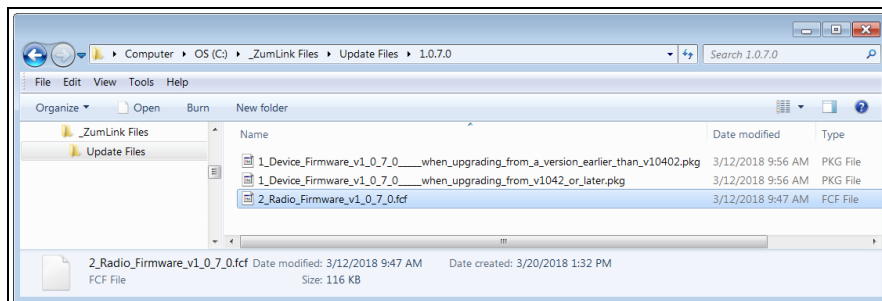
Figure 82: Selected .fcf (or .fcf.txt) file
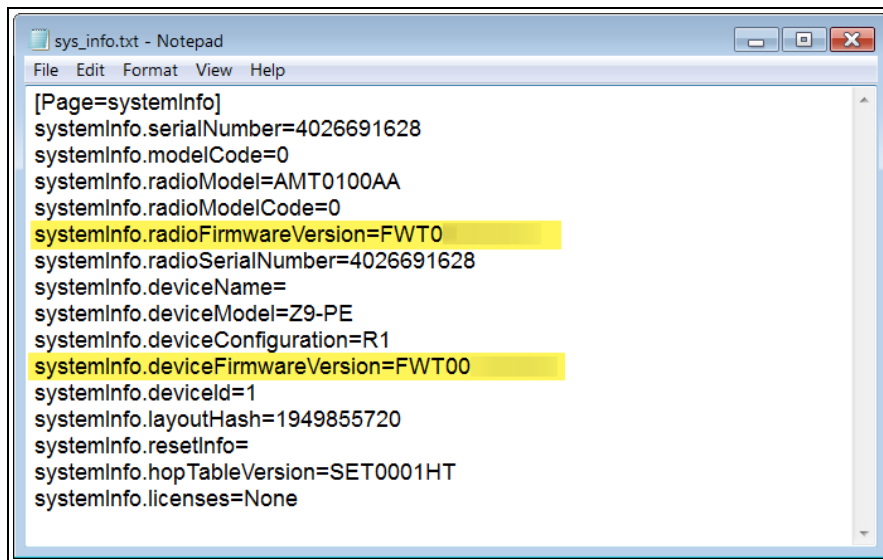
11. Drag and drop the **.fcf** or **.fcf.txt** file on to the ZumLink window.
    The **.fcf** or **.fcf.txt** file will disappear.

12. Wait for the **.fcf** or **.fcf.txt** file to be applied (≈ 1-2 minutes).

Tip The LEDs (on page 261) indicated the upgrade process.

13. Optional: Open the **sys.info.txt** file to verify the upgrade information.

Important!: The image provides example information only. Each ZumLink provides its own unique information.

Figure 83: ZumLink sys.info.txt file with updated firmware

Important!: For the v1.0.7.0 upgrade, these settings should have this information:
    systemInfo.deviceFirmwareVersion=FWT1070TB.15
    systemInfo.radioFirmwareVersion=FWT1070TR.14.
If neither of these are listed in their respective settings, repeat the upgrade procedure.

7.3. Web Interface Firmware Upgrade

> ⚠️ **Caution**: Firmware v1.0.7.0 is **NOT a required** upgrade. **ONLY** upgrade the ZumLink firmware if the user values the new features and fixes within a firmware version.

This procedure describes using a web browser window to upgrade the Z9-P / Z9-PE firmware.

> 💡 Tip Alternatively, use the Drag and Drop Firmware Upgrade (on page 62) to upgrade the Z9-P / Z9-PE.

The Z9-P / Z9-PE upgrade process requires these basic steps:

> **Note**: This method is used for computers running Windows® 7 and later.

7.3.1. Setup the Computer IP Address Configuration

> **Note**: The images in this procedure are for Windows® 7 and/or Firefox®.
> The dialog boxes and windows appear differently on each computer.

1. On the computer, click the Windows® **Start** button and select **Control Panel**.
2. View the **Control Panel** window by **Category** and click **Network and Internet > View Network Status and Tasks**.
3. Click the **Change Adapter Settings** link.
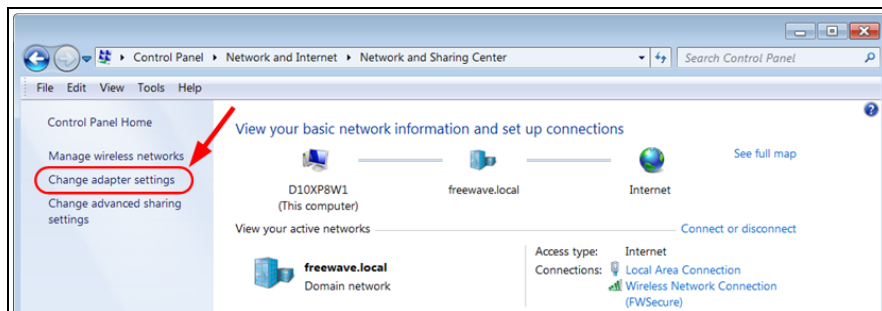
Figure 84: Change Adapter Settings Link

4. Double-click the **Local Area Connection** link.
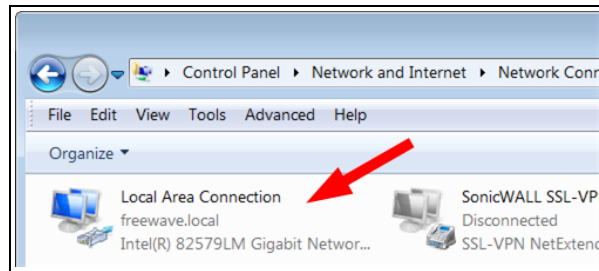
Figure 85: Local Area Connection Link

The **Local Area Connection Status** dialog box opens.
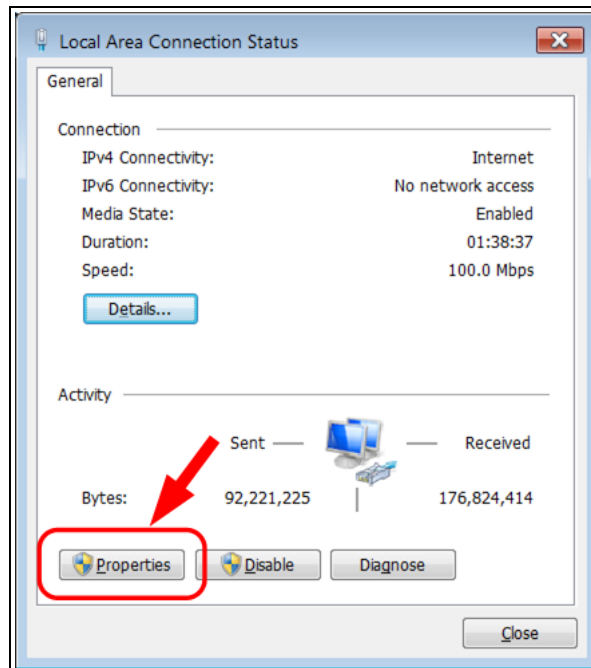
Figure 86: Local Area Connection Status dialog box

5. Click **Properties**.
    The **Local Area Connection Properties** dialog box opens.
6. Select the **Internet Protocol Version 4 (TCP/IPv4)** option.
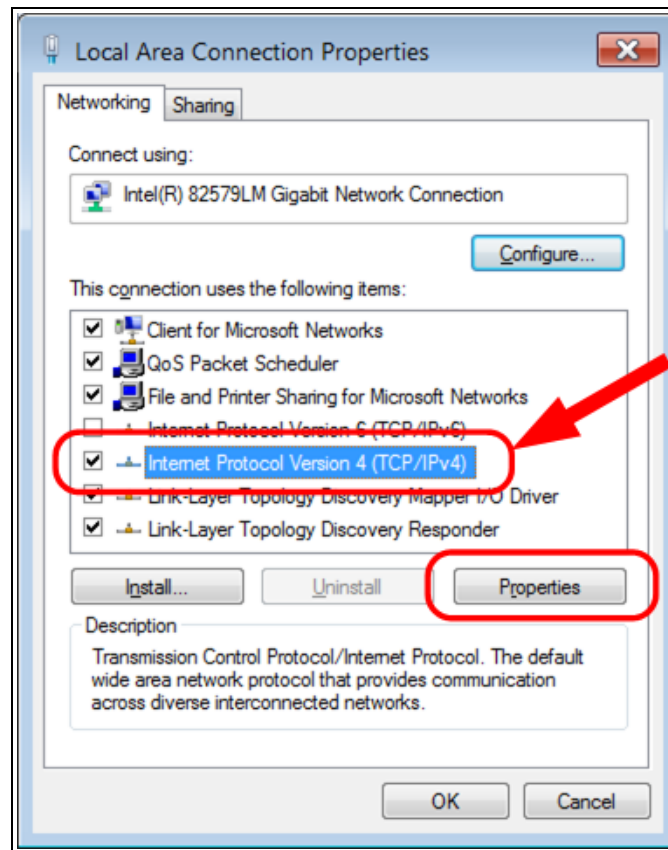
Figure 87: Local Area Connection Properties dialog box

7. Click **Properties**.
    The **Internet Protocol Version 4 (TCP/IPv4) Properties** dialog box opens.

8. **IMPORTANT**: Make a note of the current settings (to reverse this procedure later).

9. Select the **Use the following IP address** option button.

10. In the **IP Address** text box, enter an IP Address that is **in the same subnet range but a DIFFERENT IP Address** than the Z9-P / Z9-PE.

> **Example**: Enter an **IP Address** from **192.168.111.1** to **192.168.111.254** (but NOT **192.168.111.100**) and the **Subnet Mask** to **255.255.255.0**.

> **Note**: The default ZumLink IP Address is **192.168.111.100**. The default subnet mask is **255.255.255.0**.

Figure 88: Local Area Connection Properties dialog box

> **Note**: An IP Address is NOT required in the **Default Gateway** text box.

11. Click to save the changes and close the dialog box.
12. Click **Close** twice to close the **Local Area Connection Properties** and **Local Area Connection Status** dialog boxes.

7.3.2. Install the Upgrade File using the Web Interface

> **Note**: The images in this procedure are for Windows® 7 and/or Firefox®.
> The dialog boxes and windows appear differently on each computer.

1. Verify the Download the Upgrade File (on page 59) procedure is complete.
2. Using a CAT5e / CAT6 Ethernet cable, connect the Z9-P / Z9-PE Ethernet port to the Ethernet port on the computer.
3. Open a web browser.
4. In the URL address bar, enter the IP address of the attached Z9-P / Z9-PE.

> **Note**: If this is the first time the radio is accessed, enter the default Z9-P / Z9-PE IP Address of **192.168.111.100**.
> If the IP Address was changed, enter that IP Address.

5. Refresh the browser window (press <F5>).
   The Home window (on page 116) opens.

System Info

Serial Number	4026717518
Model Code	0
Radio Model	AMT0100AA
Radio Model Code	0
Radio Firmware Version	
Radio Serial Number	4026717518
Device Name	
Device Model	Z9-PE-DEV
Device Configuration	R1
Device Firmware Version	
Device ID	1
Layout Hash	1153475259
Reset Info	
Hop Table Version	SET0001HT
Licenses	None
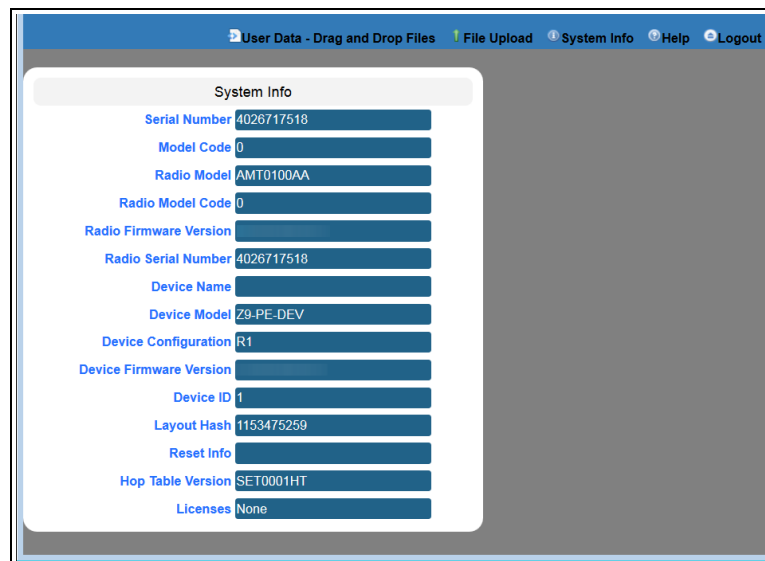
Figure 89: Home window

6. Click the **File Upload** link.
   The **Authentication Required** (Login) dialog box opens.
7. Enter **admin** in both the **User Name** and **Password** text boxes and click **OK**.
   The **Login** dialog box closes and the File Upload window opens.

> **Note**: If the **User Name** or **Password** were changed, enter the applicable information.
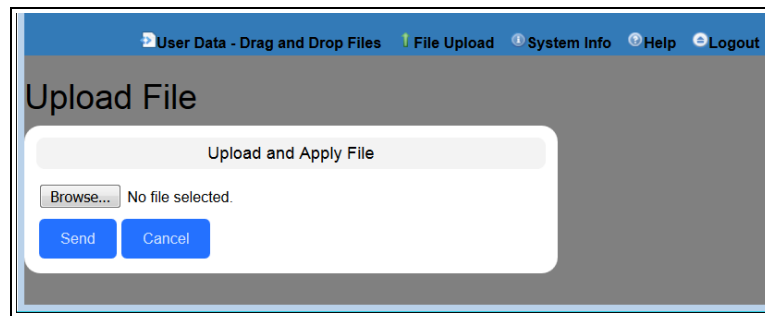
Figure 90: File Upload window

8. Click **Browse**.
   The Microsoft® **File Upload** dialog box opens.
9. Locate and select the downloaded ZumLink upgrade **.pkg** file.

v1.0.7.0 Upgrade Notes for Z9-P / Z9-PE

> **Important!**: Inside the downloaded **Z9-P-and-Z9-PE-v1070-Firmware.zip** file, there are **TWO .pkg** files.
> The **CORRECT .pkg** file to use depends on the ZumLink version you're upgrading from.

- When upgrading **from v1.0.4.2 or LATER** firmware, use the file named:
  - **1_Device_Firmware_v1_0_7_0_____when_upgrading_from_v1042_or_later.pkg**.
- When upgrading from a version **EARLIER than v1.0.4.2**, use the file named:
  - **1_Device_Firmware_v1_0_7_0_____when_upgrading_from_a_version_earlier_than_v10402.pkg**.
- For all firmware versions, use the **.fcf** file for the second part of the upgrade.

Figure 91: Microsoft® File Upload dialog box with the selected .pkg file

10. Click **Open**.
    The dialog box closes and the **File Upload** window returns showing the selected file.
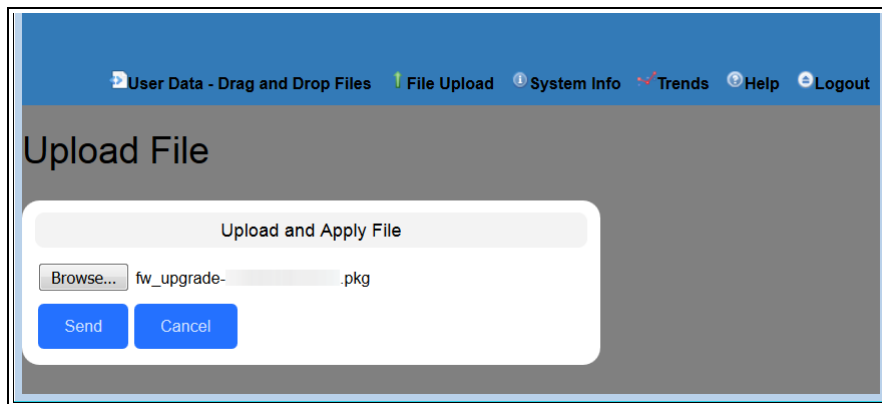
Figure 92: File Upload window with selected .pkg file.

11. Click **Send**.
    The **File Upload** window changes to show the completed upload percentage to the
    ZumLink.
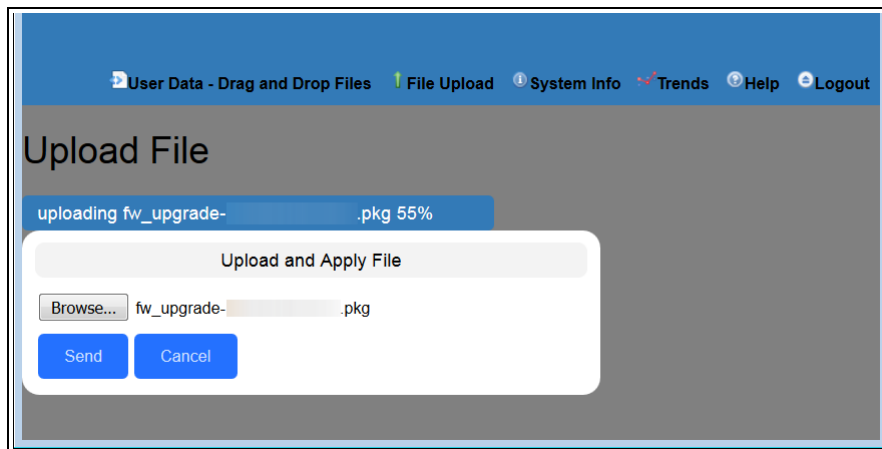
Figure 93: File Upload window showing uploading percentage.

12. Wait for the **.pkg** or **.pkg.txt** file to be applied (≈ 6-10 minutes).

    The **File Upload** window refreshes and shows the completed and uploaded file applied to
    the ZumLink.

Warning! DO NOT remove power from the Z9-P / Z9-PE during or immediately after
this process!

Wait until the Home window (on page 116) Web Interface is accessible before removing
power from the ZumLink device (approximately 6-8 minutes).

If power was removed prematurely during the upgrade process, the Web Interface pages
may not be accessible.

Reinstall the **.pkg** file and **WAIT for the file upgrade process to complete**.
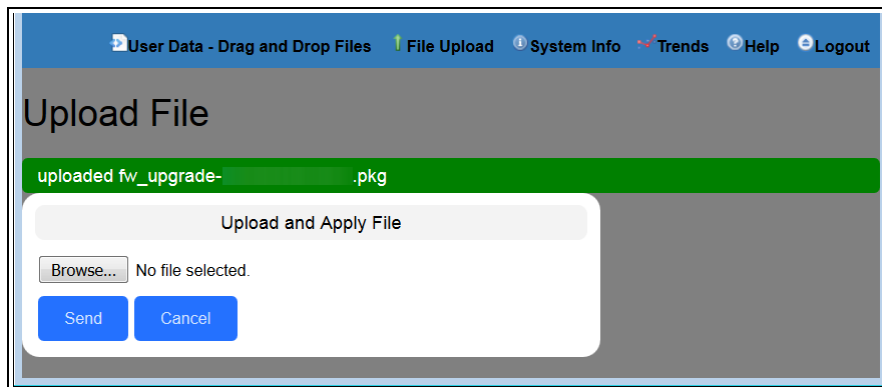
Figure 94: File Upload window showing completed upload of the selected file.

13. Click **Browse**.
    The Microsoft® **File Upload** dialog box opens.

14. Locate and select the downloaded ZumLink upgrade **.fcf** file.
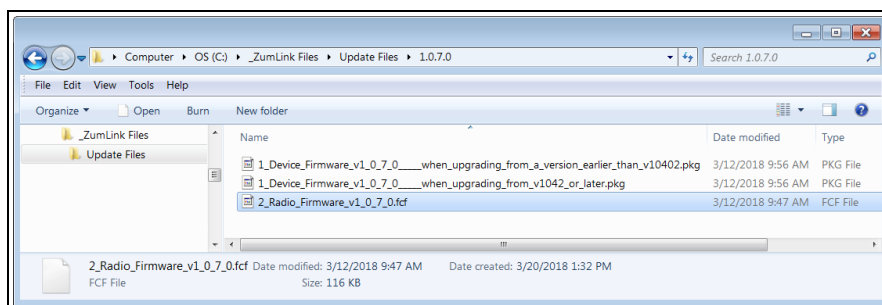
Figure 95: Microsoft® File Upload dialog box with the selected .fcf file

15. Click **Open**.
    The dialog box closes and the **File Upload** window returns showing the selected file.
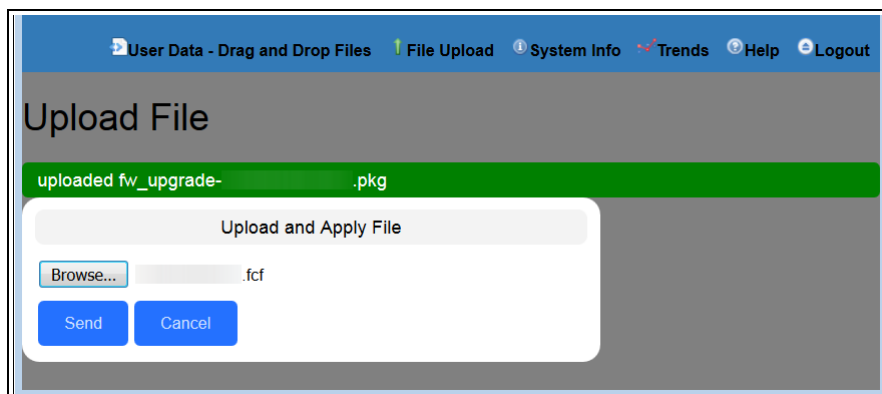
Figure 96: File Upload window with selected .fcf file

16. Click **Send**.
    The **File Upload** window changes to show the completed upload percentage to the ZumLink.

> **Note**: The **.fcf** file uploads very quickly (≈ 1-2 minutes).

> **Tip** The LEDs (on page 261) indicated the upgrade process.
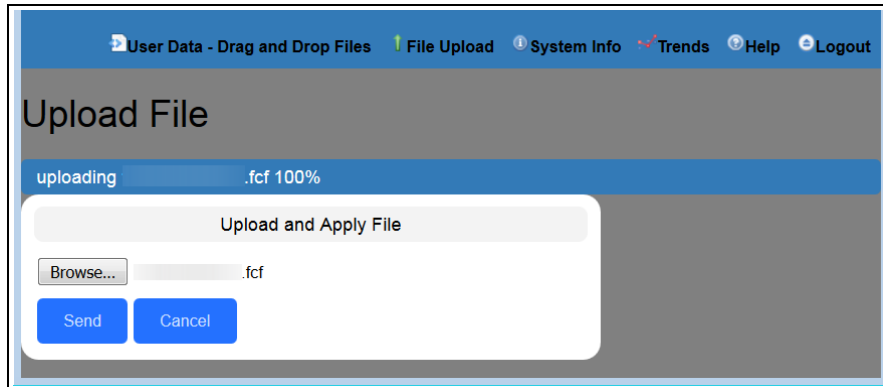
Figure 97: File Upload window showing uploading percentage.

The **File Upload** window refreshes and shows the completed and uploaded file applied to the ZumLink.
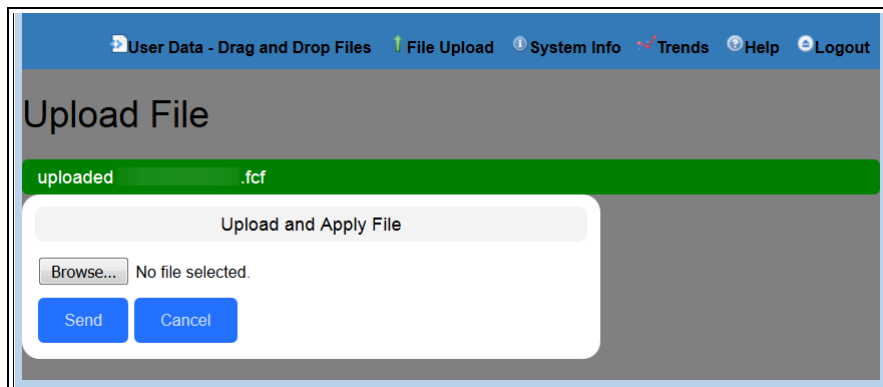
Figure 98: File Upload window showing completed upload of the selected file.

17. Optional: Click the **System Info** link.
    The System Info window opens showing the updated firmware on the ZumLink.
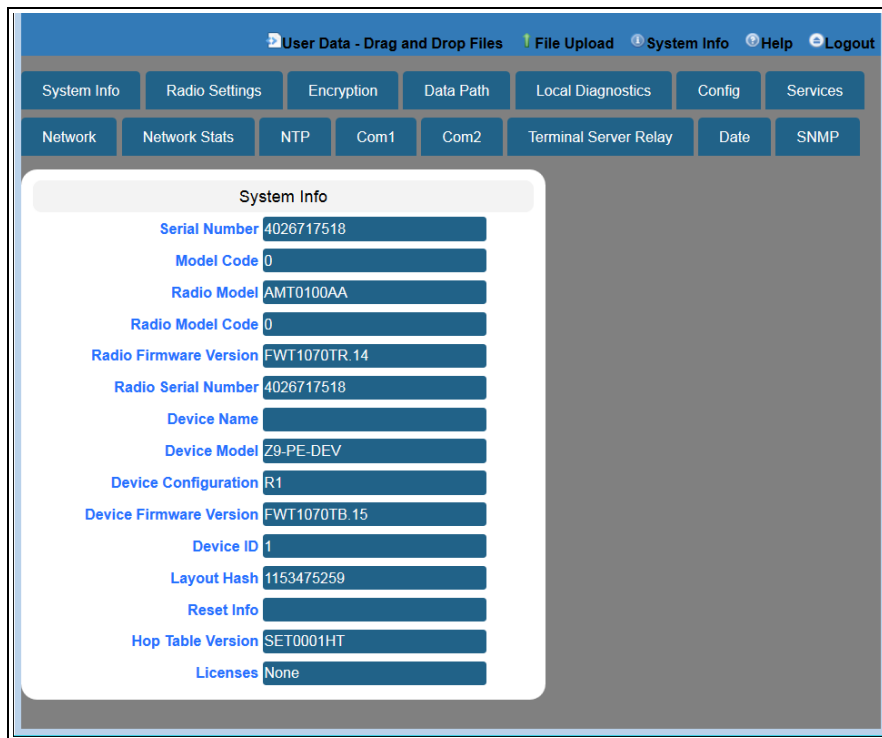
Figure 99: System Info window

Important!: For the v1.0.7.0 upgrade, these settings should have this information:
systemInfo.deviceFirmwareVersion=FWT1070TB.15
systemInfo.radioFirmwareVersion=FWT1070TR.14.
If neither of these are listed in their respective settings, repeat the upgrade procedure.

8. IP Filtering

IP Filtering is used to allow only traffic in a designated IP subnet to traverse the radio network.

- Within the radio subnet, IPv4, TCP, ICMP (ping), ARP, and UDP traffic are permitted to traverse the radio network, while all other Ethernet traffic is blocked.
- The IP Filtering setting (`network.netmaskFilterEnabled=true`) does NOT need to match on all the radios in the network.
  Only enable IP Filtering on individual radios with incoming LAN Ethernet traffic to filter from the network.

> **Tip**: IP Filtering can prevent non-radio Ethernet traffic from adversely affecting the performance and capacity of the radio network.

Note: This procedure provides a Tera Term terminal connection to the ZumLink CLI. Other terminal emulators (e.g., HyperTerminal, PuTTY) may be used.
The images in this procedure are for Windows® 7 and/or Firefox®.
The dialog boxes and windows appear differently on each computer.

Procedure

1. On the computer connected to the ZumLink Z9-P / Z9-PE device, open a terminal program (e.g., Tera Term http://ttssh2.osdn.jp/).
2. In Tera Term, on the **File** menu, select **New Connection**.
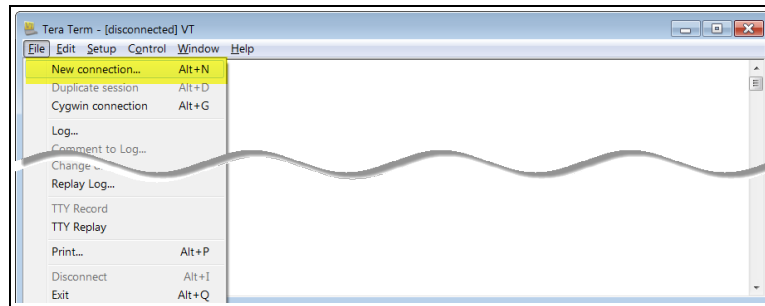
Figure 100: File menu > New Connection

The **Tera Term New Connection** dialog box opens.

3. Click the **Port** list box arrow and select the COM port the ZumLink device is connected to.
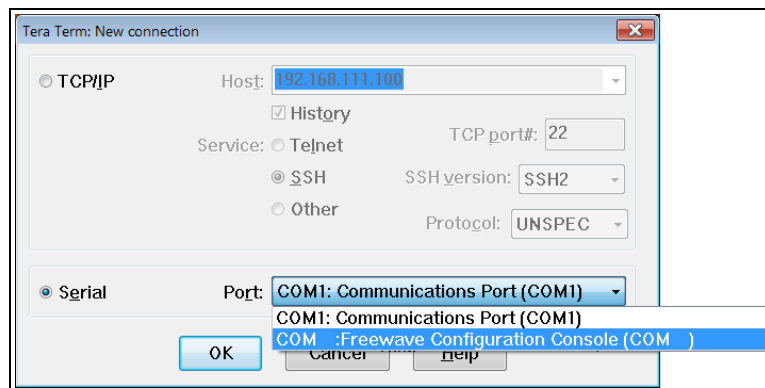
Figure 101: Select the ZumLink COM port

> **Important!**: The **Port** assignment varies from computer to computer.

4. Click **OK** to save the changes and close the dialog box.
   The Tera Term window shows the connected COM port and Baud rate in the title bar of the window.

5. In the Tera Term window, click the **Setup** menu and select **Serial Port**.
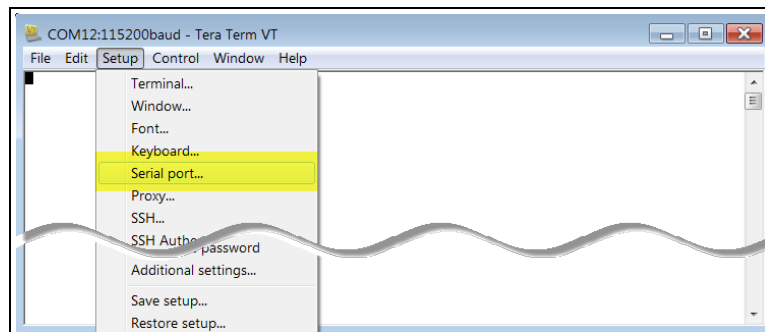
Figure 102: Serial menu > Setup Port

The **Tera Term: Serial Port Setup** dialog box opens.

> **Note**: The image shows the default ZumLink settings.
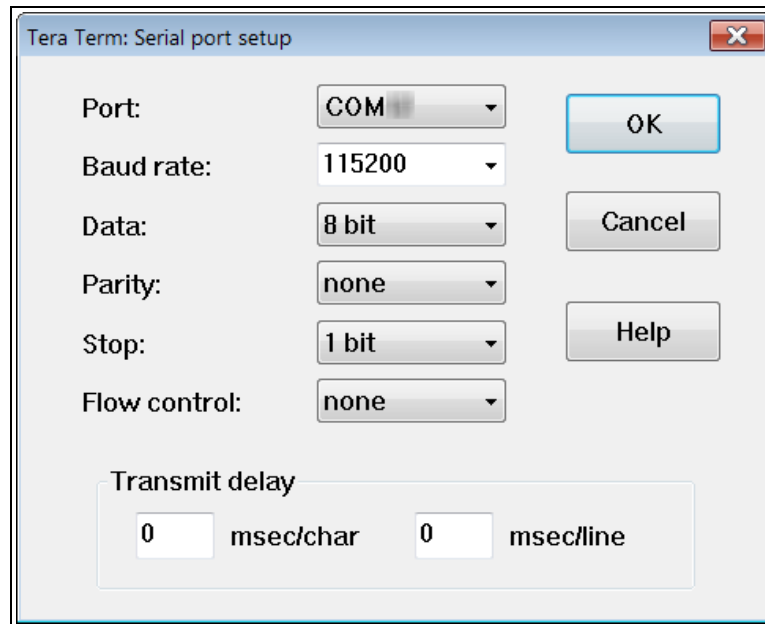
Figure 103: Tera Term: Serial Port Setup dialog box with default settings

6. Verify, and change if required, the Tera Term serial port settings (except the **Port** setting) of the connected ZumLink so the settings are the same as the defaults shown in Figure 103.

7. Verify the COM port settings are:
   Baud Rate / **Baudrate**: 115200
   Data / **Databits**: 8 bit
   Parity: none
   Stop / **Stopbits**: 1 bit

8. Click **OK** to save the changes and close the dialog box.

9. In the Tera Term window, press <Enter>.
   The ZumLink CLI Login returns.

10. Login using the current **username** and **password**.

> **Note**: The password does not appear when typing - it looks blank.

The **FreeWave Shell** returns.

Figure 104: The FreeWave Shell returns.

> **Note**: The login times out after 3600 seconds.
> Repeat the login procedure if needed.

11. At the > prompt, type **network** and press <Enter>.
    The ZumLink **network** settings appear.

Figure 105: network Settings Page

12. At the > prompt, type **network.netmaskFilterEnabled=true** and press <Enter>.
    The IP Filtering is now active on the ZumLink device.

> The IP Filtering setting (**network.netmaskFilterEnabled=true**) does NOT need
> to match on all the radios in the network.
> Only enable IP Filtering on individual radios with incoming LAN Ethernet traffic to filter
> from the network.

13. At the > prompt, type **save** and press <Enter>.

> **Note**: See Example: Network Topology with Traffic at the Gateway (on page 81).

8.0.1. Example: Network Topology with Traffic at the Gateway

Figure 106 shows:

- The yellow communication link arrows are used to denote which of the radio units can directly communicate.
- Devices in green can communicate with IPv4.
- Devices in red and other traffic is excluded from ZumLink network.
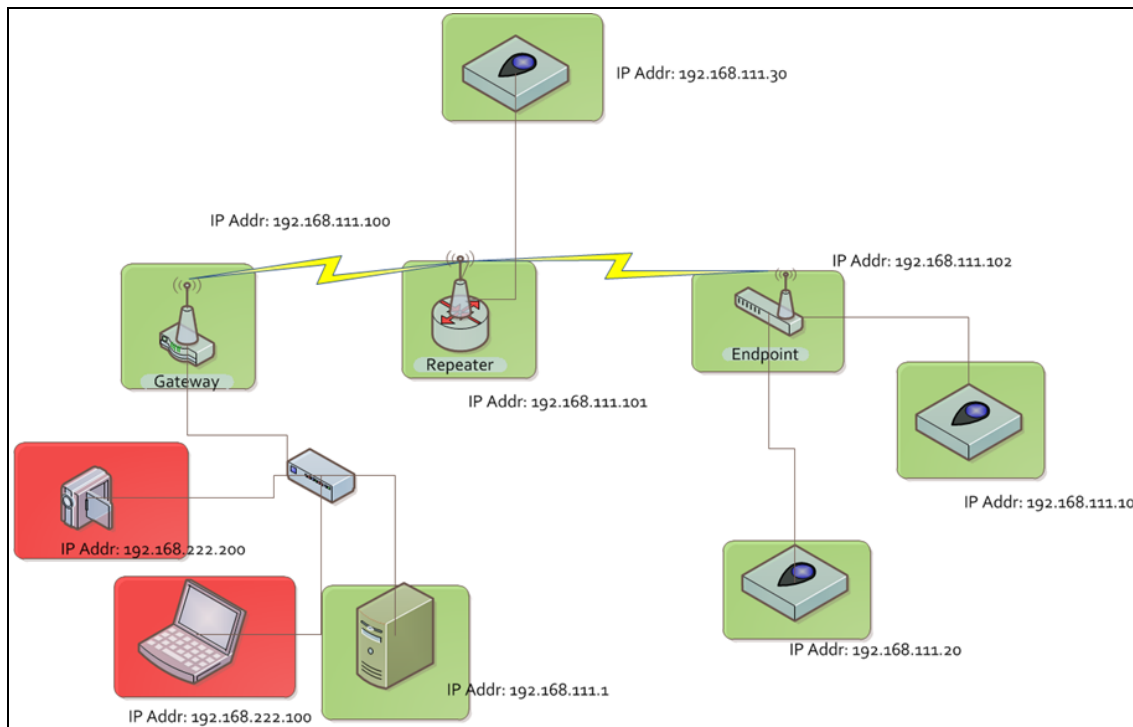
Figure 106: Network Topology with Traffic at the Gateway but not Desired on the Rest of the Network

Figure 106 is a common network topology where IP filtering on the Gateway radio reduces unwanted traffic on the radio network.

In this example:

- Only traffic on the 192.168.111.255 netmask passes over the radio network.
- The red laptop and the camera traffic are on the 222.nnn subnet; their traffic is blocked at the Gateway radio.
- Only IPv4. TCP, UDP, ICMP (ping), and ARP traffic destined to and from the desired subnet is transmitted over the radio network.
- VLAN tagged packets are filtered out because the radio is not considered on the VLAN and therefore VLAN packets cannot be on the same subnet.

9. Repeaters

ZumLink Repeater allows the extension of the ZumLink network, forwarding packets between ZumLink devices that could otherwise not communicate directly with each other. The advantage of using Repeaters is to reach very long distances and "hop" over or around obstacles like buildings or hills.

The ZumLink Repeater can be configured as either a Gateway-Repeater or Endpoint-Repeater.

- The Gateway-Repeater is a Gateway that also repeats packets.
- The Endpoint-Repeater is an Endpoint able to repeat packets and master beacons.

This section has this information:

ZumLink Repeaters support all 5 data rates; 115.2kbps, 250kbps, 500kbps, 1Mbps, and 4Mbps.

- At 115.2kbps and 250kbps data rates, hopping capability must be enabled for the ZumLink Repeaters.
- At 500kbps, 1Mbps, and 4Mbps data rates, hopping capability is optional.

When hopping capability is employed, one radio must be configured as the Gateway (or Gateway-Repeater).

- The beacon from the Gateway radio must be heard by the Repeater.
- The Repeater must also re-send the beacon so that the Endpoints, and downstream Repeaters, it communicates with can stay synchronized with the frequency hopping pattern.
- To keep the Gateway and Endpoint-Repeater beacons from colliding, the Endpoint-Repeaters must have their own time slot (radio Repeater slot).
- The Endpoint-Repeater has a radio Repeater slot range from 1-3.
    - A maximum number of 3 Endpoint-Repeaters are supported in an overlapping communication space or RF coverage area.
    - The radio Repeater slot numbers can be reused where there is no RF connectivity or overlap between the reused radio Repeater slots.

Where multiple communication paths are available, the ZumLink Repeater can be influenced to a preferred communication path by optimizing the minimum signal level margin. The minimum signal level margin establishes a minimum signal threshold required for a Repeater hop to be considered.

> **FREEWAVE Recommends**: Set the beaconBurstCount (on page 178) to 2 or more for optimal throughput when Repeaters are used and the RF environment is noisy.
> This increases the number of beacons sent in a beacon interval.

> **Caution**: The repeating operation occurs on the same frequencies normally used for transmit and receive.
> This causes the throughput of the communication path utilizing the Repeater to be reduced by approximately 50 percent with each Repeater hop.
> Only communication paths via Repeaters are impacted, communication paths that do not utilize the Repeater remain at full throughput.

9.1. Repeater - Setup Table

These tables show the basic setting configurations in a Repeater network with either:

- Hopping OFF Repeater Setup (on page 84)
- Hopping ON Repeater Setup (on page 85)

Note: For detailed procedures, see Basic Gateway and Endpoint-Repeater Setup (on page 87).

9.1.1. Hopping OFF Repeater Setup

The settings in this table assumes that `radioHoppingMode=Hopping_Off`.

- Hopping is required at data rates below 500kbps.
- Hopping is optional at data rate 500kbps or above.
- With hopping disabled, a Gateway or Gateway-Repeater is optional.

Repeater Network Configuration			
radioSettings Setting*	**Gateway Setup**	**Endpoint-Repeater Setup**	**Endpoint Setup**
radioMode=	Gateway	Endpoint_Repeater	Endpoint
nodeId=	N/A	= **unique** Node ID for each device	= **unique** Node ID for each device
networkId=	= **same** Network ID for all devices	= **same** Network ID for all devices	= **same** Network ID for all devices
rfDataRate=	= **same** Data Rate for all devices	= **same** Data Rate for all devices	= **same** Data Rate for all devices
dataPath Setting*	**Gateway Setup**	**Endpoint-Repeater Setup**	**Endpoint Setup**
routeMinSignalMarginThresh=	= **desired** Link Signal Margin minus 4dB	= **desired** Link Signal Margin minus 4dB	= **desired** Link Signal Margin minus 4dB
network Setting*	**Gateway Setup**	**Endpoint-Repeater Setup**	**Endpoint Setup**
ip_address=	= **unique** IP address for each device.	= **unique** IP address for each device.	= **unique** IP address for each device.

Note: *See the dataPath Pages (on page 134), network Pages (on page 164), or radioSettings Pages (on page 177) for additional information.

9.1.2. Hopping ON Repeater Setup

The settings in this table assumes that `radioHoppingMode=Hopping_On`.

- Hopping is required at data rates below 500kbps.
- Hopping is optional at data rate 500kbps or above.
- With hopping enabled, a Gateway or Gateway-Repeater must be configured.

Repeater Network Configuration			
radioSettings Setting****	**Gateway Setup**	**Endpoint-Repeater Setup**	**Endpoint Setup**
radioMode=	Gateway	Endpoint_Repeater	Endpoint
nodeId=	N/A	= **unique** Node ID for each device	= **unique** Node ID for each device
networkId=	= **same** Network ID for all devices	= **same** Network ID for all devices	= **same** Network ID for all devices
rfDataRate=	= **same** Data Rate for all devices	= **same** Data Rate for all devices	= **same** Data Rate for all devices
radioMaxRepeaters=	0-3 [1]	NA	NA
radioRepeaterSlot=	NA	1-3 [2]	NA
beaconBurstCount=	1-7 [3]	NA	NA
dataPath Setting****	**Gateway Setup**	**Endpoint-Repeater Setup**	**Endpoint Setup**
routeMinSignalMarginThresh=	= **desired** Link Signal Margin minus 4dB	= **desired** Link Signal Margin minus 4dB	= **desired** Link Signal Margin minus 4dB
network Setting****	**Gateway Setup**	**Endpoint-Repeater Setup**	**Endpoint Setup**
ip_address=	= **unique** IP address for each device.	= **unique** IP address for each device.	= **unique** IP address for each device.

1. Set the **radioMaxRepeaters** to match the number of overlapping Repeaters with a maximum of 3.
   - Setting this value too high adds unnecessary latency to the network.
   - In this example, set this to 1.
2. Set the **radioRepeaterSlot** to designate which Repeater slot to use, up to the **radioMaxRepeaters** setting.
   - In this example, set this to 1.

3. Set the beaconBurstCount (on page 178) to 2 or more for optimal throughput when Repeaters are used and the RF environment is noisy.

    This increases the number of beacons sent in a beacon interval.

> **Note**: ****See the dataPath Pages (on page 134), network Pages (on page 164), or radioSettings Pages (on page 177) for additional information.

9.2. Basic Gateway and Endpoint-Repeater Setup

Important!: This procedure assumes the user has 3 new ZumLink devices.
The number of Endpoint-Repeaters in the network **must be known before** starting this procedure.

The basic setup procedures are:

B. Configure using either:

9.2.1. Open a Terminal Emulator Application

Note: This procedure provides a Tera Term terminal connection to the ZumLink CLI. Other terminal emulators (e.g., HyperTerminal, PuTTY) may be used.
The images in this procedure are for Windows® 7 and/or Firefox®.
The dialog boxes and windows appear differently on each computer.

1. On the computer connected to the ZumLink Z9-P / Z9-PE device, open a terminal program (e.g., Tera Term http://ttssh2.osdn.jp/).
2. In Tera Term, on the **File** menu, select **New Connection**.
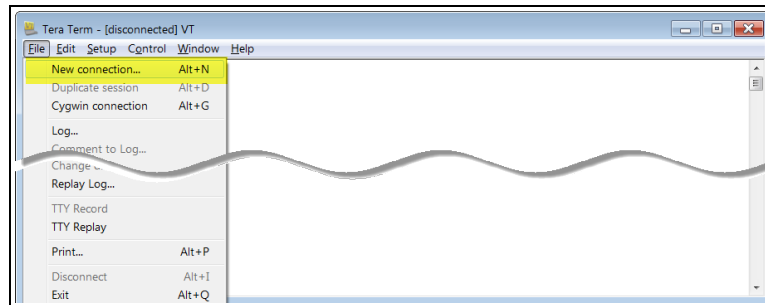
Figure 107: File menu > New Connection

The **Tera Term New Connection** dialog box opens.

3. Click the **Port** list box arrow and select the COM port the ZumLink device is connected to.
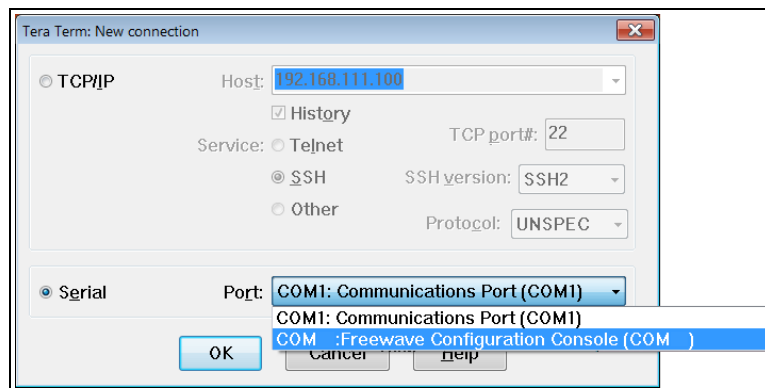
Figure 108: Select the ZumLink COM port

Important!: The **Port** assignment varies from computer to computer.

4. Click **OK** to save the changes and close the dialog box.
   The Tera Term window shows the connected COM port and Baud rate in the title bar of the window.
5. In the Tera Term window, click the **Setup** menu and select **Serial Port**.
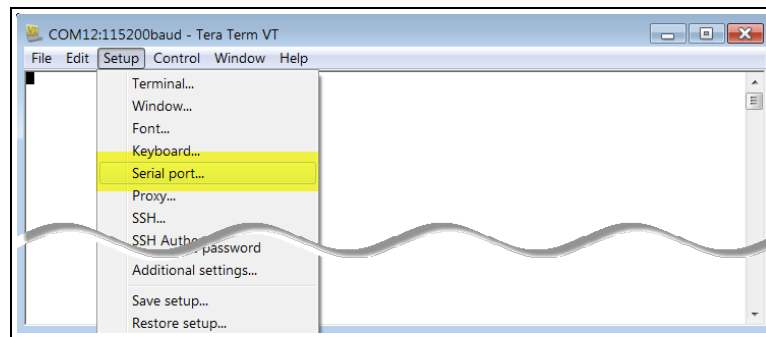
Figure 109: Serial menu > Setup Port

The **Tera Term: Serial Port Setup** dialog box opens.

> **Note**: The image shows the default ZumLink settings.
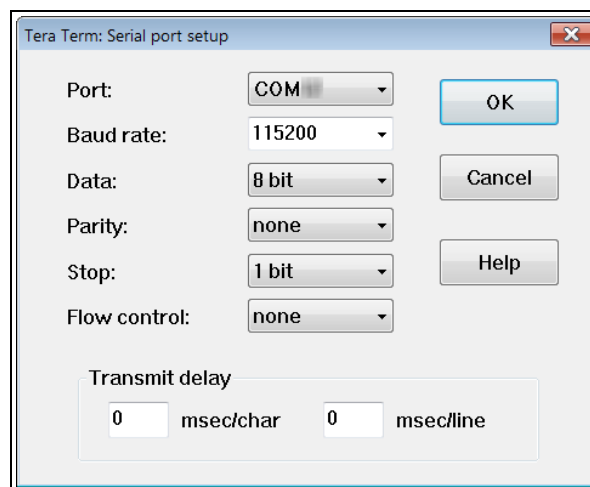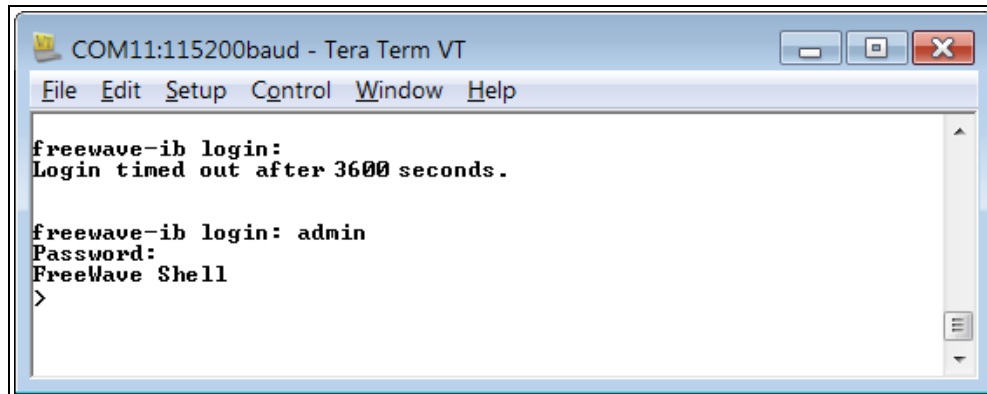
Figure 110: Tera Term: Serial Port Setup dialog box with default settings

6. Verify, and change if required, the Tera Term serial port settings (except the **Port** setting) of the connected ZumLink so the settings are the same as the defaults shown in Figure 110.

7. Verify the COM port settings are:
   Baud Rate / **Baudrate**: 115200
   Data / **Databits**: 8 bit
   Parity: none
   Stop / **Stopbits**: 1 bit

8. Click **OK** to save the changes and close the dialog box.

9. In the Tera Term window, press <Enter>.
   The ZumLink CLI Login returns.

10. Login using the current **username** and **password**.

> **Note**: If the **User Name** or **Password** were changed, enter the applicable information.
> The password does not appear when typing - it looks blank.
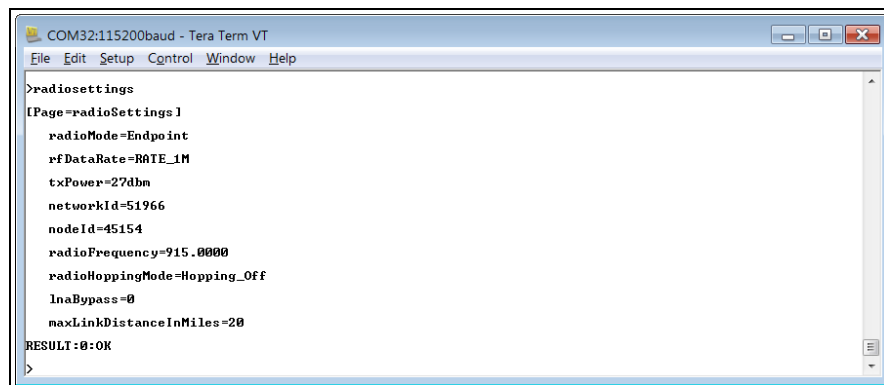
The **FreeWave Shell** returns.

Figure 111: The FreeWave Shell returns.

Note: The login times out after 3600 seconds.
Repeat the login procedure if needed.

11. At the > prompt, type`radioSettings` and press <Enter>.
    The current [Page=radioSettings] appears. (Figure 112)

Figure 112: radioSettings Page

12. Continue with either:

    -
    -

9.2.2. Hopping On: Gateway and Endpoint-Repeater Setup

> **Important!**: This procedure has **HOPPING ON** (`radioHoppingMode=Hopping_On`).
>
> If Hopping is OFF (`radioHoppingMode=Hopping_Off`) go to
> Hopping Off: Gateway and Endpoint-Repeater Setup (on page 93).

1. On the **Gateway** ZumLink device:
    a. Complete the Open a Terminal Emulator Application (on page 88) procedure.
    b. At the > prompt, type:
        i. `radioSettings.radioMode=Gateway` and press <Enter>.
        ii. `radioSettings.networkId=nnnnn` where nnnnn is the designated Network ID and press <Enter>.
        iii. `network.ip_address=nnn.nnn.nnn.nnn` where nnn.nnn.nnn.nnn is the **unique** IP address for each device and press <Enter>.
        iv. `radioSettings.rfDataRate=Rate_nnnn.nn` where nnnn.nn is the RF data rate in Kilobytes or Megabytes and press <Enter>.

        > **Note**: See rfDataRate (on page 191) for the correct command format of the RF Data Rate.

        v. `radioHoppingMode=Hopping_On` and press <Enter>.
        vi. `radioSettings.maxRepeater=1` and press <Enter>.
        vii. `radioSettings.beaconBurstCount=2` and press <Enter>.
    c. At the > prompt, type `save` and press <Enter>.
2. Disconnect the computer from the **Gateway** ZumLink device.
3. On the **Endpoint-Repeater** ZumLink device:
    a. Complete the Open a Terminal Emulator Application (on page 88) procedure.
    b. At the > prompt, type:
        i. `radioSettings.radioMode=Endpoint_Repeater` and press <Enter>.
        ii. `radioSettings.networkId=nnnnn` where nnnnn is the designated Network IDused when configuring the Gateway ZumLink device and press <Enter>.
        iii. `network.ip_address=nnn.nnn.nnn.nnn` where nnn.nnn.nnn.nnn is the **unique** IP address for each device and press <Enter>.
        iv. `radioSettings.rfDataRate=Rate_nnnn.nn` where nnnn.nn is the same data rate in Kilobytes or Megabytes used when configuring the Gateway ZumLink device and press <Enter>.

        > **Note**: See rfDataRate (on page 191) for the correct command format of the RF Data Rate.

    v. `radioSettings.nodeId=nnnnn` where nnnnn is the unique ID of the device and press <Enter>.

    vi. Verify the `radioSettings.radioRepeaterSlot=1` and press <Enter>.

  c. At the > prompt, type `save` and press <Enter>.

4. Disconnect the computer from the **Endpoint-Repeater** ZumLink device.

5. On the **Endpoint** ZumLink device:

  a. Complete the Open a Terminal Emulator Application (on page 88) procedure.

  b. At the > prompt, type:

    i. `radioSettings.radioMode=Endpoint` and press <Enter>.

    ii. `radioSettings.networkId=nnnnn` where nnnnn is the designated Network ID used when configuring the Gateway ZumLink device and press <Enter>.

    iii. `network.ip_address=nnn.nnn.nnn.nnn` where nnn.nnn.nnn.nnn is the **unique** IP address for each device and press <Enter>.

    iv. `radioSettings.rfDataRate=Rate_nnnn.nn` where nnnn.nn is the same data rate in Kilobytes or Megabytes used when configuring the Gateway ZumLink device and press <Enter>.

> **Note**: See rfDataRate (on page 191) for the correct command format of the RF Data Rate.

    v. `radioSettings.nodeId=nnnnn` where nnnnn is the unique ID of the device and press <Enter>

  c. At the > prompt, type `save` and press <Enter>.

> **Note**: The LEDs indicate a successful setup.
> See LEDs (on page 261) for additional information.

> **Tip**   See the Gateway-Repeater (on page 96) example.

9.2.3. Hopping Off: Gateway and Endpoint-Repeater Setup

> **Important!**: This procedure has **HOPPING OFF** (`radioHoppingMode=Hopping_Off`).
>
> If Hopping is ON (`radioHoppingMode=Hopping_On`) go to
> Hopping On: Gateway and Endpoint-Repeater Setup (on page 91).

1. On the **Gateway** ZumLink device:
   a. Complete the Open a Terminal Emulator Application (on page 88) procedure.
   b. At the > prompt, type:
      i. `radioSettings.radioMode=Gateway` and press <Enter>.
      ii. `radioSettings.networkId=nnnnn` where nnnnn is the designated Network ID and press <Enter>.
      iii. `network.ip_address=nnn.nnn.nnn.nnn` where nnn.nnn.nnn.nnn is the **unique** IP address for each device and press <Enter>.
      iv. `radioSettings.rfDataRate=Rate_nnnn.nn` where nnnn.nn is the RF data rate in Kilobytes or Megabytes and press <Enter>.

      > **Note**: See rfDataRate (on page 191) for the correct command format of the RF Data Rate.

      v. Verify `radioHoppingMode=Hopping_Off` and press <Enter>.
   c. At the > prompt, type `save` and press <Enter>.
2. Disconnect the computer from the **Gateway** ZumLink device.
3. On the **Endpoint-Repeater** ZumLink device:
   a. Repeat Steps 1 to 12.
   b. At the > prompt, type:
      i. `radioSettings.radioMode=Endpoint_Repeater` and press <Enter>.
      ii. `radioSettings.networkId=nnnnn` where nnnnn is the designated Network ID used when configuring the Gateway ZumLink device and press <Enter>.
      iii. `network.ip_address=nnn.nnn.nnn.nnn` where nnn.nnn.nnn.nnn is the **unique** IP address for each device and press <Enter>.
      iv. `radioSettings.rfDataRate=Rate_nnnn.nn` where nnnn.nn is the same data rate in Kilobytes or Megabytes used when configuring the Gateway ZumLink device and press <Enter>.

      > **Note**: See rfDataRate (on page 191) for the correct command format of the RF Data Rate.

      v. `radioSettings.nodeId=nnnnn` where nnnnn is the unique ID of the device and press <Enter>.

vi.   Verify **`radioHoppingMode=Hopping_Off`** and press <Enter>.

  c.   At the > prompt, type **`save`** and press <Enter>.

4.   Disconnect the computer from the **Endpoint-Repeater** ZumLink device.

5.   On the **Endpoint** ZumLink device:

  a.   Complete the Open a Terminal Emulator Application (on page 88) procedure.

  b.   At the > prompt, type:

i.   **`radioSettings.radioMode=Endpoint`** and press <Enter>.

ii.   **`radioSettings.networkId=nnnnn`**where nnnnn is the designated Network IDused when configuring the Gateway ZumLink device and press <Enter>.

iii.   **`network.ip_address=nnn.nnn.nnn.nnn`**where nnn.nnn.nnn.nnn is the **unique** IP address for each device and press <Enter>.

iv.   **`radioSettings.rfDataRate=Rate_nnnn.nn`**where nnnn.nn is the same data rate in Kilobytes or Megabytesused when configuring the Gateway ZumLink device and press <Enter>.

> **Note**: See rfDataRate (on page 191) for the correct command format of the RF Data Rate.

v.   **`radioSettings.nodeId=nnnnn`**where nnnnn is the unique ID of the device and press <Enter>

  c.   At the > prompt, type **`save`** and press <Enter>.

> **Note**: The LEDs indicate a successful setup.
> See LEDs (on page 261) for additional information.

> Tip   See the Gateway-Repeater (on page 96) example.

9.3. Repeater - Examples

> **Note**: The yellow communication link arrows are used to denote which of the radio units can directly communicate.
>
> Radio units that DO NOT have yellow communication links between them are considered to be in different communication spaces.

- Gateway-Repeater (on page 96)
- Endpoint-Repeater (on page 97)
- Multiple Repeaters: Gateway-Repeater and Endpoint-Repeater (on page 98)
- Multiple Repeaters: Four Endpoint-Repeaters (on page 99)

9.3.1. Gateway-Repeater

Figure 113 shows:

- Endpoints that cannot peer directly can communicate through a Gateway-Repeater, extending the length of a point-to-multipoint network.
- Repeater is operating in Gateway-Repeater mode.
- No performance loss for Gateway-Repeater to Endpoint 1-Endpoint 2-Endpoint 3 communication.
- The throughput for Endpoint 2 to Endpoint 3 communication via Gateway-Repeater is reduced by approximately 50 percent.
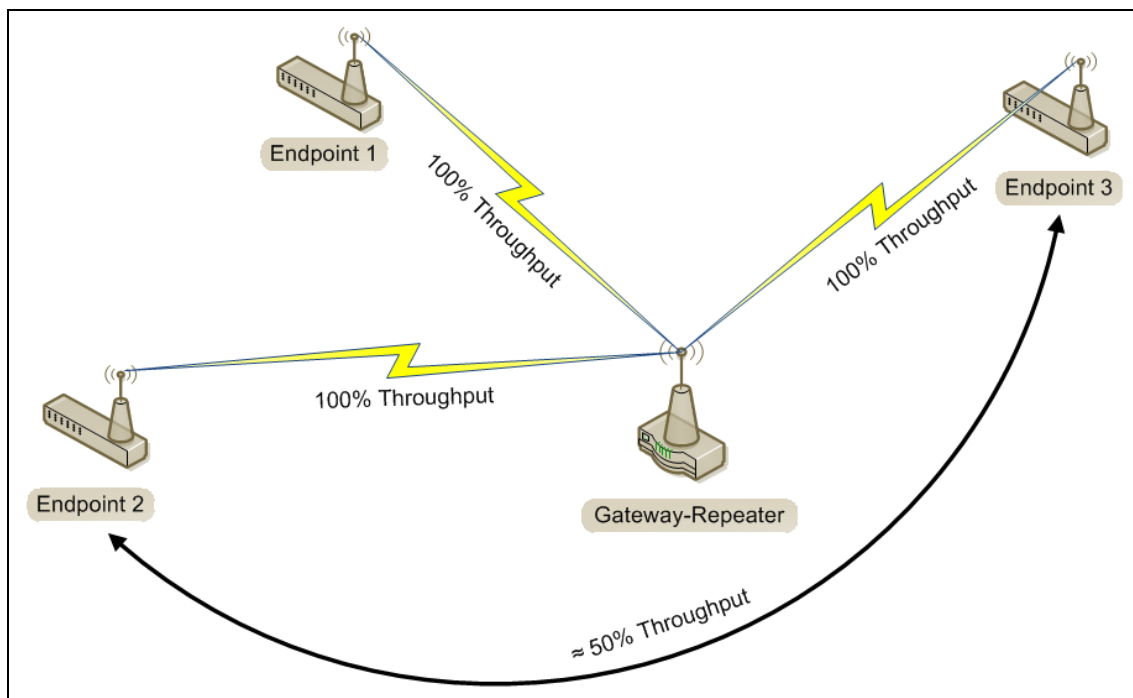
Figure 113: Gateway-Repeater

9.3.2. Endpoint-Repeater

Figure 114 shows:

- Endpoints that cannot peer directly can communicate through an Endpoint-Repeater, extending the length of a point-to-point network.
- Repeater is operating in Endpoint-Repeater mode.
- No performance loss for Gateway to Endpoint 3, Gateway to Endpoint-Repeater, or Endpoint-Repeater to Endpoint 1-Endpoint 2 communication.
- The throughput for Endpoint 1-Endpoint 2 to Gateway communication via Endpoint-Repeater is reduced by approximately 50 percent.

> **Tip** User devices can be physically attached to the Endpoint-Repeater.
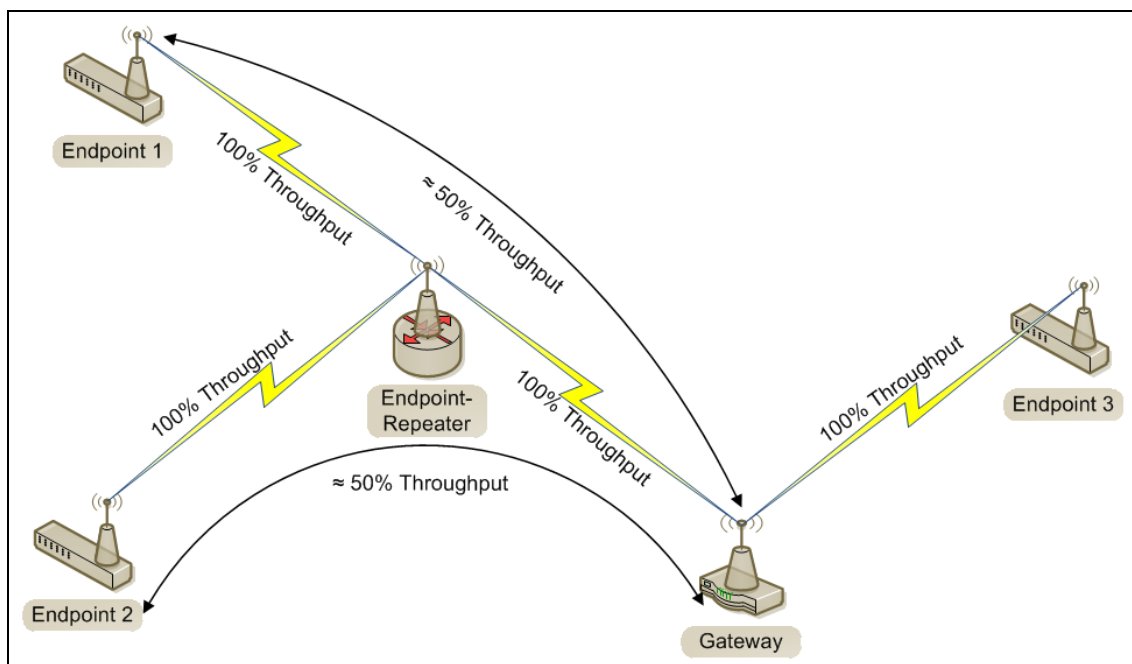
Figure 114: Endpoint-Repeater

9.3.3. Multiple Repeaters: Gateway-Repeater and Endpoint-Repeater

Figure 115 shows:

- Repeaters are operating in Gateway-Repeater and Endpoint-Repeater mode.
- No performance loss for Endpoint-Repeater to Gateway-Repeater, Endpoint 1 to Endpoint-Repeater, Endpoint 2 to Gateway-Repeater communication.
- The throughput for Endpoint 1 to Gateway communication via Endpoint-Repeater is reduced by approximately 50 percent.
- The throughput for Endpoint 2 to Endpoint-Repeater via the Gateway-Repeater is reduced by approximately 50 percent.
- Endpoint 1 to Endpoint 2 communicate via the Endpoint-Repeater and Gateway-Repeater, or 2 repeater hops.
- The throughput for Endpoint 1 to Endpoint 2 communication is approximately 25%.
- As Repeaters are chained in the network, round trip delay will increase.
    - When issuing pings of large packet sizes at the lower data rates, such as 115.2K, and a beaconInterval = `TWENTY_FIVE_MS`, the latency can increase causing the pings to fail.
    - Allowing appropriate delay between pings resolves this issue.

> **FREEWAVE Recommends**: Set the `beaconBurstCount=2` or more and `beaconInterval=ONE_HUNDRED_MS` or more for optimal throughput when extended Repeater networks are used.
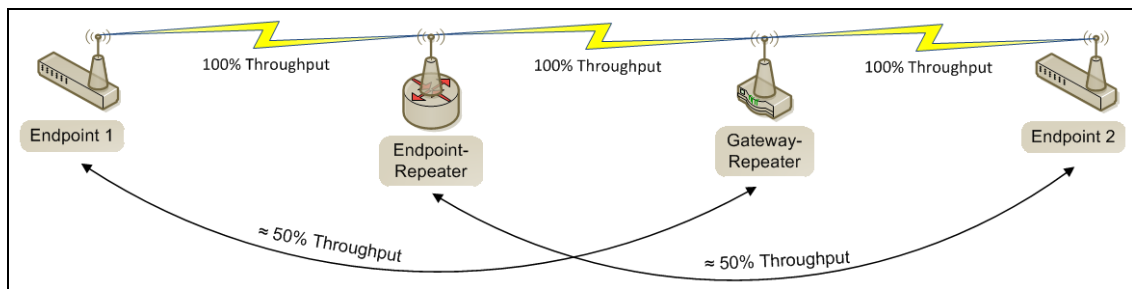
Figure 115: Repeater with Additional Endpoint to Enhance Connectivity

9.3.4. Multiple Repeaters: Four Endpoint-Repeaters

Figure 116 shows:

- Gateway has radio maximum of three Repeaters slots.
- Repeaters are operating in Endpoint-Repeater mode.
- Repeaters in the same network that have overlapping RF coverage must have unique radio Repeater slots.
  - Endpoint-Repeater 1 has a Repeater slot of 1.
  - Endpoint-Repeater 2 has a Repeater slot of 2.
  - Endpoint-Repeater 3 has a radio Repeater slot of 3.
  - Endpoint-Repeater 4 has a radio Repeater slot of 1.
- Endpoint-Repeater 1 and Endpoint-Repeater 4 do NOT overlap in RF coverage; therefore they can use the same repeater slot number.
- Endpoint 1 to Gateway communicate via the Endpoint-Repeater 1-2-3-4 or 4 Repeater hops.
- The throughput for Endpoint 1 to Gateway communication will be approximately 6.25%.

> **Important!**: Supporting three Repeaters in the same overlapping RF coverage does NOT limit the total number of Repeaters that can be chained together. However, careful consideration should be made regarding the throughput impact of chained Repeaters.
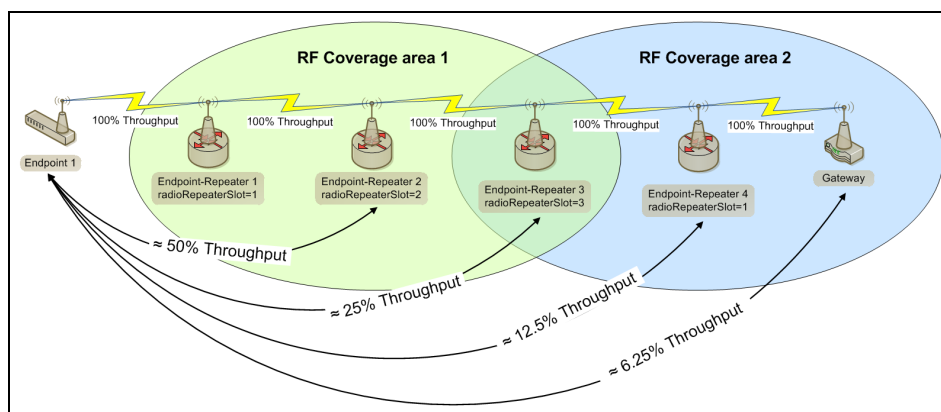
Figure 116: Multiple Repeaters: Four Endpoint-Repeaters

- As Repeaters are chained in the network, round trip delay will increase.
  - When issuing pings of large packet sizes at the lower data rates, such as 115.2K, and a beaconInterval = `TWENTY_FIVE_MS`, the latency can increase causing the pings to fail.
  - Allowing appropriate delay between pings resolves this issue.

> **FREEWAVE Recommends**: Set the `beaconBurstCount=2` or more and `beaconInterval=ONE_HUNDRED_MS` or more for optimal throughput when extended Repeater networks are used.

10. Ports and Pinouts

This section identifies the ports and pinouts of the ZumLink device.

Ports

Pinouts

10.1. Ports

10.1.1. Z9-P Ports

Figure 117: ZumLink Z9-P Ports

10.1.2. Z9-PE Ports
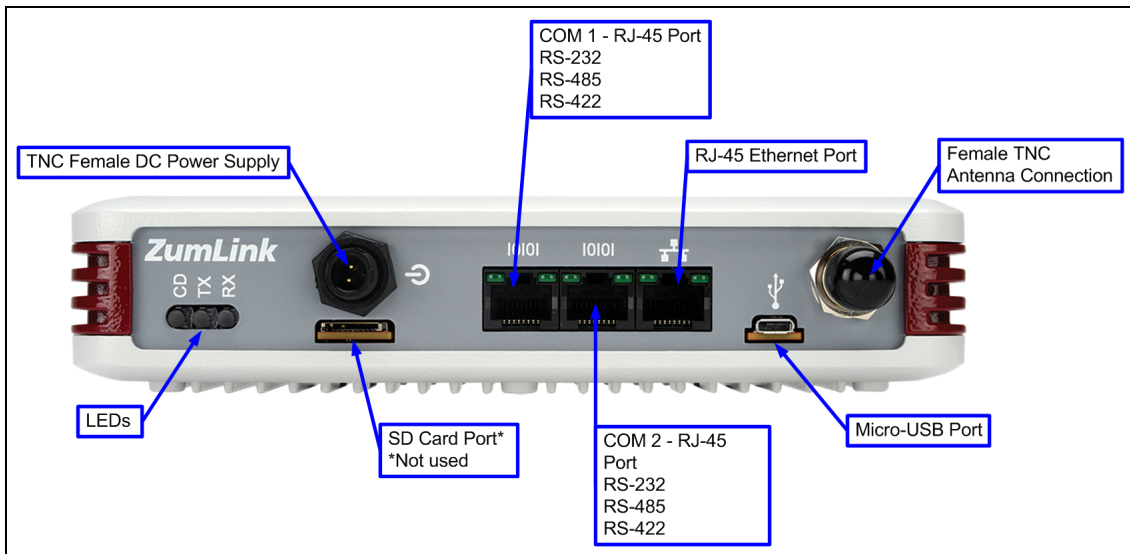
Figure 118: ZumLink Z9-PE Ports

10.2. Serial and Ethernet Port Details

Note: The RJ-45 Ethernet and the micro USB connectors are standard connectors with industry standard pinout and signals. See the LEDs (on page 261) for additional information.
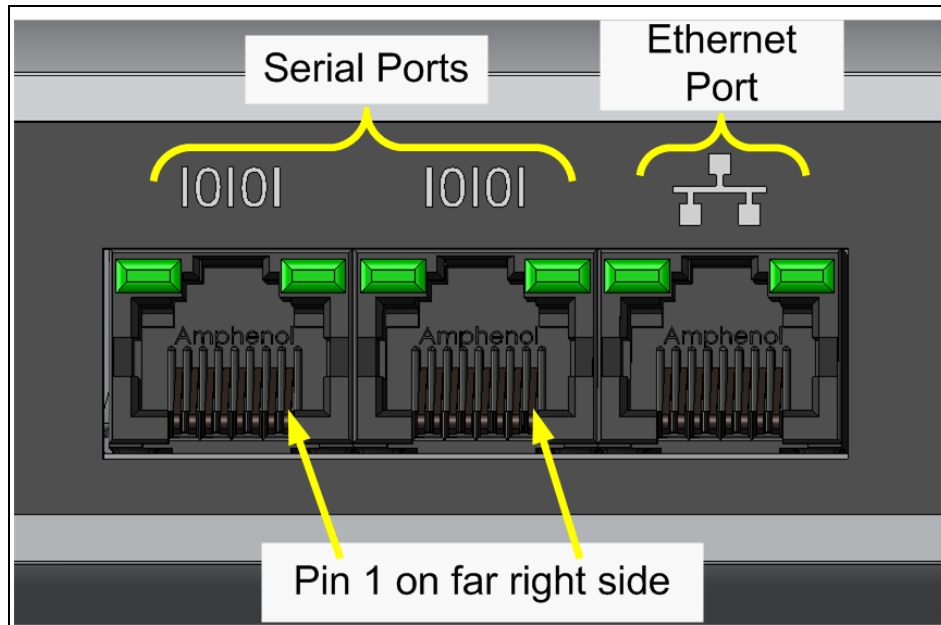
Figure 119: Serial and Ethernet Ports

10.2.1. Z9-P Pinouts
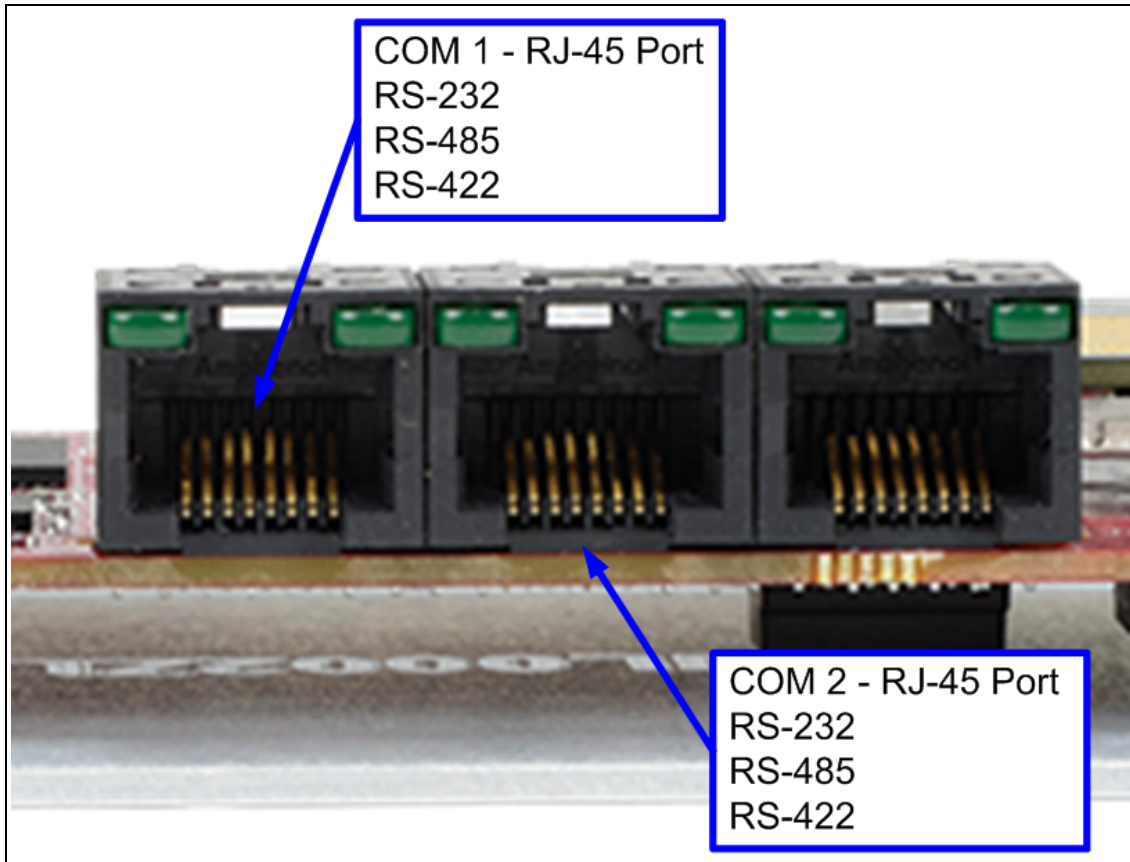
Figure 120: Z9-P Pinouts

(I) - Input   (O) - Output   (B) - Bidirectional

Z9-P / Z9-PE Serial Port Pinout Information			
Pin Number	**RS232**	**RS485**	**RS422**
1	--	--	--
2	CD --- (O)	--	--
3	DTR --- (I)	--	--
4	GND	GND	GND
5	RXD --- (I)	--	TX+ (A+) --- (O)
6	TXD --- (O)	RX+ (Y+) --- (B)	RX+ (Y+) --- (I)
7	CTS --- (O)	RX- (Z-) --- (B)	RX- (Z-) --- (I)
8	RTS --- (I)	--	TX- (B-) --- (O)

Z9-P / Z9-PE Serial Port Pinout Information			
Pin Number	**RS232**	**RS485**	**RS422**
***Com1.mode= Com2.mode=	RS232	RS485	RS485
***Com1.duplex= Com2.duplex=	Half or Full	Half	Full

Note: ***See the Com1 or Com2 section for detailed information.

Important!: The RTS and CTS signals are **ONLY** available for COM2.
The RTS and CTS signals are **NOT supported for COM1**.

11. Mounting the ZumLink

Separate mounting kits are available for purchase from FreeWave.

- **Z9-P** FreeWave Part Number: AOH0001HT
- **Z9-PE** FreeWave Part Number: AOH4003SP

Mounting Procedures

- Z9-P Mounting (on page 106)
- Z9-PE Mounting (on page 107)

11.1. Z9-P Mounting

11.1.1. Included Equipment

Z9-P - Included Equipment	
Qty	**Description**
1	DIN Rail Spring Clip
3	Flat-head machine screws, Phillips, M4 x 0.7, 12mm Long
1	DIN Rail Bracket
4	Pan-head machine screws, Phillips, 4-40, 1/4" Long, Lock Patch
1	Mounting Instruction Sheet

User-supplied Equipment

- Medium Phillips-head screwdriver
- Medium Flat-head screwdriver

Procedure

1. Use the Pan-head machine screws to attach the DIN Rail Bracket to the ZumLink.
2. Orient the DIN Rail Bracket / DIN Rail Spring Clip assembly so:
   a. The spring-loaded end of the DIN Rail Spring Clip is on the bottom lip of the rail.
   b. The **fixed (not spring-loaded)** end of the DIN Rail Spring Clip is on the top.

   > ⚠ **Caution**: Per the manufacturer's instructions, the DIN Rail Spring Clip is oriented with **spring-loaded end on the bottom lip of the rail**.

3. Use the Flat-head machine screws to attach the DIN Rail Spring Clip to the DIN Rail Bracket.

4. Mount the ZumLink to the 35mm DIN rail using the rail slide on the enclosure.
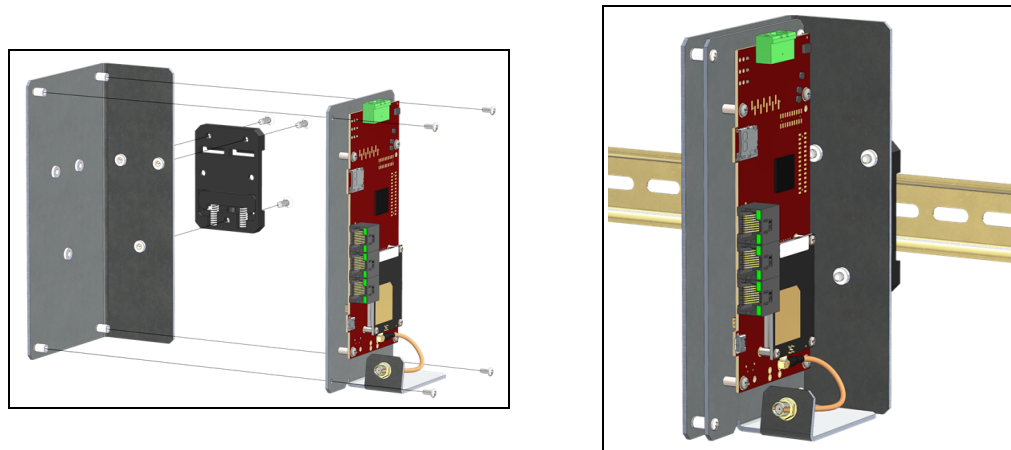
Figure 121: Z9-P attached to a DIN rail with the power connection on top.

11.2. Z9-PE Mounting

11.2.1. Included Equipment

Z9-PE Mounting Kit - Included Equipment	
Qty	**Description**
1	DIN Rail Spring Clip
3	Flat-head machine screws, Phillips, M4 x 0.7, 12mm Long
1	DIN Rail Bracket
3	Pan-head machine screws, Phillips, 6-32 Unc, 1/4" Long
1	Mounting Instruction Sheet

User-supplied Equipment

- Medium Phillips-head screwdriver
- Medium Flat-head screwdriver

Procedure

1. Use the Pan-head machine screws to attach the DIN Rail Bracket to the ZumLink.
2. Decide the orientation of the ZumLink.

> **Note**: The ZumLink can be mounted with either the power connection or antenna connection at the top.

3. Orient the DIN Rail Bracket / DIN Rail Spring Clip assembly so:
   a. The spring-loaded end of the DIN Rail Spring Clip is on the bottom lip of the rail.
   b. The **fixed (not spring-loaded)** end of the DIN Rail Spring Clip is on the top.

> ⚠️ **Caution**: Per the manufacturer's instructions, the DIN Rail Spring Clip is oriented with **spring-loaded end on the bottom lip of the rail**.

4. Use the Flat-head machine screws to attach the DIN Rail Spring Clip to the DIN Rail Bracket.

5. Mount the ZumLink to the 35mm DIN rail using the rail slide on the enclosure.

Figure 122: Z9-PE attached to a DIN rail with the power connection on top.
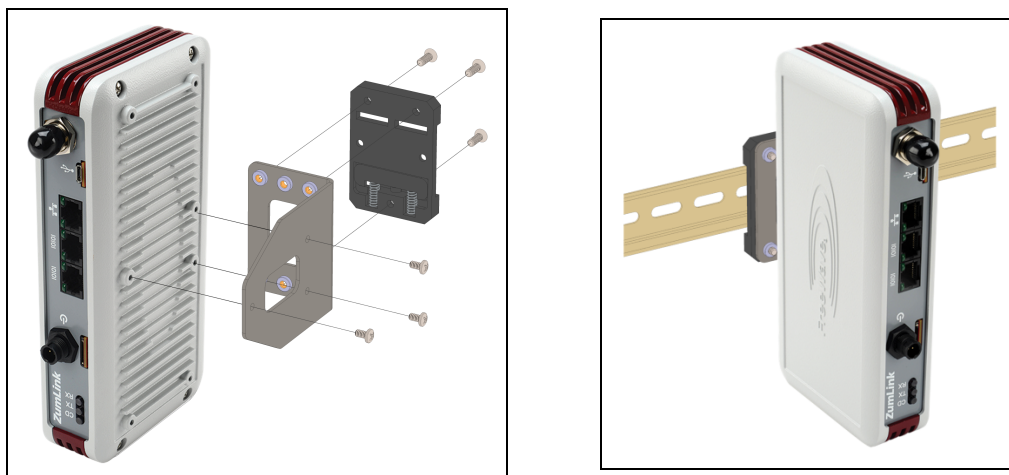
Figure 123: Z9-PE attached to a DIN rail with the antenna connection on top.

11.3. Removing the ZumLink from the DIN Rail

1. Push upwards on the DIN Rail Spring Clip (compressing the springs in the bottom).
2. Pivot the top of the DIN Rail Bracket / DIN Rail Spring Clip assembly off of the rail.
3. Move the whole DIN Rail Spring Clip down to release the bottom of the clip.

12. Approved Antennas

12.0.1. Omni-Directional Antennas

The 900MHz is approved by the FCC for use with omni-directional antennas with a 10.5dBi gain or less.

> **Note**: These antennas, including antenna gains, are approved for use with the ZumLink device.

900MHz Omni-Directional Antennas				
Gain (dBd)	Gain (dBi)	Manufacturer	Manufacturer Model Number	FreeWave Part Number
3.85	5.0	Antenex	EB8965C	EAN0905WC
3.0	5.15	Maxrad	MAX-9053	EAN0900WC
-0.15	2.0	Mobile Mark	PSKN3-925S	EAN0900SR
-2.15	0.0	Mobile Mark	PSTG0-915SE	EAN0900SQ

12.0.2. Directional Antennas

The 900MHz is approved by the FCC for use with Yagi-directional antennas with a 16.0 dBi gain or less.

900MHz Directional Antennas				
Gain (dBd)	Gain (dBi)	Manufacturer	Manufacturer Model Number	FreeWave Part Number
6.45	8.6	WaveLink	PRO890-8-40F02N4	EAN0906YC

12.0.3. Alternative Antennas

Antennas other than those listed in this section can potentially be used with the ZumLink with provisions.

- The antennas must be of a similar type.
- The antenna gain CANNOT exceed 10.5dBi for Omni-directional.
- The antenna gain CANNOT exceed 16.0dBi for Directional antennas.
- The overall system EIRP does not exceed 36dBm.

STOP **Warning!** A proper combination with the ZumLink is required to ensure the system meets FCC requirements.

13. Web Interface

The Z9-P / Z9-PE has a web interface used to:

- Drag and drop a customized configuration (**.cfg**) file
- Search the Help information.
- Upgrade the firmware on the ZumLink.
- View System information
- View Trends

These windows are available to view information, complete a firmware upgrade, and change the configuration of the Z9-P / Z9-PE:

13.1. File Upload window

The **File Upload** window is used to search for and upload these file types into the Z9-P / Z9-PE:

Extension	File Type
.cfg; **.cfg.txt**	Configuration changes
.fcf; **.fcf.txt**	Radio module Firmware updates
.pkg; **.pkg.txt**	Interface board Firmware updates

Access and Window Description

> **Note**: The images in this procedure are for Windows® 7 and/or Firefox®.
> The dialog boxes and windows appear differently on each computer.

1. Open a web browser.
2. In the URL address bar, enter the IP address of the attached Z9-P / Z9-PE.

   > **Note**: If this is the first time the radio is accessed, enter the default Z9-P / Z9-PE IP Address of **192.168.111.100**.
   > If the IP Address was changed, enter that IP Address.

3. Refresh the browser window (press <F5>).
   The Home window (on page 116) opens.
4. Click the **File Upload** link.
   The **Authentication Required** (Login) dialog box opens.
5. Enter **admin** in both the **User Name** and **Password** text boxes and click **OK**.
   The **Login** dialog box closes and the **File Upload** window opens.

   > **Note**: If the **User Name** or **Password** were changed, enter the applicable information.
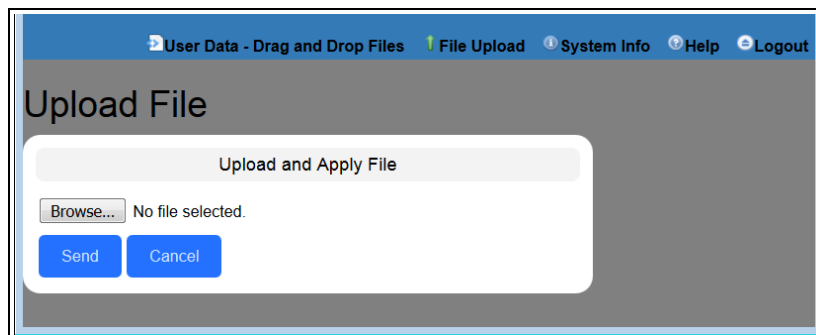
Figure 124: File Upload window

File Upload window	
Control Title	**Control Description**
Browse button	Click to open the Microsoft® **File Upload** dialog box. **Note**: The **Browse** button title is dependent on the chosen browser.
Send button	Click to start the upgrade process on the ZumLink.
Cancel button	Click to cancel the file transfer if the transfer is already started or refresh the window and clear the selected file.

13.2. Help window

The **Help** window is used to read information about the settings of the Z9-P / Z9-PE.

Access and Window Description

1. Open a web browser.
2. In the URL address bar, enter the IP address of the attached Z9-P / Z9-PE.

   > **Note**: If this is the first time the radio is accessed, enter the default Z9-P / Z9-PE IP Address of **192.168.111.100**.
   > If the IP Address was changed, enter that IP Address.

3. Refresh the browser window (press <F5>).
   The Home window (on page 116) opens.
4. Click the **Help** link.
   The **Authentication Required** (Login) dialog box opens.
5. Enter **admin** in both the **User Name** and **Password** text boxes and click **OK**.
   The **Login** dialog box closes and the **Help** window opens.

   > **Note**: If the **User Name** or **Password** were changed, enter the applicable information.
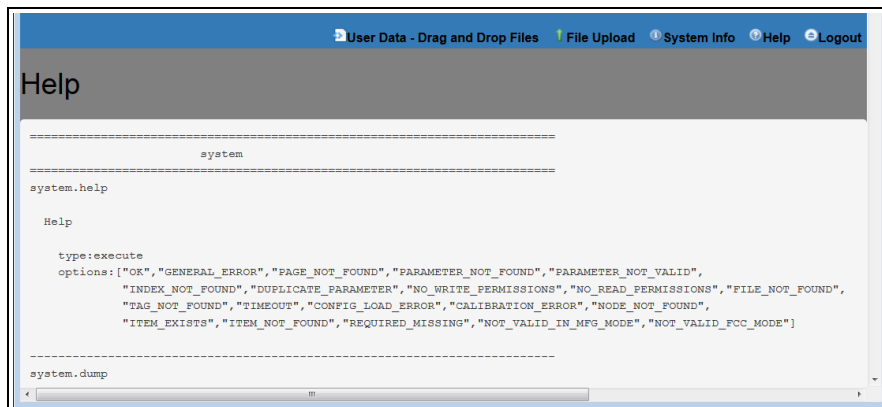
Figure 125: Help window

> **Note**: The information in this window is read-only.

13.3. Home window

The **Home** window is the default window when Z9-P / Z9-PE is opened in a web browser.

It is used to:

- View basic System information of the connected Z9-P / Z9-PE.
- Provide links to other windows of the Z9-P / Z9-PE.

Access and Window Description

1. Open a web browser.
2. In the URL address bar, enter the IP address of the attached Z9-P / Z9-PE.

   > **Note**: If this is the first time the radio is accessed, enter the default Z9-P / Z9-PE IP Address of 192.168.111.100.
   > If the IP Address was changed, enter that IP Address.

3. Refresh the browser window (press <F5>).
   The Z9-P / Z9-PE **Home** window opens.

   > **Note**: See the for detailed information about the settings.

Figure 126: Home window

> **Note**: The information in this window is read-only.

13.4. System Info window

The **System Info** window allows the user to explore settings organized by page of the connected Z9-P / Z9-PE.

Access and Window Description

1. Open a web browser.

2. In the URL address bar, enter the IP address of the attached Z9-P / Z9-PE.

   > **Note**: If this is the first time the radio is accessed, enter the default Z9-P / Z9-PE IP Address of **192.168.111.100**.
   > If the IP Address was changed, enter that IP Address.

3. Refresh the browser window (press <F5>).
   The Home window (on page 116) opens.

4. Click the **System Info** link.
   The **Authentication Required** (Login) dialog box opens.

5. Enter **admin** in both the **User Name** and **Password** text boxes and click **OK**.
   The **Login** dialog box closes and the **System Info** window opens.
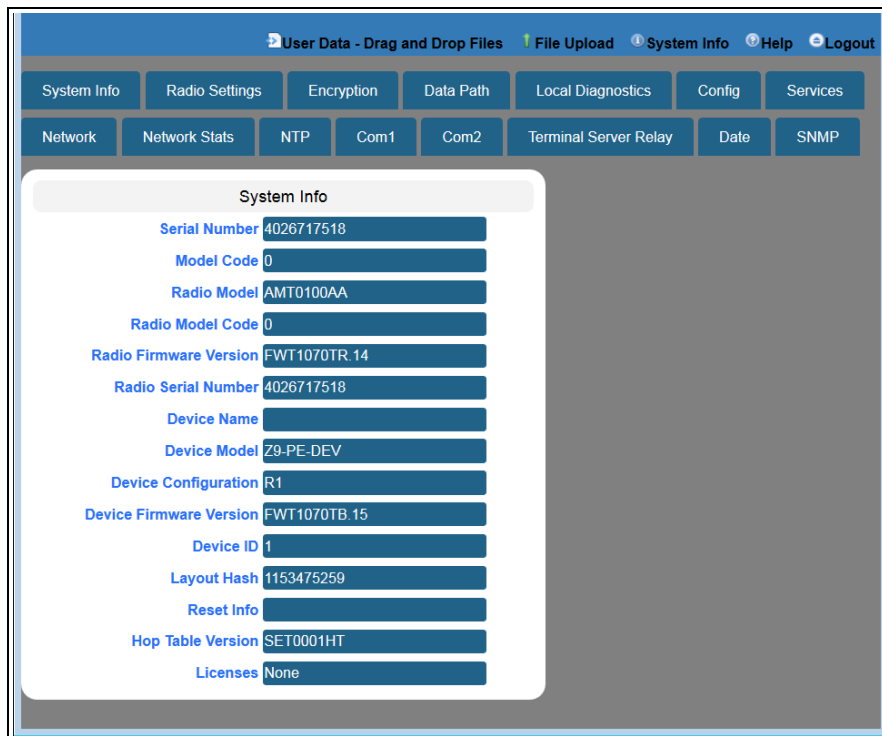
Figure 127: System Info window

> **Note**: The information in this window is read-only.

13.5. User Data - Drag and Drop window

The **User Data - Drag and Drop** window lists the default files of the Z9-P / Z9-PE.
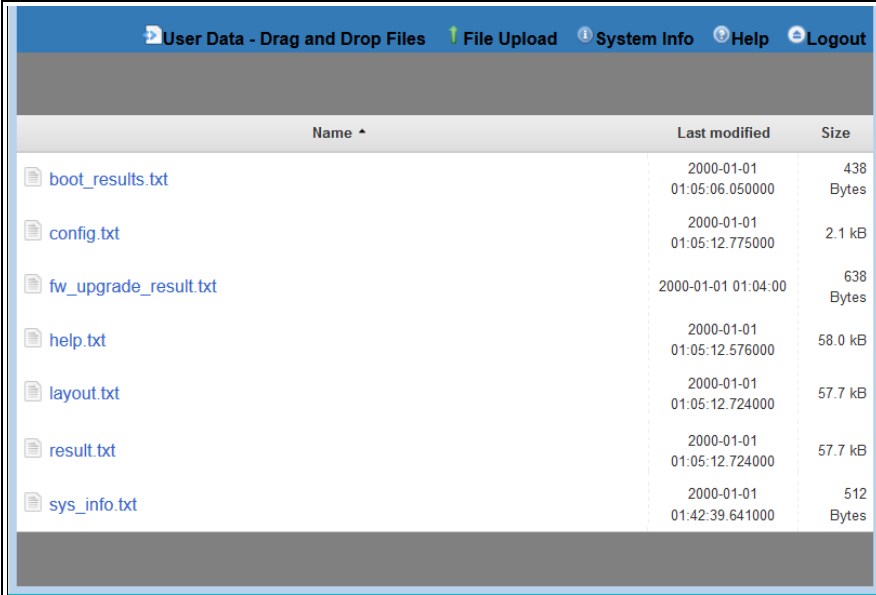
Access and Window Description

1. Open a web browser.
2. In the URL address bar, enter the IP address of the attached Z9-P / Z9-PE.

> **Note**: If this is the first time the radio is accessed, enter the default Z9-P / Z9-PE IP Address of 192.168.111.100.
> If the IP Address was changed, enter that IP Address.

3. Refresh the browser window (press <F5>).
   The Home window (on page 116) opens.
4. Click the **User Data - Drag and Drop** link.
   The **Authentication Required** (Login) dialog box opens.
5. Enter admin in both the **User Name** and **Password** text boxes and click **OK**.
   The **Login** dialog box closes and the **User Data - Drag and Drop** window opens.

> **Note**: If the **User Name** or **Password** were changed, enter the applicable information.

Name ▲	Last modified	Size
boot_results.txt	2000-01-01 01:05:06.050000	438 Bytes
config.txt	2000-01-01 01:05:12.775000	2.1 kB
fw_upgrade_result.txt	2000-01-01 01:04:00	638 Bytes
help.txt	2000-01-01 01:05:12.576000	58.0 kB
layout.txt	2000-01-01 01:05:12.724000	57.7 kB
result.txt	2000-01-01 01:05:12.724000	57.7 kB
sys_info.txt	2000-01-01 01:42:39.641000	512 Bytes

User Data - Drag and Drop Files   File Upload   System Info   Help   Logout

Figure 128: User Data - Drag and Drop window

> **Note**: See the Z9-P / Z9-PE Files and Descriptions (on page 264) for detailed information about these files.

14. COM Pages

Note: If the "=" sign is appended to the parameter, it is an implied change to that parameter.
If a value is NOT included after the "=", the value becomes a null, space, or 0 (zero) **depending on the parameter**.

Example: Entering **frequencyKey** returns the current value of **frequencyKey**.
Entering **frequencyKey=** is an implied change to **frequencyKey**.
If a value is NOT included, it changes **frequencyKey** to 0 (zero).

14.1. baudrate

baudrate	
Setting	**Description**
CLI / Web Page	[Page=Com1] [Page=Com2]
CLI Command	• `Com1.baudrate=nnnn` • `Com2.baudrate=nnnn` **Note**: Where nnnn is the baudrate value.
Web Interface Control	Baudrate
Default Setting	115200
Options	**Options**
		Options			---	---		1200	38400		2400	57600		4800	115200		9600	230400		14400	250000		19200		
Description	The **Com1.baudrate** or **Com2.baudrate** setting designates the COM port baud rate for COM1 or COM2.

14.2. breakBeforeSendUs

breakBeforeSendUs	
Setting	**Description**
CLI / Web Page	[Page=Com1] [Page=Com2]
CLI Command	• `Com1.breakBeforeSendUs=nnnn` • `Com2.breakBeforeSendUs=nnnn` **Note**: Where nnnn is the break signal value.
Web Interface Control	Break Before Send Us
Default Setting	0 (zero)

breakBeforeSendUs	
Setting	**Description**
Options	• The maximum value is 0 (zero). • The minimum value is 1000.
Description	The **Com1.breakBeforeSendUs** or **Com2.breakBeforeSendUs** setting designates how long the COM port will send a break signal for at least the number of microseconds specified before sending the data. **Example**: For COM1, enter `Com1.breakBeforeSendUs=500` to have the COM1 port send a break signal for 500 microseconds.

14.3. ConectionDrops

ConectionDrops	
Setting	**Description**
CLI / Web Page	[Page=Com1] [Page=Com2]
CLI Command	• `Com1.ConectionDrops` • `Com2.ConectionDrops`
Web Interface Control	Connection Drops
Default Setting	N/A
Options	N/A
Description	The **Com1.ConectionDrops** or **Com2.ConectionDrops** command reports the number of terminal server connections dropped due to inactivity on the network socket. **Note**: This is a Read-only parameter.

14.4. databits

databits	
Setting	**Description**
CLI / Web Page	[Page=Com1] [Page=Com2]

databits	
Setting	**Description**

CLI Command	• `Com1.databits=7`
	  • `Com2.databits=7`
	• `Com1.databits=8`
	  • `Com2.databits=8`

Web Interface Control	Databits
Default Setting	8
Options	7 or 8
Description	The **Com1.databits** or **Com2.databits** setting designates the number of data bits in the frame for COM1 or COM2.

14.5. delayBeforeSendMs

delayBeforeSendMs	
Setting	**Description**
CLI / Web Page	[Page=Com1] [Page=Com2]
CLI Command	• `Com1.delayBeforeSendMs=nnnn` • `Com2.delayBeforeSendMs=nnnn` **Note**: Where nnnn is the time delay in milliseconds.
Web Interface Control	Delay Before Send MS
Default Setting	0 (zero)
Options	• The maximum value is 0 (zero). • The minimum value is 5000.
Description	The **Com1.delayBeforeSendMs** or **Com2.delayBeforeSendMs** setting designates the amount of time delay in milliseconds the ZumLink waits to allow the device connected to the COM port to switch from transmit (Tx) to receive (Rx) mode. **Example**: For COM1, enter `Com1.delayBeforeSendMs=100` for a 100 millisecond delay. Increase this delay if the ZumLink is responding **before** a polling system is ready for a response.

14.6. duplex

duplex	
Setting	**Description**
CLI / Web Page	[Page=Com1] [Page=Com2]

CLI Command	• `Com1.duplex=Half`
	   • `Com2.duplex=Half`
	• `Com1.duplex=Full`
	   • `Com2.duplex=Full`

Web Interface Control	
Web Interface Control	Duplex
Default Setting	Full
Options	Half or Full
Description	**Important!**: This setting **ONLY** applies to the RS485 mode. The **Com1.duplex** or **Com2.duplex** setting designates whether the COM port is Full or Half duplex. The command is: **Note**: See Ports and Pinouts (on page 100) for input and output information. **Note**: The default value is Full.

14.7. flowControl

flowControl	
Setting	**Description**
CLI / Web Page	[Page=Com1] [Page=Com2]
CLI Command	**For Com2**, the command is: • **Off**: `Com2.flowControl=Off` • **On**: `Com2.flowControl=Hardware`

flowControl	
Setting	**Description**
Web Interface Control	Flow Control
Default Setting	Off
Options	• Off • Hardware
Description	**Important!**: The RTS and CTS signals are **ONLY** available for COM2. The RTS and CTS signals are **NOT supported for COM1**. The **Com2.flowControl** setting designates the hardware flow control as either on or off.

14.8. handler

handler	
Setting	**Description**
CLI / Web Page	[Page=Com1] [Page=Com2]

CLI Command	**CLI**
	The command is:
	
	• `Com1.handler=cli`
	   • `Com2.handler=cli`
	
	Terminal Server
	The command is:
	
	• `Com1.handler=TerminalServer`
	   • `Com2.handler=TerminalServer`
	
	Trace
	A configuration CLI with trace is on the COM port.
	
	• `Com1.handler=trace`
	   • `Com2.handler=trace`

Web Interface Control	Handler
Default Setting	TerminalServer

handler	
Setting	**Description**
Options	• CLI (on page 124) • Terminal Server (on page 124) • Trace (on page 124)
Description	The **Com1.handler** or **Com2.handler** setting designates the protocol of the COM port as CLI, Terminal Server, or Trace. **Notes** • The COM port will act as a terminal server. • The TCP port number is determined by the COM **TerminalServerPort** setting. • The default port number for COM1 is 5041. • The default port number for COM2 is 5042. **Important!**: If using **Terminal Server Relay**, the TCP port numbers **MUST BE** be consistent across all involved radios. **FREEWAVE Recommends**: If using the **Terminal Server Relay** setting, keep the TCP port numbers as their defaults.

14.9. mode

mode	
Setting	**Description**
CLI / Web Page	[Page=Com1] [Page=Com2]

CLI Command	• `Com1.mode=RS232`
	  • `Com2.mode=RS232`
	• `Com1.mode=RS485`
	  • `Com2.mode=RS485`

Web Interface Control	Mode
Default Setting	RS232
Options	• RS232 • RS485

mode	
Setting	**Description**
Description	The **Com1.mode** or **Com2.mode** setting designates the COM port mode as either RS232 or RS485. **Note**: When `Com1.mode=RS485` or `Com2.mode=RS485` AND `Com1.duplex=Full` or `Com2.duplex=Full`, the COM supports RS422.

14.10. parity

parity	
Setting	**Description**
CLI / Web Page	[Page=Com1] [Page=Com2]
CLI Command	• `Com1.parity=None` • `Com2.parity=None` • `Com1.parity=Even` • `Com2.parity=Even` • `Com1.parity=Odd` • `Com2.parity=Odd`
Web Interface Control	Parity
Default Setting	None
Options	• None • Even • Odd
Description	The **Com1.parity** or **Com2.parity** setting designates the COM port parity bits for the system.

14.11. RxBytes

RxBytes	
Setting	**Description**
CLI / Web Page	[Page=Com1] [Page=Com2]
CLI Command	• `Com1.RxBytes` • `Com2.RxBytes`

RxBytes	
Setting	**Description**
Web Interface Control	RX Bytes
Default Setting	N/A
Options	N/A
Description	The **Com1.RxBytes** or **Com2.RxBytes** command reports the total bytes received from the COM port.
	Note: This is a Read-only parameter.

14.12. stopbits

stopbits	
Setting	**Description**
CLI / Web Page	[Page=Com1] [Page=Com2]

CLI Command	• `Com1.stopbits=1`
	  • `Com2.stopbits=1`
	 • `Com1.stopbits=2`
	  • `Com2.stopbits=2`

Web Interface Control	Stopbits
Default Setting	1
Options	• 1 • 2
Description	The **Com1.stopbits** or **Com2.stopbits** setting designates the COM port number of stop bits.

14.13. TerminalServerPort

Note: See Examples - Terminal Server Relay (on page 221) for additional information.

TerminalServerPort	
Setting	**Description**
CLI / Web Page	[Page=Com1] [Page=Com2]

TerminalServerPort	
Setting	**Description**
CLI Command	• `Com1.TerminalServerPort=nnn` • `Com2.TerminalServerPort=nnn`
Web Interface Control	Terminal Server Port
Default Setting	• The default port number for COM1 is 5041. • The default port number for COM2 is 5042.
Options	• The minimum value is0 (zero). • The maximum value is 65535.
Description	The **Com1.TerminalServerPort** or **Com2.TerminalServerPort** setting designates the TCP port number. **FREEWAVE Recommends**: If using the **Terminal Server Relay** setting, keep the TCP port numbers as their defaults.

14.14. TerminalServerTimeOut

Note: See Examples - Terminal Server Relay (on page 221) for additional information.

TerminalServerTimeOut	
Setting	**Description**
CLI / Web Page	[Page=Com1] [Page=Com2]
CLI Command	• `Com1.TerminalServerTimeOut=nnn` • `Com2.TerminalServerTimeOut=nnn`
Web Interface Control	Terminal Server Time Out
Default Setting	300
Options	• The minimum value is 0 (zero). • The maximum value is 3600.
Description	The **Com1.TerminalServerTimeOut** or **Com2.TerminalServerTimeOut** setting designates the amount of time, in seconds, the Terminal Server remains open without data being received from the network. **Note**: This can prevent an idle socket from remaining open indefinitely, preventing new connections.

14.15. TxBytes

TxBytes	
Setting	**Description**
CLI / Web Page	[Page=Com1] [Page=Com2]
CLI Command	• Com1.TxBytes • Com2.TxBytes
Web Interface Control	TX Bytes
Default Setting	N/A
Options	N/A
Description	The **Com1.TxBytes** or **Com2.TxBytes** command reports the total bytes sent out of the COM port. **Note**: This is a Read-only parameter.

15. Config Pages

Note: If the "=" sign is appended to the parameter, it is an implied change to that parameter.
If a value is NOT included after the "=", the value becomes a null, space, or 0 (zero) **depending on the parameter**.

Example: Entering **frequencyKey** returns the current value of **frequencyKey**.
Entering **frequencyKey=** is an implied change to **frequencyKey**.
If a value is NOT included, it changes **frequencyKey** to 0 (zero).

15.1. addTraceMask

> **Important!**: FreeWave internal use only.

15.2. factoryDefaults

factoryDefaults	
Setting	**Description**
CLI / Web Page	[Page=config]
CLI Command	`config.factoryDefaults=set`
Web Interface Control	Factory Defaults
Default Setting	N/A
Options	Set
Description	The **config.factoryDefaults** command restores the ZumLink to its factory default configuration.

15.3. getCurrentConfig

> **Important!**: FreeWave internal use only.

15.4. handleDragDrop

> **Important!**: FreeWave internal use only.

15.5. licenseState

licenseState	
Setting	**Description**
CLI / Web Page	[Page=config]
CLI Command	`config.licenseState`
Web Interface Control	License State
Default Setting	N/A
Options	N/A

licenseState	
Setting	**Description**
Description	The **config.licenseState** command reports the extra feature licenses in the Z9-P / Z9-PE. **Note**: This is a Read-only parameter.

15.6. loadConfig

Important!: FreeWave internal use only.

15.7. removeTraceMask

Important!: FreeWave internal use only.

15.8. reset

reset	
Setting	**Description**
CLI / Web Page	[Page=config]

CLI Command	• **Reboot** the entire ZumLink device:
	  • `config.reset=now`
	  • `config.reset=reboot`
	• **Reset** to restart the main application:
	  • `config.reset=reset`

Web Interface Control	Reset
Default Setting	N/A
Options	N/A
Description	The **config.reset** command restarts or reboots the Z9-P / Z9-PE.

15.9. restore

restore	
Setting	**Description**
CLI / Web Page	[Page=config]

restore	
Setting	**Description**
CLI Command	• `config.restore=now` • `config.restore` • `restore`
Web Interface Control	Restore
Default Setting	N/A
Options	N/A
Description	The **config.restore** command reloads a previously saved setting configuration of the ZumLink. **Note**: Restore happens automatically when the ZumLink starts.

15.10. save

save	
Setting	**Description**
CLI / Web Page	[Page=config]
CLI Command	• `config.save=now` • `config.save` • `save`
Web Interface Control	Save
Default Setting	N/A
Options	N/A
Description	The **config.save** command saves changes made to the ZumLink configuration.

16. dataPath Pages

Note: If the "=" sign is appended to the parameter, it is an implied change to that parameter.
If a value is NOT included after the "=", the value becomes a null, space, or 0 (zero) **depending on the parameter**.

Example: Entering frequencyKey returns the current value of **frequencyKey**.
Entering **frequencyKey=** is an implied change to **frequencyKey**.
If a value is NOT included, it changes **frequencyKey** to 0 (zero).

16.1. aggregateEnabled

aggregateEnabled	
Setting	**Description**
CLI / Web Page	[Page=dataPath]

CLI Command	• **Enable**:
	   • `dataPath.aggregateEnabled=true`
	• **Disable**:
	   • `dataPath.aggregateEnabled=false`

Web Interface Control	Aggregate Enabled
Default Setting	False
Options	• True • False
Description	The **dataPath.aggregateEnabled** setting enables the aggregation of smaller packets to enhance throughput. **Notes** • When enabled, this setting adds 20 msec of latency, however net throughput may increase due to sending fewer, larger packets. • If another packet is not received within 20 msec, the aggregated packet is transmitted. • This setting does NOT need to match on all radios. • Packets below 900 bytes are aggregated up to an aggregated packet size of 970 bytes. • All radios have the ability to de-aggregate received packets, regardless of the aggregation setting. **FREEWAVE Recommends**: Enable this setting on individual radios that send a high percentage of network data packets that are smaller than 900 bytes.

16.2. compressionEnabled

compressionEnabled	
Setting	**Description**
CLI / Web Page	[Page=dataPath]

compressionEnabled	
Setting	**Description**

CLI Command	• **Enable**:
	  • `dataPath.compressionEnabled=true`
	• **Disable**:
	  • `dataPath.compressionEnabled=false`

Web Interface Control	Compression Enabled
Default Setting	False
Options	• True • False
Description	When the **dataPath.compressionEnabled** setting is enabled, the outgoing packets are analyzed and, if the data packet can be compressed, sent compressed. **Note**: The compression ratio varies depending on the type of data being transmitted. **Example**: Text data is easily compressible, while video data is not. **Notes** • When enabled, this setting adds a maximum of 10 msec of latency, however net throughput may increase due to sending more data in each packet. • This setting does NOT need to match on all radios. • All radios have the ability to de-compress received packets, regardless of their compression setting. **FREEWAVE Recommends**: Enable this setting on individual radios that send compressible data.

16.3. fecRate

fecRate	
Setting	**Description**
CLI / Web Page	[Page=dataPath]

CLI Command	• **Enable**:
	  • `dataPath.fecRate=RATE_7_8`
	• **Disable**:
	  • `dataPath.fecRate=RATE_1_1`

fecRate	
Setting	**Description**
Web Interface Control	FEC Rate
Default Setting	RATE_1_1
Options	• RATE_1_1 • RATE_7_8
Description	The **dataPath.fecRate** setting enables the FEC (Forward Error Correction) rate. **Note**: FEC increases the reliability of the data transferred over the air at the cost of some transmission throughput. **Notes** • The FEC setting MUST match on ALL radios in the network, to maintain over-the-air compatibility. • When enabled, this setting indicates that for every 7 bytes in, the radio sends 8 bytes out, with the 8th byte used for parity / error correction. • Enables FEC with a packet overhead of about 13%. • Improves sensitivity and link range in noisy environments. • Adds resilience in noisy environments. • FEC reduces the maximum achievable throughput. • However, in noisy environments, net throughput may increase due to reduced errors and retries. ⚠️ **Caution**: When enabling FEC, start with the farthest Endpoints, then any Repeaters, then lastly the Gateway. As FEC is enabled on each radio, that radio is temporarily dropped off the network, until any downstream Repeaters and the Gateway also have FEC enabled, at which time all communication will resume. **FREEWAVE Recommends**: When viewing local diagnostics, if the RadioBadCRC (on page 157) count is more than 15-20% of the total transmitted packets (the RadioLLTx (on page 159) count), enabling the FEC setting is beneficial.

16.4. MacTableEntryAgeTimeout

MacTableEntryAgeTimeout	
Setting	**Description**
CLI / Web Page	[Page=dataPath]

MacTableEntryAgeTimeout	
Setting	**Description**
CLI Command	`MacTableEntryAgeTimeout_BETA_FEATURE=nnnnn` **Note**: Where nnnnn is the number of seconds.
Web Interface Control	MAC Table Entry Age Timeout Beta Feature
Default Setting	120
Options	• The minimum value is 30. • The maximum value is 86400.
Description	The **dataPath.MacTableEntryAgeTimeout** setting designates the number of seconds before an inactive entry in the MAC Table ages out and becomes expired. • The radio network learns the MAC address of devices connected to particular radio endpoints and stores them in a MAC table. • As traffic passes between the endpoints, the entries in the MAC table are updated. • If packets have NOT been sent or received to a MAC address within the designated **dataPath.MacTableEntryAgeTimeout** period, the entry in the table is marked as expired. • Expired entries must be relearned and will generate some extra traffic on the network until the radio endpoint associated with the MAC address is learned. • This timeout does impact the time it takes to learn the new path. • This value can be optimized in the case of parallel Repeaters to allow for fail over. • Setting this value too small such that normal traffic does not keep the MAC table entry from expiring may generate excess network traffic. **FREEWAVE Recommends**: Set this timeout longer than the polling rate on the network. Entries do not use the new timeout value until they are updated when a packet transfer. **Note**: See MacTableShow (on page 155) to view the MAC to **nodeId** mapping table.

16.5. otaMaxFragmentSize

otaMaxFragmentSize	
Setting	**Description**
CLI / Web Page	[Page=dataPath]
CLI Command	`dataPath.otaMaxFragmentSize=nnnn` **Note**: Where nnnn is the maximum fragment size.
Web Interface Control	OTA Max Fragment Size
Default Setting	1000
Options	• The minimum value is 64. • The maximum value is 1000.
Description	The **dataPath.otaMaxFragmentSize** setting designates the maximum fragment size, in bytes, sent over the air. Packets larger than the **maxPacketSize** are fragmented into smaller packets whose size is determined by the **otaMaxFragementSize**. **Notes** This setting does NOT need to match on all radios. Tip: A smaller number may give better performance in a high interference environment. A larger number can increase throughput.

16.6. routeMinSignalMarginThresh

routeMinSignalMarginThresh	
Setting	**Description**
CLI / Web Page	[Page=dataPath]
CLI Command	`dataPath.routeMinSignalMarginThresh=nnnn` **Note**: Where nnnn is the minimum signal margin.
Web Interface Control	Route Min Signal Margin Thresh
Default Setting	• 10
Options	• The minimum value is -5. • The maximum value is 60.

routeMinSignalMarginThresh	
Setting	**Description**
Description	The **dataPath.routeMinSignalMarginThresh** setting designates the minimum (threshold) signal margin, in dB, the next hop **must be** considered part of the packet route. **Notes** - When Repeaters are enabled, the packets take the path through the radio network with the minimum number of hops. - By increasing the threshold value, the possible routes can be reduced to allow a particular routing path to be preferred. **FREEWAVE Recommends**: This value should be at least 4 dB lower than the reported link margin to the next hop. **Example**: If the best-reported link margin for the next hop is 20 dB, this number should be set to 16 or less. This prevents the traffic from choosing an alternative route with lower margin.

17. Date Pages

Note: If the "=" sign is appended to the parameter, it is an implied change to that parameter.
If a value is NOT included after the "=", the value becomes a null, space, or 0 (zero) **depending on the parameter**.

Example: Entering frequencyKey returns the current value of **frequencyKey**.
Entering frequencyKey= is an implied change to **frequencyKey**.
If a value is NOT included, it changes **frequencyKey** to 0 (zero).

17.1. dcAppStartTime

Important!: Time zones **do not** apply on the ZumLink.

dcAppStartTime	
Setting	**Description**
CLI / Web Page	[Page=date]
CLI Command	• `date.dcAppStartTime` • `dcAppStartTime`
Web Interface Control	DC App Start Time
Default Setting	N/A
Options	N/A
Description	The **date.dcAppStartTime** command reports the time stamp of when the main app started. **Note**: This is a Read-only parameter.

17.2. dcAppUptime

Important!: Time zones **do not** apply on the ZumLink.

dcAppUptime	
Setting	**Description**
CLI / Web Page	[Page=date]
CLI Command	• `date.dcAppUptime` • `dcAppUptime`
Web Interface Control	DC App Uptime
Default Setting	N/A
Options	N/A
Description	The **date.dcAppUptime** command reports the number of seconds since the main app started. **Note**: This is a Read-only parameter.

17.3. time

Important!: Time zones **do not** apply on the ZumLink.

time	
Setting	**Description**
CLI / Web Page	[Page=date]
CLI Command	• date.time • time
Web Interface Control	Time
Default Setting	N/A
Options	N/A
Description	The **date.time** command reports the current time in Unix time stamp format. **Note**: This is a Read-only parameter.

17.4. timeString

Important!: Time zones **do not** apply on the ZumLink.

timeString	
Setting	**Description**
CLI / Web Page	[Page=date]
CLI Command	date.timeString=MM/DD/YYYY HH.MM.SS
Web Interface Control	Time String
Default Setting	N/A
Options	N/A
Description	The **date.timeString** setting changes the time ONLY if the ntpReference (on page 176) is set to **REFCLK_LOCALCLOCK**. Important!: If the ZumLink loses power, the time must be manually reset.

17.5. upTime

> **Important!**: Time zones **do not** apply on the ZumLink.

upTime	
Setting	**Description**
CLI / Web Page	[Page=date]
CLI Command	• date.upTime • upTime
Web Interface Control	Up Time
Default Setting	N/A
Options	N/A
Description	The **date.upTime** command reports the number of seconds since the ZumLink restarted. > **Note**: This is a Read-only parameter.

17.6. upTimeString

> **Important!**: Time zones **do not** apply on the ZumLink.

upTimeString	
Setting	**Description**
CLI / Web Page	[Page=date]
CLI Command	• date.upTimeString • upTimeString > **Example**: A return of **Uptime 5 Days 01:36:41** means the unit has been up for 5 days, 1 hour, 36 minutes, and 41 seconds.
Web Interface Control	Up Time String
Default Setting	N/A
Options	N/A

upTimeString	
Setting	**Description**
Description	The **date.upTimeString** command reports the amount of time in Days, Hours, Minutes, and Seconds the ZumLink device has been powered on without a reboot. **Note**: This is a Read-only parameter.

18. Encryption Pages

Note: If the "=" sign is appended to the parameter, it is an implied change to that parameter.
If a value is NOT included after the "=", the value becomes a null, space, or 0 (zero) **depending on the parameter**.

Example: Entering **frequencyKey** returns the current value of **frequencyKey**.
Entering **frequencyKey=** is an implied change to **frequencyKey**.
If a value is NOT included, it changes **frequencyKey** to 0 (zero).

18.1. activeKey

> ⚠ **Caution**: Encryption settings **MUST match** on ALL radios in the network to maintain over-the-air compatibility.
> When enabling Encryption, start with the farthest Endpoints, then any Repeaters, then lastly the Gateway.
> As Encryption is enabled on each radio, that radio temporarily drops off the network, until any downstream Repeaters and the Gateway also have Encryption enabled, at which time all communication will resume.

activeKey	
Setting	**Description**
CLI / Web Page	[Page=encryption]
CLI Command	• `encryption.activeKey=Off` • `encryption.activeKey=Key1 to Key16` **Example**: `encryption.activeKey=Key10`.
Web Interface Control	Active Key
Default Setting	Off
Options	• Off • Key1 to Key16
Description	The **encryption.activeKey** setting designates the active key. **Important!**: Assigning the **activeKey** to a key that is NOT set will **NOT** allow communication across the link. Keys **MUST BE** set before they can become active keys.

18.2. encryptionMode

> ⚠ **Caution**: Encryption settings **MUST match** on ALL radios in the network to maintain over-the-air compatibility.
> When enabling Encryption, start with the farthest Endpoints, then any Repeaters, then lastly the Gateway.
> As Encryption is enabled on each radio, that radio temporarily drops off the network, until any downstream Repeaters and the Gateway also have Encryption enabled, at which time all communication will resume.

encryptionMode	
Setting	**Description**
CLI / Web Page	[Page=encryption]

CLI Command	• **AES Counter Mode**:
	    • `encryption.encryptionMode=AES_CTR`
	• **AES Counter Mode with MIC** (Message Integrity Check):
	    • `encryption.encryptionMode=AES_CCM`

Web Interface Control	Encryption Mode
Default Setting	AES_CTR
Options	• AES_CCM • AES_CTR
Description	The **encryption.encryptionMode** setting designates the encryption mode. **Important!**: Use of encryption may affect latency and user throughput.

18.3. getKey

> ⚠️ **Caution**: Encryption settings **MUST match** on ALL radios in the network to maintain over-the-air compatibility.
> When enabling Encryption, start with the farthest Endpoints, then any Repeaters, then lastly the Gateway.
> As Encryption is enabled on each radio, that radio temporarily drops off the network, until any downstream Repeaters and the Gateway also have Encryption enabled, at which time all communication will resume.

getKey	
Setting	**Description**
CLI / Web Page	[Page=encryption]
CLI Command	`encryption.getKey=Key1 to Key16` **Example**: **encryption.getKey=key8**.
Web Interface Control	Get Key
Default Setting	Off
Options	• Off • Key1 to Key16

getKey	
Setting	**Description**
Description	The **encryption.getKey** command reports this information about the key: • Whether the key is 128- or 256-bit key. • If the key is empty. **Note**: This is a Read-only parameter.

18.4. remoteRestore

Important!: FreeWave internal use only.

18.5. remoteSave

Important!: FreeWave internal use only.

18.6. setKey

⚠ **Caution**: Encryption settings **MUST match** on ALL radios in the network to maintain over-the-air compatibility.
When enabling Encryption, start with the farthest Endpoints, then any Repeaters, then lastly the Gateway.
As Encryption is enabled on each radio, that radio temporarily drops off the network, until any downstream Repeaters and the Gateway also have Encryption enabled, at which time all communication will resume.

setKey	
Setting	**Description**
CLI / Web Page	[Page=encryption]
CLI Command	The format of this setting is: setKey [key] [128 or 256 key in hex] **Example**: 128 bit key: encryption.setKey=key1 1234567890abcdef1234567890abcdef **Example**: 256 bit key: encryption.setKey=key2 1234567890abcdef1234567890abcdef1234567890abcdef1234567890abcdef

setKey	
Setting	**Description**
Web Interface Control	
Web Interface Control	Set Key
Default Setting	N/A
Options	N/A
Description	The **encryption.setKey** setting loads the key. Tip: Enter `encryption.setKey=` WITHOUT an actual key to erase or clear the key.

19. localDiagnostics Pages

19.1. signalLevel

> **Important!**: The **localDiagnostics** are read-only and are dependent upon the connected ZumLink device.

signalLevel	
Setting	**Description**
CLI / Web Page	[Page=localDiagnostics]
CLI Command	• `localDiagnostics.signalLevel` • `signalLevel`
Web Interface Control	Signal Level
Default Setting	-128.00
Options	N/A
Description	The **localDiagnostics.signalLevel** command reports the Signal Level of the radio in dBm of the last received packet. **Note**: This setting shows -128.00 if no packet has been received since the stats were cleared. This is a Read-only parameter.

19.2. signalMargin

> **Important!**: The **localDiagnostics** are read-only and are dependent upon the connected ZumLink device.

signalMargin	
Setting	**Description**
CLI / Web Page	[Page=localDiagnostics]
CLI Command	• `localDiagnostics.signalMargin` • `signalMargin`
Web Interface Control	Signal Margin
Default Setting	N/A
Options	N/A

signalMargin	
Setting	**Description**
Description	The **localDiagnostics.signalMargin** command reports the amount of signal margin in dB the last received packet experienced. **Note**: The signal margin is the difference between the signal level and either the receive sensitivity or the noise level, whichever is higher, for the configured RF data rate.

19.3. cntBadBCC

Important!: FreeWave internal use only.

19.4. cntBadSync

Important!: FreeWave internal use only.

19.5. cntETX

Important!: FreeWave internal use only.

19.6. cntSTX

Important!: FreeWave internal use only.

19.7. getStats

Important!: The **localDiagnostics** are read-only and are dependent upon the connected ZumLink device.

getStats	
Setting	**Description**
CLI / Web Page	[Page=localDiagnostics]
CLI Command	• `localDiagnostics.getStats` • `getStats`

getStats	
Setting	**Description**
Web Interface Control	Get Stats
Default Setting	N/A
Options	N/A
Description	The **localDiagnostics.getStats** command reports the localDiagnostics from the radio immediately. **Note**: A refresh of the **localDiagnostics** page is required to see the updates. This is a Read-only parameter.

19.8. interfaceBytesRx

Important!: FreeWave internal use only.

19.9. interfaceBytesTx

Important!: FreeWave internal use only.

19.10. interfaceDataRx

Important!: FreeWave internal use only.

19.11. interfaceDataTx

Important!: FreeWave internal use only.

19.12. MacTableClear

Important!: The **localDiagnostics** are read-only and are dependent upon the connected ZumLink device.

MacTableClear	
Setting	**Description**
CLI / Web Page	[Page=localDiagnostics]
CLI Command	• `localDiagnostics.MacTableClear` • `MacTableClear`
Web Interface Control	Mac Table Clear
Default Setting	N/A
Options	N/A
Description	The **localDiagnostics.MacTableClear** command clears the MAC to **nodeID** mapping table and forces routes to be relearned.

19.13. MacTableShow

Important!: The **localDiagnostics** are read-only and are dependent upon the connected ZumLink device.

MacTableShow	
Setting	**Description**
CLI / Web Page	[Page=localDiagnostics]
CLI Command	• `localDiagnostics.MacTableShow` • `MacTableShow`
Web Interface Control	Mac Table Show
Default Setting	N/A
Options	N/A
Description	The **localDiagnostics.MacTableShow** command reports the MAC addresses of the devices connected to the ZumLink device in a **nodeID** table format.

19.14. monitoredNode

Important!: The **localDiagnostics** are read-only and are dependent upon the connected ZumLink device.

monitoredNode	
Setting	**Description**
CLI / Web Page	[Page=localDiagnostics]
CLI Command	• `localDiagnostics.monitoredNode=<Node ID here>` • `monitoredNode=<Node ID here>`
Web Interface Control	Monitored Node
Default Setting	N/A
Options	N/A
Description	The **localDiagnostics.monitoredNode** setting designates the Node ID to be monitored and reported back by the **localDiagnostics.showNodeDiags** command. Tip: Use the **showNodeDiags** to view the received signal level (RSSI) of this node.

19.15. RadioAckTx

Important!: FreeWave internal use only.

19.16. RadioBadAckRx

Important!: The **localDiagnostics** are read-only and are dependent upon the connected ZumLink device.

RadioBadAckRx	
Setting	**Description**
CLI / Web Page	[Page=localDiagnostics]
CLI Command	• `localDiagnostics.RadioBadAckRx` • `RadioBadAckRx`
Web Interface Control	Radio Bad Ack RX
Default Setting	N/A
Options	N/A
Description	The **localDiagnostics.RadioBadAckRx** command reports the number of received ACKs missed in unicast transmissions.

19.17. RadioBadCRC

> **Important!**: The **localDiagnostics** are read-only and are dependent upon the connected ZumLink device.

RadioBadCRC	
Setting	**Description**
CLI / Web Page	[Page=localDiagnostics]
CLI Command	• `localDiagnostics.RadioBadCRC` • `RadioBadCRC`
Web Interface Control	Radio Bad CRC
Default Setting	N/A
Options	N/A
Description	The **localDiagnostics.RadioBadCRC** command reports the number of radio packets received with data corruption.

19.18. RadioBadSync

> **Important!**: The **localDiagnostics** are read-only and are dependent upon the connected ZumLink device.

RadioBadSync	
Setting	**Description**
CLI / Web Page	[Page=localDiagnostics]
CLI Command	• `localDiagnostics.RadioBadSync` • `RadioBadSync`
Web Interface Control	Radio Bad Sync
Default Setting	N/A
Options	N/A
Description	The **localDiagnostics.RadioBadSync** command reports the number of times beacons were lost and the Endpoint needed to re-synchronize with the Gateway when **radioHoppingMode=Hopping_On**.

19.19. RadioContentionDrop

Important!: The **localDiagnostics** are read-only and are dependent upon the connected ZumLink device.

RadioContentionDrop	
Setting	**Description**
CLI / Web Page	[Page=localDiagnostics]
CLI Command	• `localDiagnostics.RadioContentionDrop` • `RadioContentionDrop`
Web Interface Control	Radio Contention Drop
Default Setting	N/A
Options	N/A
Description	The **localDiagnostics.RadioContentionDrop** command reports the number of times a transmission was backed-off due to contention on the RF channel.

19.20. RadioLLRx

Important!: The **localDiagnostics** are read-only and are dependent upon the connected ZumLink device.

RadioLLRx	
Setting	**Description**
CLI / Web Page	[Page=localDiagnostics]
CLI Command	• `localDiagnostics.RadioLLRx` • `RadioLLRx`
Web Interface Control	Radio LL RX
Default Setting	N/A
Options	N/A
Description	The **localDiagnostics.RadioLLRx** command reports the number of packets received over the air without data corruption.

19.21. RadioLLTx

> **Important!**: The **localDiagnostics** are read-only and are dependent upon the connected ZumLink device.

RadioLLTx	
Setting	**Description**
CLI / Web Page	[Page=localDiagnostics]
CLI Command	• `localDiagnostics.RadioLLTx` • `RadioLLTx`
Web Interface Control	Radio LL TX
Default Setting	N/A
Options	N/A
Description	The **localDiagnostics.RadioLLTx** command reports the number of packets transmitted over the air.

19.22. RadioNoAckTx

> **Important!**: FreeWave internal use only.

19.23. RadioReliableRx

> **Important!**: FreeWave internal use only.

19.24. RadioReliableTx

> **Important!**: FreeWave internal use only.

19.25. RadioRexmit

> **Important!**: FreeWave internal use only.

19.26. RadioRx

> **Important!**: The **localDiagnostics** are read-only and are dependent upon the connected ZumLink device.

RadioRx	
Setting	**Description**
CLI / Web Page	[Page=localDiagnostics]
CLI Command	• `localDiagnostics.RadioRx` • `RadioRx`
Web Interface Control	Radio RX
Default Setting	N/A
Options	N/A
Description	The **localDiagnostics.RadioRx** command reports the number of data packets correctly received over the wireless RF link for this node.

19.27. RadioSendingDrop

> **Important!**: FreeWave internal use only.

19.28. RadioTimedOut

> **Important!**: FreeWave internal use only.

19.29. RadioTooLong

> **Important!**: FreeWave internal use only.

19.30. RadioTooShort

> **Important!**: FreeWave internal use only.

19.31. RadioTx

> **Important!**: The **localDiagnostics** are read-only and are dependent upon the connected ZumLink device.

RadioTx	
Setting	**Description**
CLI / Web Page	[Page=localDiagnostics]
CLI Command	• `localDiagnostics.RadioTx` • `RadioTx`
Web Interface Control	Radio TX
Default Setting	N/A
Options	N/A
Description	The **localDiagnostics.RadioTx** command reports the number of data packets scheduled to be transmitted.

19.32. resetsDetected

> **Important!**: FreeWave internal use only.

19.33. resetSent

> **Important!**: FreeWave internal use only.

19.34. resetStats

> **Important!**: The **localDiagnostics** are read-only and are dependent upon the connected ZumLink device.

resetStats	
Setting	**Description**
CLI / Web Page	[Page=localDiagnostics]
CLI Command	• `localDiagnostics.resetStats` • `resetStats`

resetStats	
Setting	**Description**
Web Interface Control	Reset Stats
Default Setting	N/A
Options	N/A
Description	The **localDiagnostics.resetStats** command resets the local diagnostics.

19.35. showChannelDiags

Important!: The **localDiagnostics** are read-only and are dependent upon the connected ZumLink device.

showChannelDiags	
Setting	**Description**
CLI / Web Page	[Page=localDiagnostics]
CLI Command	• localDiagnostics.showChannelDiags • showChannelDiags
Web Interface Control	Show Channel Diags
Default Setting	N/A
Options	N/A
Description	The **localDiagnostics.showChannelDiags** command reports the received signal level (RSSI) and node ID of the last packet received on the displayed frequencies.

19.36. showNodeDiags

Important!: The **localDiagnostics** are read-only and are dependent upon the connected ZumLink device.

showNodeDiags	
Setting	**Description**
CLI / Web Page	[Page=localDiagnostics]

showNodeDiags	
Setting	**Description**
CLI Command	• `localDiagnostics.showNodeDiags` • `showNodeDiags`
Web Interface Control	Show Node Diags
Default Setting	N/A
Options	N/A
Description	The **localDiagnostics.showNodeDiags** command reports the channel frequency and signal level for the node selected by the **localDiagnostics.monitoredNode** parameter.

19.37. timestamp

Important!: The **localDiagnostics** are read-only and are dependent upon the connected ZumLink device.

timestamp	
Setting	**Description**
CLI / Web Page	[Page=localDiagnostics]
CLI Command	• `localDiagnostics.timestamp` • `timestamp`
Web Interface Control	Timestamp
Default Setting	N/A
Options	N/A
Description	The **localDiagnostics.timestamp** command reports the time the Diagnostics Information was collected by the device.

20. network Pages

> **Note**: If the "=" sign is appended to the parameter, it is an implied change to that parameter.
> If a value is NOT included after the "=", the value becomes a null, space, or 0 (zero) **depending on the parameter**.

> **Example**: Entering **frequencyKey** returns the current value of **frequencyKey**.
> Entering **frequencyKey=** is an implied change to **frequencyKey**.
> If a value is NOT included, it changes **frequencyKey** to 0 (zero).

20.1. gateway

gateway	
Setting	**Description**
CLI / Web Page	[Page=network]
CLI Command	`network.gateway=nnn.nnn.nnn.nnn`
Web Interface Control	Gateway
Default Setting	192.168.111.1
Options	N/A
Description	The **network.gateway** setting designates the Gateway IP address for the network. **Important!**: The use of a Gateway here is **NOT** related to the **radioSettings.radioMode=Gateway** or **radioSettings.radioMode=Endpoint**.

20.2. ip_address

ip_address	
Setting	**Description**
CLI / Web Page	[Page=network]
CLI Command	`network.ip_address=nnn.nnn.nnn.nnn`
Web Interface Control	IP Address
Default Setting	192.168.111.100
Options	N/A
Description	The **network.ip_address** setting designates the IP address of the ZumLink device.

20.3. mac_address

mac_address	
Setting	**Description**
CLI / Web Page	[Page=network]
CLI Command	• `network.mac_address` • `mac_address`

mac_address	
Setting	**Description**
Web Interface Control	MAC Address
Default Setting	N/A
Options	N/A
Description	The **network.mac_address** command reports the MAC Address of the ZumLink device. **Important!**: This setting is read-only and is unique for each radio.

20.4. mtu

mtu	
Setting	**Description**
CLI / Web Page	[Page=network]
CLI Command	• `network.mtu=nnnn` • `mtu=nnnn` **Note**: Where nnnn is the maximum transmission unit.
Web Interface Control	MTU
Default Setting	1500
Options	• The minimum value is 100. • The maximum value is 65521.
Description	The **network.mtu** setting designates the maximum transmission unit (MTU). **Notes** • The MTU size only effects communications that originate or terminate on this device, such as the web services or the Terminal Servers. • All other traffic passing through the radio network is unaffected by this setting.

20.5. netmask

netmask	
Setting	**Description**
CLI / Web Page	[Page=network]

netmask	
Setting	**Description**
CLI Command	• `network.netmask=nnn.nnn.nnn.nnn` • `netmask=nnn.nnn.nnn.nnn`
Web Interface Control	Netmask
Default Setting	255.255.255.0
Options	N/A
Description	The **network.netmask** setting designates the Netmask of the ZumLink device.

20.6. netmaskFilterEnabled

netmaskFilterEnabled	
Setting	**Description**
CLI / Web Page	[Page=network]

CLI Command	• **Enable**:
	  • `network.netmaskFilterEnabled=true`
	• **Disable**:
	  • `network.netmaskFilterEnabled=false`

Web Interface Control	Netmask Filter Enabled
Default Setting	False
Options	• True • False
Description	The **network.netmaskFilterEnabled** setting enables the bridge firewall. **Notes** • Allows ONLY IPv4, TCP, UDP, ICMP (ping), and ARP communication that is in the **network.netmask** parameter subnet to enter into the radio network. • VLAN tagged packets are filtered out because the radio is not considered on the VLAN and therefore VLAN packets cannot be on the same subnet. Tip: Enable a bridge firewall to restrict network communication to the current IPv4 subnet. **Important!**: ZumLink acts as a layer 2 switch. ALL Ethernet traffic is passed when IP Netmask Filter is NOT enabled. Multicast packets are treated the same as Ethernet broadcast packets.

20.7. stpEnabled

stpEnabled	
Setting	**Description**
CLI / Web Page	[Page=network]

CLI Command	• **Enable**:
	  • `network.stpEnabled=true`
	• **Disable**:
	  • `network.stpEnabled=false`

Web Interface Control	STP Enabled
Default Setting	False
Options	• True • False
Description	The **network.stpEnabled** setting enables the Spanning Tree Protocol.

20.8. txqueuelen

txqueuelen	
Setting	**Description**
CLI / Web Page	[Page=network]
CLI Command	`network.txqueuelen=nnnn`
Web Interface Control	Txqueuelen
Default Setting	25
Options	• The minimum value is 1. • The maximum value is 1000.
Description	The **network.txqueuelen** setting designates how many Ethernet packets to hold in the transmit queue before sending them over the radio link. **Notes** • A large number can increase latency if the packets are arriving at the Ethernet interface at an average rate that is above the capacity of the radio link. • If the queue size is too small in an Ethernet network with a high rate of small packets, then packets could be lost. **Example**: `network.txqueuelen=750` allows 750 Ethernet packets to be held in the transmit queue.

21. networkStats Pages

Note: If the "=" sign is appended to the parameter, it is an implied change to that parameter.
If a value is NOT included after the "=", the value becomes a null, space, or 0 (zero) **depending on the parameter**.

Example: Entering **frequencyKey** returns the current value of **frequencyKey**.
Entering **frequencyKey=** is an implied change to **frequencyKey**.
If a value is NOT included, it changes **frequencyKey** to 0 (zero).

21.1. rx_bytes

rx_bytes	
Setting	**Description**
CLI / Web Page	[Page=networkStats]
CLI Command	• `networkStats.rx_bytes` • `rx_bytes`
Web Interface Control	RX Bytes
Default Setting	N/A
Options	N/A
Description	The **networkStats.rx_bytes** command reports the number of bytes received from the radio network. **Note**: This is a Read-only parameter.

21.2. rx_dropped

rx_dropped	
Setting	**Description**
CLI / Web Page	[Page=networkStats]
CLI Command	• `networkStats.rx_dropped` • `rx_dropped`
Web Interface Control	RX Dropped
Default Setting	N/A
Options	N/A
Description	The **networkStats.rx_dropped** command reports the number of Ethernet packets received from the radio network that were dropped at the Ethernet interface. **Note**: This is a Read-only parameter.

21.3. rx_errors

rx_errors	
Setting	**Description**
CLI / Web Page	[Page=networkStats]

rx_errors	
Setting	**Description**
CLI Command	• networkStats.rx_errors • rx_errors
Web Interface Control	RX Errors
Default Setting	N/A
Options	N/A
Description	The **networkStats.rx_errors** command reports the number of Ethernet packets received from the radio network that had Ethernet errors. **Note**: This is a Read-only parameter.

21.4. rx_packets

rx_packets	
Setting	**Description**
CLI / Web Page	[Page=networkStats]
CLI Command	• networkStats.rx_packets • rx_packets
Web Interface Control	RX Packets
Default Setting	N/A
Options	N/A
Description	The **networkStats.rx_packets** command reports the number of Ethernet packets received from the radio network. **Note**: This is a Read-only parameter.

21.5. tx_bytes

tx_bytes	
Setting	**Description**
CLI / Web Page	[Page=networkStats]
CLI Command	• networkStats.tx_bytes • tx_bytes

tx_bytes	
Setting	**Description**
Web Interface Control	TX Bytes
Default Setting	N/A
Options	N/A
Description	The **networkStats.tx_bytes** command reports the number of bytes of Ethernet packets received from the Ethernet port and sent over the radio network. **Note**: This is a Read-only parameter.

21.6. tx_dropped

tx_dropped	
Setting	**Description**
CLI / Web Page	[Page=networkStats]
CLI Command	• networkStats.tx_dropped • tx_dropped
Web Interface Control	TX Dropped
Default Setting	N/A
Options	N/A
Description	The **networkStats.tx_dropped** command reports the number of Ethernet packets received from the Ethernet port but dropped because the transmit queue is full. **Note**: An increase of this counter may indicate that increasing the **txqueuelen** parameter may improve overall network performance. **Note**: This is a Read-only parameter.

21.7. tx_errors

tx_errors	
Setting	**Description**
CLI / Web Page	[Page=networkStats]
CLI Command	• networkStats.tx_errors • tx_errors

tx_errors	
Setting	**Description**
Web Interface Control	
Default Setting	N/A
Options	N/A
Description	The **networkStats.tx_errors** command reports the number of Ethernet packets received from the Ethernet port that were in error. **Note**: This is a Read-only parameter.

21.8. tx_packets

tx_packets	
Setting	**Description**
CLI / Web Page	[Page=networkStats]
CLI Command	• `networkStats.tx_packets` • `tx_packets`
Web Interface Control	TX Packets
Default Setting	N/A
Options	N/A
Description	The **networkStats.tx_packets** command reports the number of Ethernet packets received from the Ethernet port and sent over the radio network. **Note**: This is a Read-only parameter.

22. NTP Pages

Note: If the "=" sign is appended to the parameter, it is an implied change to that parameter.
If a value is NOT included after the "=", the value becomes a null, space, or 0 (zero) **depending on the parameter**.

Example: Entering **frequencyKey** returns the current value of **frequencyKey**.
Entering **frequencyKey=** is an implied change to **frequencyKey**.
If a value is NOT included, it changes **frequencyKey** to 0 (zero).

22.1. ntp_address

ntp_address	
Setting	**Description**
CLI / Web Page	[Page=ntp]
CLI Command	• `ntp.ntp_address1=nnn.nnn.nnn.nnn` • `ntp.ntp_address2=nnn.nnn.nnn.nnn` • `ntp.ntp_address3=nnn.nnn.nnn.nnn` • `ntp.ntp_address4=nnn.nnn.nnn.nnn` • `ntp.ntp_address5=nnn.nnn.nnn.nnn`
Web Interface Control	NTP Address 1 NTP Address 2 NTP Address 3 NTP Address 4 NTP Address 5
Default Setting	0.0.0.0 for all NTP addresses
Options	N/A
Description	The **ntp.ntp_address1-5** setting designates the IP address of the servers used for synchronizing time. **Notes** • A maximum of five NTP servers are allowed. Tip: Use `0.0.0.0` to skip a specific server. **Example**: Enter `ntp.ntp_address2=0.0.0.0` to skip a second server, if it's available.

22.2. ntpDate

ntpDate	
Setting	**Description**
CLI / Web Page	[Page=ntp]
CLI Command	• `ntp.ntpDate` • `ntpDate`
Web Interface Control	NTP Date
Default Setting	N/A

ntpDate	
Setting	**Description**
Options	N/A
Description	The **ntp.ntpDate** setting synchronizes the local clock with the time from the NTP servers specified in the **ntp.ntp_address1 to 5** settings. **Note**: The server with the best clock, as defined by the NTP protocol, is used.

22.3. ntpReference

ntpReference	
Setting	**Description**
CLI / Web Page	[Page=ntp]

CLI Command	• `ntp.ntpReference=NETWORK_TIME_SERVER`
	   • The reference will come from other systems on the network.
	• `ntp.ntpReference=REFCLK_LOCALCLOCK`
	   • The reference will be generated by the local clock.

Web Interface Control	NTP Reference
Default Setting	REFCLK_LOCALCLOCK
Options	• NETWORK_TIME_SERVER • REFCLK_LOCALCLOCK
Description	The **ntp.ntpReference** setting designates the clock reference for NTP.

22.4. ntpRestart

ntpRestart	
Setting	**Description**
CLI / Web Page	[Page=ntp]
CLI Command	`ntp.ntpRestart`
Web Interface Control	NTP Restart
Default Setting	N/A
Options	N/A
Description	The **ntp.ntpRestart** setting restarts the NTP system.

23. radioSettings Pages

Note: If the "=" sign is appended to the parameter, it is an implied change to that parameter.
If a value is NOT included after the "=", the value becomes a null, space, or 0 (zero) **depending on the parameter**.

Example: Entering **frequencyKey** returns the current value of **frequencyKey**.
Entering **frequencyKey=** is an implied change to **frequencyKey**.
If a value is NOT included, it changes **frequencyKey** to 0 (zero).

23.1. beaconBurstCount

> **Important!**: Only **radioSettings** that apply to the current **radioMode**, **HoppingMode**, and **rfDataRate** are visible in the CLI and the Web Interface and can be changed.

beaconBurstCount	
Setting	**Description**
CLI / Web Page	[Page=radioSettings]
CLI Command	• `radioSettings.beaconBurstCount=n` • `beaconBurstCount=n` **Note**: Where `n` is any number between 1 and 7.
Web Interface Control	Beacon Burst Count
Default Setting	1
Options	Any number between 1 and 7.
Description	The **radioSettings.beaconBurstCount** setting designates the number of beacons to send per beacon interval time. **Notes** • The **radioSettings.beaconBurstCount** is set on the Gateway device. • The Endpoint radios obtain this value from a Gateway with the same **networkId** via the beacon frame. • This setting is **only** used when `radioHoppingMode=Hopping_On`. 💡 Increasing this number can improve link performance under heavy interference environments. **FREEWAVE Recommends**: Set the beaconBurstCount (on page 178) to 2 or more for optimal throughput when Repeaters are used and the RF environment is noisy. This increases the number of beacons sent in a beacon interval.

23.2. beaconInterval

Important!: Only **radioSettings** that apply to the current **radioMode**, **HoppingMode**, and **rfDataRate** are visible in the CLI and the Web Interface and can be changed.

beaconInterval	
Setting	**Description**
CLI / Web Page	[Page=radioSettings]
CLI Command	• `radioSettings.beaconInterval=TWENTY_FIVE_MS` • `radioSettings.beaconInterval=FIFTY_MS` • `radioSettings.beaconInterval=ONE_HUNDRED_MS` • `radioSettings.beaconInterval=TWO_HUNDRED_MS` • `radioSettings.beaconInterval=FOUR_HUNDRED_MS`
Web Interface Control	Beacon Interval
Default Setting	ONE_HUNDRED_MS
Options	• TWENTY_FIVE_MS • FIFTY_MS • ONE_HUNDRED_MS • TWO_HUNDRED_MS • FOUR_HUNDRED_MS
Description	The **radioSettings.beaconInterval** controls how often a Gateway radio sends out a beacon packet and changes to the next radio frequency in the hopping pattern. **Notes** • The **radioSettings.beaconInterval** is set on the Gateway device. • The Endpoint radios obtain this value from a Gateway with the same **networkId** via the beacon frame. • This setting is **only** used when `radioHoppingMode=Hopping_On`. A longer **radioSettings.beaconInterval** gives the system better throughput in channel environments where interference is minimal. Throughput can be improved in some situations with shorter beacon intervals.

23.3. frequencyKey

> **Important!**: Only **radioSettings** that apply to the current **radioMode**, **HoppingMode**, and **rfDataRate** are visible in the CLI and the Web Interface and can be changed.

frequencyKey	
Setting	**Description**
CLI / Web Page	[Page=radioSettings]
CLI Command	• `radioSettings.frequencyKey=Key0` • `radioSettings.frequencyKey=Key1 to Key16`
Web Interface Control	Frequency Key
Default Setting	Key0 (zero)
Options	• Key0 (zero) • Key1 to Key16 **Valid frequencyKey Values**

Data Rate of 115.2K

Frequency Key Values	Description
Key0 to Key14	Select classic hop tables.
Key15	Select standard randomized hop table.
Key16	Select sequential hop table in reverse order of center frequencies.

All Other Data Rates

Frequency Key Values	Description
Key0	Select standard randomized hop table.
Key1	Select sequential hop table in reverse order of center frequencies.

frequencyKey	
Setting	**Description**
Description	The **radioSettings.frequencyKey** setting designates the number used as an index to select a hopping table. **Notes** - This setting is **only** used when `radioHoppingMode=Hopping_On`. - The number of available frequency keys is based on the number of hopping sequences in the hop table. - An invalid frequency key setting is determined by: - Being outside of the specified range. - If an invalid frequency key setting is found, the **radioSettings.frequencyKey** is NOT changed. - The frequency key setting being larger than the number of hopping tables configured for a specific **rfDataRate**. - In this instance, the **radioSettings.frequencyKey** is set to Key0 (zero). **Important!**: The Endpoint radios obtain this value from a Gateway with the same **networkId** via the beacon frame. After communications are established, any change of this value are picked up by the Endpoints.

23.4. frequencyMasks

Important!: Only **radioSettings** that apply to the current **radioMode**, **HoppingMode**, and **rfDataRate** are visible in the CLI and the Web Interface and can be changed.

frequencyMasks	
Setting	**Description**
CLI / Web Page	[Page=radioSettings]
CLI Command	1. After setting the `radioSettings.frequencyMasks=`, wait a few seconds after the **RESULT:0:OK** for the radio to process the command. 2. Issue a `radioSettings` command to determine if the mask was accepted. 3. If the **radioSettings.frequencyMasks** setting is **NOT what was requested**, issue a `frequencyMasksErrors` command to determine the error that exist in the frequency mask string.
Web Interface Control	Frequency Masks

frequencyMasks	
Setting	**Description**
Default Setting	Blank
Options	⚠️ **Caution**: ONLY A comma MUST separate the values - NOT a comma with a space. **Use this information in examples A to C:** • xxx is a value between 902-927 MHz. • yyyy is a value between .0000-.9999 MHz. **A. Single Channel Format** • A single entry masks the specified frequency plus the bandwidth on each side of the center frequency as a function of the **rfDataRate**. • `frequencyMasks=xxx.yyyy,xxx.yyyy,xxx.yyyy` **B. Range of Channels Format** **Important!**: If a radio channel intersects with the mask limits, it will be masked and not used. • `frequencyMasks=xxx.yyyy-xxx.yyyy,xxx.yyyy-xxx.yyyy` **C. Combination of Channels Format** • `frequencyMasks=xxx.yyyy-xxx.yyyy,xxx.yyyy`

frequencyMasks	
Setting	**Description**

Description	The **radioSettings.frequencyMasks** setting designates specific frequencies or a set of frequencies in the hopping pattern to be removed from usage.
	
	 ⚠️ **Caution**: Frequency mask entries MUST BE less than 128 bytes. ONLY A comma MUST separate the values - NOT a comma with a space.
	
	 Notes
	
	 • This setting is **only** used when `radioHoppingMode=Hopping_On`.
	 • All radios in the network **MUST** use the same value for this setting.
	 • Least significant zeros are NOT required.
	     • .9, .09, .009 are valid entries as well as .9000, .0900, .0090.
	
	 💡 Type `frequencyMasks=` and press <Enter> to clear all Frequency Mask entries.
	
	 Important!: Special rules must be applied for the 115.2 and 250 kbps data rates to enforce regulatory rules.
	
	 • If the `radioSettings.rfDataRate=RATE_250K`:
	     • If the number of hopping channels in the hop table is:
	        • **>=50**, the maximum **txPower** is 30dBm and the **txPower** is NOT automatically changed.
	        • **>=25 and <=49**, the maximum **txPower** is 24dBm and the **txPower** is automatically reduced to 24dBm.
	        • **<25**, all masking is removed. All channels contained in the hop table are re-enabled. **txPower** is NOT automatically changed.
	 • If the `radioSettings.rfDataRate=RATE_115.2K`:
	     • If the number of hopping channels in the hop table is:
	        • **>=50**, the maximum **txPower** is 30dBm and the **txPower** is NOT automatically changed.
	        • **<50**, all masking is removed. All channels are re-enabled. **txPower** is NOT automatically changed.

23.5. lnaBypass

Important!: Only **radioSettings** that apply to the current **radioMode**, **HoppingMode**, and **rfDataRate** are visible in the CLI and the Web Interface and can be changed.

lnaBypass	
Setting	**Description**
CLI / Web Page	[Page=radioSettings]
CLI Command	**Enable LNA**: `radioSettings.lnaBypass=0` `lnaBypass=0` **Bypass LNA**: `radioSettings.lnaBypass=1` `lnaBypass=1`
Web Interface Control	LNA Bypass
Default Setting	0 (zero)
Options	0 1
Description	The **radioSettings.lnaBypass** setting enables the Low Noise Amplifier (LNA) used to boost the radio module receive signal by 10dB. **Tip** It can be useful to bypass the LNA if there is a presence of strong signals in band and packet reception is not good.

23.6. maxLinkDistanceinMiles

Important!: Only **radioSettings** that apply to the current **radioMode**, **HoppingMode**, and **rfDataRate** are visible in the CLI and the Web Interface and can be changed.

maxLinkDistanceinMiles	
Setting	**Description**
CLI / Web Page	[Page=radioSettings]
CLI Command	`radioSettings.maxLinkDistanceinMiles=nnn` `maxLinkDistanceinMiles=nnn`

maxLinkDistanceinMiles	
Setting	**Description**
Web Interface Control	Max Link Distance in Miles
Default Setting	20 miles
Options	• The minimum value is 5 miles. • The maximum value is 120 miles.
Description	The **radioSettings.maxLinkDistanceinMiles** setting designates the maximum one-way distance (in miles) between any nodes in the network. **FREEWAVE Recommends**: All nodes in the network that communicate with each other should use the same distance value.

23.7. networkId

Important!: Only **radioSettings** that apply to the current **radioMode**, **HoppingMode**, and **rfDataRate** are visible in the CLI and the Web Interface and can be changed.

networkId	
Setting	**Description**
CLI / Web Page	[Page=radioSettings]
CLI Command	• `radioSettings.networkId=nnnnn` • `networkId=nnnnn`
Web Interface Control	Network ID
Default Setting	51966
Options	• The minimum value is 2. • The maximum value is 65535.
Description	The **radioSettings.networkId** setting designates the network identifier which subdivides traffic on radio units. **Notes** • Radio units can **only** communicate with other units that have the same **radioSettings.networkId** setting. **Important!**: If radios are on the same frequency, they still receive data from radios of a different **networkId**, but the data is dropped.

23.8. nodeId

> **Important!**: Only **radioSettings** that apply to the current **radioMode**, **HoppingMode**, and **rfDataRate** are visible in the CLI and the Web Interface and can be changed.

nodeId	
Setting	**Description**
CLI / Web Page	[Page=radioSettings]
CLI Command	• `radioSettings.nodeId=nnnnn` • `nodeId=nnnnn`
Web Interface Control	Node ID
Default Setting	0 (zero)
Options	N/A
Description	The **radioSettings.nodeId** setting designates the unique ID of the device. **Notes** • Each radio with the same **networkId must have** a UNIQUE **nodeId**. • The Gateway or Gateway-Repeater device **ALWAYS** has a **nodeId** of value 1. It cannot be changed. Optional: For **Endpoints** in the network, use the command: `radioSettings.nodeId=0`. This allows the Endpoint to **automatically** set the **nodeId** to a predetermined unique number from 2 through 65533.

23.9. radioFrequency

> **Important!**: Only **radioSettings** that apply to the current **radioMode**, **HoppingMode**, and **rfDataRate** are visible in the CLI and the Web Interface and can be changed.

radioFrequency	
Setting	**Description**
CLI / Web Page	[Page=radioSettings]
CLI Command	• `radioSettings.radioFrequency=nnn.nnnn` • `radioFrequency=nnn.nnnn`

radioFrequency	
Setting	**Description**
Web Interface Control	Radio Frequency
Default Setting	915.0000
Options	**Valid Ranges**

Data Rate	**MHz Range**
4Mbps	904.5504 - 925.7472
1Mbps	903.0528 - 927.0144
500Kbps	902.7072 - 927.3600

Description	The **radioSettings.radioFrequency** setting designates the operating center frequency in MHz.

Notes

- All radios in the network **MUST** use the same value for this setting.
- This setting is **only** used when `radioHoppingMode=Hopping_Off`.
- The range of this setting is dependent on the **rfDataRate** setting.
- The frequency interval is 100 MHz.
- The minimum value increases and the maximum value decreases as the **rfDataRate** increases.
  - The increase in channel bandwidth affects these ranges.
- If the **radioSettings.radioFrequency** setting is set too close to the band edge for the current **rfDataRate**, the radio module rejects the setting.

> **Important!**: A few seconds are needed to apply the change; allow some time prior to reading back this value.

> Read back this value after setting it to determine if it was accepted by the radio module.

23.10. radioHoppingMode

> **Important!**: Only **radioSettings** that apply to the current **radioMode**, **HoppingMode**, and **rfDataRate** are visible in the CLI and the Web Interface and can be changed.

radioHoppingMode	
Setting	**Description**
CLI / Web Page	[Page=radioSettings]

radioHoppingMode	
Setting	**Description**

CLI Command	• **Enable**:
	   • `radioHoppingMode=Hopping_On`
	• **Disable**:
	   • `radioHoppingMode=Hopping_Off`

Web Interface Control	Radio Hopping Mode
Default Setting	Hopping_Off
Options	• Hopping_Off • Hopping_On
Description	The **radioSettings.radioHoppingMode** setting enables frequency hopping. **Notes** • All radios in the network **MUST** use the same value for this setting. • For **rfDataRate** values **< 500kbps**, the **radioSettings.radioHoppingMode** is forced **On** and CANNOT be set to `radioHoppingMode=Hopping_Off`. • For **rfDataRate** values **>= 500kbps**, the choice of the selected hopping mode is based on network frequency planning and channel conditions.

23.11. radioMaxRepeaters

Important!: Only **radioSettings** that apply to the current **radioMode**, **HoppingMode**, and **rfDataRate** are visible in the CLI and the Web Interface and can be changed.

radioMaxRepeaters	
Setting	**Description**
CLI / Web Page	[Page=radioSettings]
CLI Command	• `radioSettings.radioMaxRepeaters=n` **Note**: Where `n` is the number of Repeater slots in the network.
Web Interface Control	Radio Max Repeaters
Default Setting	0 (zero)

radioMaxRepeaters	
Setting	**Description**
Options	0 (zero) 1 2 3
Description	The **radioSettings.radioMaxRepeaters** setting designates the maximum Repeater slots in the network when the `radioHoppingMode=Hopping_On`. **Note**: The Endpoint radios obtain this value from a Gateway with the same **networkId** via the beacon frame. - The **radioSettings.radioMaxRepeaters** is set on the network Gateway device and the Gateway beacon carries this information. - If `radioSettings.radioMaxRepeaters=0`: - Set the value to `0 (zero)` when there are no Endpoint-Repeaters or when `radioHoppingMode=Hopping_Off`. - If `radioSettings.radioMaxRepeaters=n`: - If the network has one Repeater, set this to `1`. - If the network has two Repeaters, set this to `2`. - If the network has three or more Repeaters, set this to `3`. - Set the value to match the number of overlapping Repeaters, with a maximum of 3. - Set the value to the **maximum number of repeater slots** used in the network when Endpoint-Repeaters are present in the network and when the `radioHoppingMode=Hopping_On`. - Setting this value too high adds unnecessary latency to the network.

23.12. radioMode

Important!: Only **radioSettings** that apply to the current **radioMode**, **HoppingMode**, and **rfDataRate** are visible in the CLI and the Web Interface and can be changed.

radioMode	
Setting	**Description**
CLI / Web Page	[Page=radioSettings]

radioMode	
Setting	**Description**
CLI Command	- `radioSettings.radioMode=Gateway` - `radioSettings.radioMode=Endpoint` - `radioSettings.radioMode=Gateway_Repeater` - `radioSettings.radioMode=Endpoint_Repeater`
Web Interface Control	Radio Mode
Default Setting	Endpoint
Options	- Endpoint - Endpoint-Repeater - Gateway - Gateway-Repeater

Description	The **radioSettings.radioMode** setting designates the device type.
	Notes
	
	- Each network can have only ONE Gateway or Gateway-Repeater device.
	  - See Repeaters (on page 82) for additional information.
	- The remaining devices MUST be configured as Endpoints or Endpoint-Repeaters.
	- The Gateway or Gateway-Repeater device **ALWAYS** has a **nodeId** of value 1. It cannot be changed.
	- The Endpoint or Endpoint-Repeater **nodeId** values are 2 through 65535.
	- A Gateway **is required** when the `radioHoppingMode=Hopping_On`.
	- A Gateway **is NOT required** when the `radioHoppingMode=Hopping_Off`.
	- The Gateway-Repeater repeats packets.
	- The Endpoint-Repeater has a unique **nodeId** and repeats packets and master beacons.
	  - See Repeaters (on page 82) for additional information.

23.13. radioRepeaterSlot

Important!: Only **radioSettings** that apply to the current **radioMode**, **HoppingMode**, and **rfDataRate** are visible in the CLI and the Web Interface and can be changed.

radioRepeaterSlot	
Setting	**Description**
CLI / Web Page	[Page=radioSettings]
CLI Command	`radioSettings.radioRepeaterSlot=n` **Note**: Where `n` is the Repeater slot.
Web Interface Control	Radio Repeater Slot
Default Setting	1
Options	• 1 • 2 • 3
Description	The **radioSettings.radioRepeaterSlot** setting designates which repeater slot, up to the **radioSettings.radioMaxRepeaters=** setting, the Endpoint-Repeater will use. **Important!**: This setting is only available when `radioSettings.radioMode=Endpoint_Repeater`. **Notes** • The **radioSettings.radioRepeaterSlot** is set on the Endpoint-Repeater device when `radioHoppingMode=Hopping_On`. • This setting does NOT apply when `radioHoppingMode=Hopping_Off`. • Repeater slots **must be** unique for Repeaters that are in communication range so the beacons do not collide. • Endpoint-Repeaters can share a slot number when they do not overlap and form longer repeater chains. • The number of entered Repeater slots cannot be larger than the numbered entered in the radioMaxRepeaters (on page 188) setting.

23.14. rfDataRate

Important!: Only **radioSettings** that apply to the current **radioMode**, **HoppingMode**, and **rfDataRate** are visible in the CLI and the Web Interface and can be changed.

rfDataRate	
Setting	**Description**
CLI / Web Page	[Page=radioSettings]

rfDataRate	
Setting	**Description**
CLI Command	• `radioSettings.rfDataRate=RATE_4M` • `radioSettings.rfDataRate=RATE_1M` • `radioSettings.rfDataRate=RATE_1.5M_BETA_FEATURE` • `radioSettings.rfDataRate=RATE_500K` • `radioSettings.rfDataRate=RATE_250K` • `radioSettings.rfDataRate=RATE_115.2K`
Web Interface Control	RF Data Rate
Default Setting	RATE_1M
Options	• RATE_4M (4Mbps mode) • RATE_1M (1Mbps mode) • RATE_1.5M_BETA_FEATURE (1.5Mbps mode) • RATE_500K (500 kbps mode) • RATE_250K (250 kbps mode) • RATE_115.2K (115.2 kbps mode)
Description	The **radioSettings.rfDataRate** setting designates the RF link data rate in bits per second. **Notes** • All radios in the network **MUST** use the same value for this setting. • A higher RF link data rate provides more throughput but at the expense of link distance or fade margin. • When changing from lower data rates to higher ones (e.g., `rfDataRate=RATE_115.2K` to `rfDataRate=RATE_1M`), the **radioFrequency** may be set back to 915.0000 MHz if the frequency would have been out of band. • When selecting data rates of either `rfDataRate=RATE_115.2K` or `rfDataRate=RATE_250K`, **radioHoppingMode** is automatically forced to `radioHoppingMode=Hopping_On` and **cannot** be turned off. • For all other data rates, the **radioHoppingMode** is left to its current setting. ⚠️ **Caution**: The `RATE_1.5M_BETA_FEATURE` data rate is a Beta feature NOT recommended for production deployment.

23.15. txPower

Important!: Only **radioSettings** that apply to the current **radioMode**, **HoppingMode**, and **rfDataRate** are visible in the CLI and the Web Interface and can be changed.

txPower	
Setting	**Description**
CLI / Web Page	[Page=radioSettings]
CLI Command	• radioSettings.txPower=nn • txPower=nn **Note**: Where `nn` is the RF output transmit power.
Web Interface Control	TX Power
Default Setting	• 27
Options	• The minimum value is 10. • The maximum value is 30.
Description	The **radioSettings.txPower** setting designates the RF output transmit power, in dB, for the radio. **Notes** • Use a higher power to increase link margin. • Use a lower transmit power to reduce interference when multiple radio links are in close proximity. • The maximum **txPower** can be limited if the **radioHoppingMode=Hopping_On**. • See frequencyMasks (on page 181) for additional details. 💡 Entering **txpower=0** or **radiosettings.txpower=0** changes the power to minimum or 10.

24. radioSettingsHelpers Pages

Note: If the "=" sign is appended to the parameter, it is an implied change to that parameter.
If a value is NOT included after the "=", the value becomes a null, space, or 0 (zero) **depending on the parameter**.

Example: Entering **frequencyKey** returns the current value of **frequencyKey**.
Entering **frequencyKey=** is an implied change to **frequencyKey**.
If a value is NOT included, it changes **frequencyKey** to 0 (zero).

24.1. frequencyMasksErrors

frequencyMasksErrors	
Setting	**Description**
CLI / Web Page	[Page=radioSettingsHelpers]
CLI Command	• `radioSettingsHelpers.frequencyMasksErrors` • `frequencyMasksErrors`
Web Interface Control	Frequency Masks Errors
Default Setting	N/A
Options	N/A
Description	The **radioSettingsHelpers.frequencyMasksErrors** command reports the results of any errors in the frequency mask. **Note**: This is a Read-only parameter.

24.2. rCli

Important!: FreeWave internal use only.

24.3. resetRadio

Important!: FreeWave internal use only.

24.4. setAllRadioSettings

Important!: FreeWave internal use only.

24.5. syncSettingsFromRadio

Important!: FreeWave internal use only.

25. services Pages

> **Note**: If the "=" sign is appended to the parameter, it is an implied change to that parameter.
> If a value is NOT included after the "=", the value becomes a null, space, or 0 (zero) **depending on the parameter**.

> **Example**: Entering **frequencyKey** returns the current value of **frequencyKey**.
> Entering **frequencyKey=** is an implied change to **frequencyKey**.
> If a value is NOT included, it changes **frequencyKey** to 0 (zero).

25.1. timeOutCli

timeOutCli	
Setting	**Description**
CLI / Web Page	[Page=services]
CLI Command	• `services.timeOutCli=nnnn` • `timeOutCli=nnnn` **Note**: Where `nnnn` is the number of seconds of idle time.
Web Interface Control	Time Out CLI
Default Setting	900
Options	**FREEWAVE Recommends**: Enter any number between 60 and 3600.
Description	The **services.timeOutCli** setting designates the number of seconds of idle time before the CLI connection is closed. **STOP** **Warning!** DO NOT enter 0 (zero). 0 disables the timeout.

26. SNMP Pages

Note: If the "=" sign is appended to the parameter, it is an implied change to that parameter.
If a value is NOT included after the "=", the value becomes a null, space, or 0 (zero) **depending on the parameter**.

Example: Entering **frequencyKey** returns the current value of **frequencyKey**.
Entering **frequencyKey=** is an implied change to **frequencyKey**.
If a value is NOT included, it changes **frequencyKey** to 0 (zero).

26.1. roCommunityName

roCommunityName	
Setting	**Description**
CLI / Web Page	[Page=SNMP]
CLI Command	• `snmp.roCommunityName=enter_unique_name_here` • `roCommunityName=enter_unique_name_here` **Note**: Where `enter_unique_name_here` is a user-designated name.
Web Interface Control	RO Community Name
Default Setting	public
Options	Maximum of 31 characters.
Description	The **snmp.roCommunityName** setting designates the user-defined community string for SNMP V1/V2C read-only access. **Important!**: Special characters are allowed EXCEPT # but they **may not** be compatible with 3rd-party SNMP managers.

26.2. rwCommunityName

rwCommunityName	
Setting	**Description**
CLI / Web Page	[Page=SNMP]
CLI Command	• `snmp.rwCommunityName=enter_unique_name_here` • `rwCommunityName=enter_unique_name_here` **Note**: Where `enter_unique_name_here` is a user-designated name.
Web Interface Control	RW Community Name
Default Setting	private
Options	Maximum of 31 characters.
Description	The **snmp.rwCommunityName** setting designates the user-defined community string for SNMP V1/V2C read-write access. **Important!**: Special characters are allowed EXCEPT # but they **may not** be compatible with 3rd-party SNMP managers.

26.3. snmpUser

snmpUser	
Setting	**Description**
CLI / Web Page	[Page=SNMP]
CLI Command	**View All Users**: `snmpUser=show` **Remove User**: `snmpUser=remove <username>` **Add User****: `snmpUser=add <username>` **Modify User****: `snmpUser=modify <username>`
Web Interface Control	SNMP User
Default Setting	Blank
Options	****Add** or **Modify** access authorization options are: <AES> <Encryption Passphrase> <DES> <Encryption Passphrase> <MD5> <Authentication Passphrase> <ReadOnly> <ReadWrite> <SHA> <Authentication Passphrase>
Description	The **snmp.snmpUser** setting manages the SNMP V3 users. **Example**: `snmpUser=add <username> <AES> <Encryption Passphrase>`. `snmpUser=modify <username> <ReadWrite>` **Important!**: The Passphrase requires a minimum of 8 characters.

26.4. v1Enabled

v1Enabled	
Setting	**Description**
CLI / Web Page	[Page=SNMP]

v1Enabled	
Setting	**Description**

CLI Command	• **Enable SNMP V1**:
	  • snmp.v1Enabled=true
	• **Disable SNMP V1**:
	  • snmp.v1Enabled=false

Web Interface Control	V1 Enabled
Default Setting	False
Options	• True • False
Description	The **snmp.v1Enabled** setting enables SNMP V1.

26.5. v2cEnabled

v2cEnabled	
Setting	**Description**
CLI / Web Page	[Page=SNMP]

CLI Command	• **Enable SNMP V2C**:
	  • snmp.v2cEnabled=true
	• **Disable SNMP V2C**:
	  • snmp.v2cEnabled=false

Web Interface Control	V2C Enabled
Default Setting	False
Options	• True • False
Description	The **snmp.v2cEnabled** setting enables SNMP V2C.

26.6. v3Enabled

v3Enabled	
Setting	**Description**
CLI / Web Page	[Page=SNMP]

CLI Command	• **Enable SNMP V3**:
	  • snmp.v3Enabled=true
	• **Disable SNMP V3**:
	  • snmp.v3Enabled=false

v3Enabled	
Setting	**Description**
Web Interface Control	V3 Enabled
Default Setting	False
Options	• True • False
Description	The **snmp.v3Enabled** setting enables SNMP V3.

27. System Pages

Note: If the "=" sign is appended to the parameter, it is an implied change to that parameter.
If a value is NOT included after the "=", the value becomes a null, space, or 0 (zero) **depending on the parameter**.

Example: Entering **frequencyKey** returns the current value of **frequencyKey**.
Entering **frequencyKey=** is an implied change to **frequencyKey**.
If a value is NOT included, it changes **frequencyKey** to 0 (zero).

27.1. dump

> **Important!**: The [Page=system] settings are only available in the CLI window.
> See Tera Term Activation and ZumLink Setup (on page 35) for access.

dump	
Setting	**Description**
CLI / Web Page	[Page=system]
CLI Command	• `system.dump` • `dump`
Web Interface Control	**Important!**: The [Page=system] settings are only available in the CLI window. See Tera Term Activation and ZumLink Setup (on page 35) for access.
Default Setting	N/A
Options	N/A
Description	The **system.dump** command reports all of the device configuration and status values. **Note**: This is a Read-only parameter.

27.2. dumpConfig

> **Important!**: FreeWave internal use only.

27.3. dumpFormat

> **Important!**: FreeWave internal use only.

27.4. dumpPage

> **Important!**: The [Page=system] settings are only available in the CLI window.
> See Tera Term Activation and ZumLink Setup (on page 35) for access.

dumpPage	
Setting	**Description**
CLI / Web Page	[Page=system]
CLI Command	• `system.dumpPage=enter_page_name_here` • `dumpPage=enter_page_name_here` **Note**: Where `enter_page_name_here` is a CLI page.
Web Interface Control	**Important!**: The [Page=system] settings are only available in the CLI window. See Tera Term Activation and ZumLink Setup (on page 35) for access.
Default Setting	N/A
Options	N/A
Description	The **system.dumpPage** command reports the specified page name. **Example**: Enter `dumpPage=SNMP` to show the SNMP settings. **Note**: This is a Read-only parameter.

27.5. dumpTag

Important!: FreeWave internal use only.

27.6. filter

Important!: FreeWave internal use only.

27.7. help

Important!: The [Page=system] settings are only available in the CLI window.
See Tera Term Activation and ZumLink Setup (on page 35) for access.

help	
Setting	**Description**
CLI / Web Page	[Page=system]

help	
Setting	**Description**
CLI Command	• `system.help` • `help` • `help <parameter>` • to see help for a specific parameter
Web Interface Control	**Important!**: The [Page=system] settings are only available in the CLI window. See Tera Term Activation and ZumLink Setup (on page 35) for access.
Default Setting	N/A
Options	N/A
Description	The **system.help** command lists the **help.txt** file. **Important!**: Help information is only available for active parameters. **Example**: If the ZumLink is designated as a gateway, the Help information for **radioSettings.nodeId** is not provided since the **nodeId** parameter cannot be changed.

27.8. login

Important!: FreeWave internal use only.

27.9. logout

Important!: FreeWave internal use only.

27.10. modbusLayout

Important!: FreeWave internal use only.

27.11. pages

Important!: The [Page=system] settings are only available in the CLI window.
See Tera Term Activation and ZumLink Setup (on page 35) for access.

Note: If the "=" sign is appended to the parameter, it is an implied change to that parameter.
If a value is NOT included after the "=", the value becomes a null, space, or 0 (zero) **depending on the parameter**.

Example: Entering **frequencyKey** returns the current value of **frequencyKey**.
Entering **frequencyKey=** is an implied change to **frequencyKey**.
If a value is NOT included, it changes **frequencyKey** to 0 (zero).

pages	
Setting	**Description**
CLI / Web Page	[Page=system]
CLI Command	• `system.pages` • `pages`
Web Interface Control	**Important!**: The [Page=system] settings are only available in the CLI window. See Tera Term Activation and ZumLink Setup (on page 35) for access.
Default Setting	N/A
Options	N/A
Description	The **system.pages** command lists all of the pages in the ZumLink.

27.12. password

Important!: The [Page=system] settings are only available in the CLI window.
See Tera Term Activation and ZumLink Setup (on page 35) for access.

password	
Setting	**Description**
CLI / Web Page	[Page=system]
CLI Command	`system.password=[oldpassword],[newpassword],[newpassword]`
Web Interface Control	**Important!**: The [Page=system] settings are only available in the CLI window. See Tera Term Activation and ZumLink Setup (on page 35) for access.
Default Setting	N/A
Options	N/A

password	
Setting	**Description**
Description	The **system.password** setting designates the password. **Example**: The default password is `admin`. The CLI to change this is: `system.password=admin,NewPasswrd123,NewPasswrd123`. **Note**: An error message appears when there is an error in typing the new password command.

27.13. passwordRestoreDefaults

Important!: The [Page=system] settings are only available in the CLI window.
See Tera Term Activation and ZumLink Setup (on page 35) for access.

passwordRestoreDefaults	
Setting	**Description**
CLI / Web Page	[Page=system]
CLI Command	• `system.passwordRestoreDefaults=now` • `passwordRestoreDefaults=now`
Web Interface Control	**Important!**: The [Page=system] settings are only available in the CLI window. See Tera Term Activation and ZumLink Setup (on page 35) for access.
Default Setting	N/A
Options	Now
Description	The **system.passwordRestoreDefaults** command restores all passwords back the default of **admin**.

27.14. showLayout

Important!: FreeWave internal use only.

27.15. tags

Important!: FreeWave internal use only.

27.16. whoami

> **Important!**: The [Page=system] settings are only available in the CLI window.
> See Tera Term Activation and ZumLink Setup (on page 35) for access.

whoami	
Setting	**Description**
CLI / Web Page	[Page=system]
CLI Command	• `system.whoami` • `whoami`
Web Interface Control	**Important!**: The [Page=system] settings are only available in the CLI window. See Tera Term Activation and ZumLink Setup (on page 35) for access.
Default Setting	N/A
Options	N/A
Description	The **system.whoami** command reports the user currently signed in. **Note**: This is a Read-only parameter.

28. systemInfo Pages

Note: If the "=" sign is appended to the parameter, it is an implied change to that parameter.
If a value is NOT included after the "=", the value becomes a null, space, or 0 (zero) **depending on the parameter**.

Example: Entering **frequencyKey** returns the current value of **frequencyKey**.
Entering **frequencyKey=** is an implied change to **frequencyKey**.
If a value is NOT included, it changes **frequencyKey** to 0 (zero).

28.1. deviceConfiguration

deviceConfiguration	
Setting	**Description**
CLI / Web Page	[Page=systemInfo]
CLI Command	• `systemInfo.deviceConfiguration` • `deviceConfiguration`
Web Interface Control	Device Configuration
Default Setting	N/A
Options	N/A
Description	The **systemInfo.deviceConfiguration** command reports the device configuration. **Note**: This is a Read-only parameter.

28.2. deviceFirmwareVersion

deviceFirmwareVersion	
Setting	**Description**
CLI / Web Page	[Page=systemInfo]
CLI Command	• `systemInfo.deviceFirmwareVersion` • `deviceFirmwareVersion`
Web Interface Control	Device Firmware Version
Default Setting	N/A
Options	N/A
Description	The **systemInfo.deviceFirmwareVersion** command reports the device firmware version of the ZumLink. **Note**: This is a Read-only parameter.

28.3. deviceId

deviceId	
Setting	**Description**
CLI / Web Page	[Page=systemInfo]

deviceId	
Setting	**Description**
CLI Command	• `systemInfo.deviceId` • `deviceId`
Web Interface Control	Device ID
Default Setting	1
Options	N/A
Description	The **systemInfo.deviceId** command reports the Device Identifier selected for the ZumLink. **Note**: This is a Read-only parameter.

28.4. deviceModel

deviceModel	
Setting	**Description**
CLI / Web Page	[Page=systemInfo]
CLI Command	• `systemInfo.deviceModel` • `deviceModel`
Web Interface Control	Device Model
Default Setting	N/A
Options	N/A
Description	The **systemInfo.deviceModel** command reports the device model. **Note**: This is a Read-only parameter.

28.5. deviceName

deviceName	
Setting	**Description**
CLI / Web Page	[Page=systemInfo]
CLI Command	• `systemInfo.deviceName` • `deviceName`
Web Interface Control	Device Name

deviceName	
Setting	**Description**
Default Setting	N/A
Options	N/A
Description	The **systemInfo.deviceName** command reports the user-defined device name. **Note**: This is a Read-only parameter.

28.6. hopTableVersion

hopTableVersion	
Setting	**Description**
CLI / Web Page	[Page=systemInfo]
CLI Command	• systemInfo.hopTableVersion • hopTableVersion
Web Interface Control	Hop Table Version
Default Setting	N/A
Options	N/A
Description	The **systemInfo.hopTableVersion** command reports the radio Hop Table Version. **Note**: This is a Read-only parameter.

28.7. layoutHash

layoutHash	
Setting	**Description**
CLI / Web Page	[Page=systemInfo]
CLI Command	• systemInfo.layoutHash • layoutHash
Web Interface Control	Layout Hash
Default Setting	N/A
Options	N/A

layoutHash	
Setting	**Description**
Description	The **systemInfo.layoutHash** command reports the Unique Layout Identifier. **Note**: This is a Read-only parameter.

28.8. licenses

licenses	
Setting	**Description**
CLI / Web Page	[Page=systemInfo]
CLI Command	• systemInfo.licenses • licenses
Web Interface Control	Licenses
Default Setting	None
Options	N/A
Description	The **systemInfo.licenses** command reports all of the license information. **Note**: This is a Read-only parameter.

28.9. modelCode

modelCode	
Setting	**Description**
CLI / Web Page	[Page=systemInfo]
CLI Command	• systemInfo.modelCode • modelCode
Web Interface Control	Model Code
Default Setting	N/A
Options	N/A
Description	The **systemInfo.modelCode** command reports the model code of the ZumLink. **Note**: This is a Read-only parameter.

28.10. radioFirmwareVersion

radioFirmwareVersion	
Setting	Description
CLI / Web Page	[Page=systemInfo]
CLI Command	• systemInfo.radioFirmwareVersion • radioFirmwareVersion
Web Interface Control	Radio Firmware Version
Default Setting	N/A
Options	N/A
Description	The **systemInfo.radioFirmwareVersion** command reports the radio firmware version of the ZumLink. **Note**: This is a Read-only parameter.

28.11. radioModel

radioModel	
Setting	Description
CLI / Web Page	[Page=systemInfo]
CLI Command	• systemInfo.radioModel • radioModel
Web Interface Control	Radio Model
Default Setting	N/A
Options	N/A
Description	The **systemInfo.radioModel** command reports the radio model of the ZumLink. **Note**: This is a Read-only parameter.

28.12. radioModelCode

radioModelCode	
Setting	Description
CLI / Web Page	[Page=systemInfo]

radioModelCode	
Setting	**Description**
CLI Command	• `systemInfo.radioModelCode` • `radioModelCode`
Web Interface Control	Radio Model Code
Default Setting	N/A
Options	N/A
Description	The **systemInfo.radioModelCode** command reports the radio model code of the ZumLink. **Note**: This is a Read-only parameter.

28.13. radioSerialNumber

radioSerialNumber	
Setting	**Description**
CLI / Web Page	[Page=systemInfo]
CLI Command	• `systemInfo.radioSerialNumber` • `radioSerialNumber`
Web Interface Control	Radio Serial Number
Default Setting	N/A
Options	N/A
Description	The **systemInfo.radioSerialNumber** command reports the radio serial number of the ZumLink. **Note**: This is a Read-only parameter.

28.14. resetInfo

Important!: FreeWave internal use only.

28.15. serialNumber

serialNumber	
Setting	**Description**
CLI / Web Page	[Page=systemInfo]
CLI Command	• `systemInfo.serialNumber` • `serialNumber`
Web Interface Control	Serial Number
Default Setting	N/A
Options	N/A
Description	The **systemInfo.serialNumber** command reports the serial number of the ZumLink. **Note**: This is a Read-only parameter.

29. TerminalServerRelay Pages

Note: If the "=" sign is appended to the parameter, it is an implied change to that parameter.
If a value is NOT included after the "=", the value becomes a null, space, or 0 (zero) **depending on the parameter**.

Example: Entering **frequencyKey** returns the current value of **frequencyKey**.
Entering **frequencyKey=** is an implied change to **frequencyKey**.
If a value is NOT included, it changes **frequencyKey** to 0 (zero).

29.1. remote_termserv_ip_address

remote_termserv_ip_address	
Setting	**Description**
CLI / Web Page	[Page=system]
CLI Command	`TerminalServerRelay.remote_termserv_ip_address`
Web Interface Control	Remote Termserv IP Address
Default Setting	0.0.0.0
Options	N/A
Description	The **TerminalServerRelay.remote_termserv_ip_address** setting reports the IP address of remote terminal server. **Note**: This is a Read-only parameter.

29.2. termserv_relay_mapping

termserv_relay_mapping	
Setting	**Description**
CLI / Web Page	[Page=TerminalServerRelay]
CLI Command	• `TerminalServerRelay.termserv_relay_mapping=TERMSERV_RELAY_DISABLED` • `TerminalServerRelay.termserv_relay_mapping=LOCAL_BOTH_COM_TO_REMOTE_BOTH_COM` • `TerminalServerRelay.termserv_relay_mapping=LOCAL_COM1_TO_REMOTE_COM1` • `TerminalServerRelay.termserv_relay_mapping=LOCAL_COM2_TO_REMOTE_COM2` • `TerminalServerRelay.termserv_relay_mapping=LOCAL_BOTH_COM_TO_REMOTE_COM1` • `TerminalServerRelay.termserv_relay_mapping=LOCAL_BOTH_COM_TO_REMOTE_COM2` • `TerminalServerRelay.termserv_relay_mapping=LOCAL_COM1_TO_REMOTE_BOTH_COM` • `TerminalServerRelay.termserv_relay_mapping=LOCAL_COM2_TO_REMOTE_BOTH_COM`
Web Interface Control	Termserv Relay Mapping
Default Setting	TERMSERV_RELAY_DISABLED

termserv_relay_mapping	
Setting	**Description**

Options	• TERMSERV_RELAY_DISABLED
	   • Data forwarding between local and remote COM ports is disabled.
	• LOCAL_BOTH_COM_TO_REMOTE_BOTH_COM (on page 223).
	   • Data is forwarded between the local COM1 and remote COM1 or local COM2 and remote COM2 ports.
	• LOCAL_COM1_TO_REMOTE_COM1 (on page 224).
	   • Data is forwarded between the local COM1 and remote COM1 ports.
	• LOCAL_COM2_TO_REMOTE_COM2 (on page 225).
	   • Data is forwarded between the local COM2 and remote COM2 ports.
	• LOCAL_BOTH_COM_TO_REMOTE_COM1 (on page 226).
	   • Data is forwarded between the local COM1 and COM2 and remote COM1 ports.
	• LOCAL_BOTH_COM_TO_REMOTE_COM2 (on page 227).
	   • Data is forwarded between the local COM1 and COM2 and remote COM2 ports.
	• LOCAL_COM1_TO_REMOTE_BOTH_COM (on page 228).
	   • Data is forwarded between the local COM1, remote COM1, and COM2 ports.
	• LOCAL_COM2_TO_REMOTE_BOTH_COM (on page 229).
	   • Data is forwarded between the local COM2, remote COM1, and COM2 ports.

Description	The **TerminalServerRelay.termserv_relay_mapping** setting is used for the transfer of a bi-directional byte stream between two serial device servers. **Notes** • If using Terminal Server Relay, the TCP port numbers **must be** consistent across all involved radios. • The data relay is only supported between the terminal server on this ZumLink and the terminal server on a separate ZumLink on the same IP network. See Examples - Terminal Server Relay (on page 221). **Important!**: The **TerminalServerRelay.termserv_relay_mapping** should only be enabled on one side of the connection. **FREEWAVE Recommends**: If using the **Terminal Server Relay** setting, keep the TCP port numbers as their defaults.

30. Examples - Terminal Server Relay

30.1. Connected Terminal Servers and Terminal Server Relay

Figure 129 shows the Terminal Servers and the Terminal Server Relay (client) connected together through the Bridge.

- The Bridge connects the Ethernet interface with the radio interface.
- The Terminal Servers are connected to the COM ports.
- From any network interface you can get to the Terminal Servers.

The Terminal Server Relay is designed to connect the local Terminal Servers (hence the COM ports) to any remote Terminal Server.

- This connection could be over the Ethernet or radio interface.
- It does not matter since it is a TCP connection.
- Each terminal server can have 20 concurrent TCP connections.
- Expects COM1 to be on port 5041 for both local and remote units.
- Expects COM2 to be on port 5042 for both local and remote units.
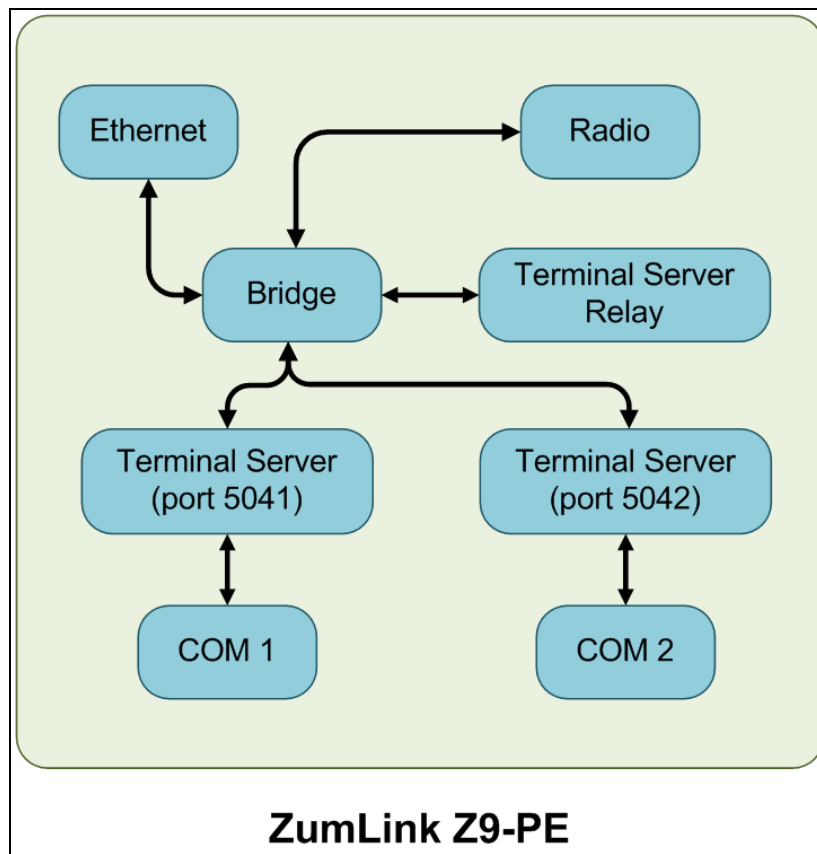
Figure 129: Terminal Servers and Terminal Server Relay (Client) Connected Together through the Bridge

30.2. LOCAL_BOTH_COM_TO_REMOTE_BOTH_COM

Figure 130 illustrates the Terminal Server Relay command:
LOCAL_BOTH_COM_TO_REMOTE_BOTH_COM.
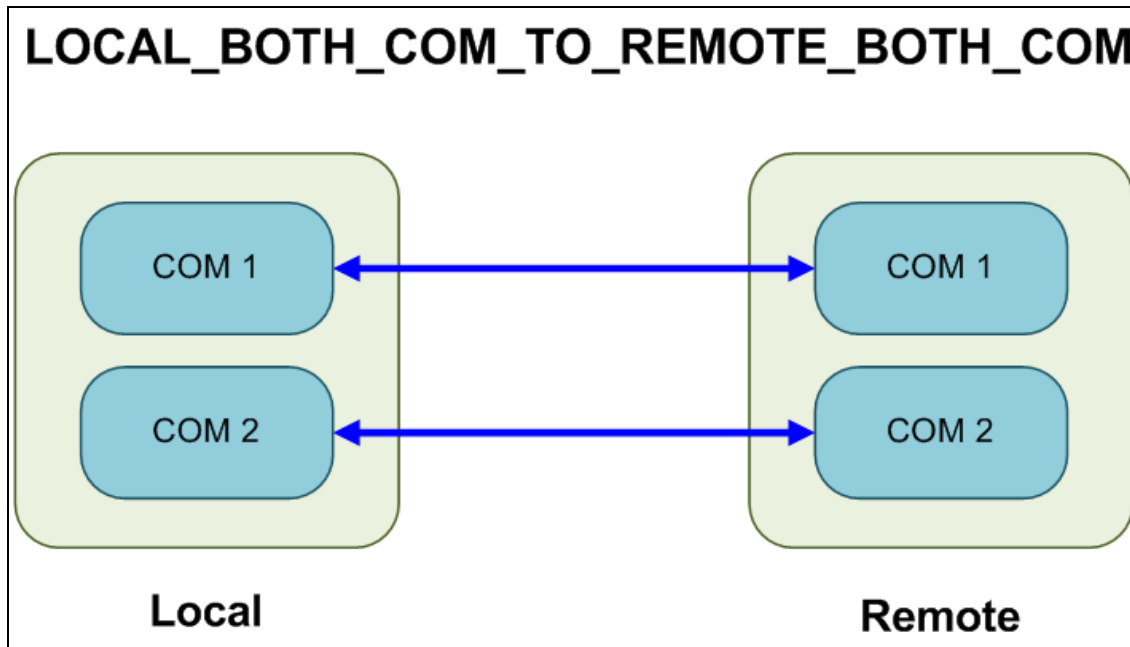
Figure 130: Terminal Server Relay command:
LOCAL_BOTH_COM_TO_REMOTE_BOTH_COM

30.3. LOCAL_COM1_TO_REMOTE_COM1

Figure 130 illustrates the Terminal Server Relay command:
`LOCAL_COM1_TO_REMOTE_COM1`.
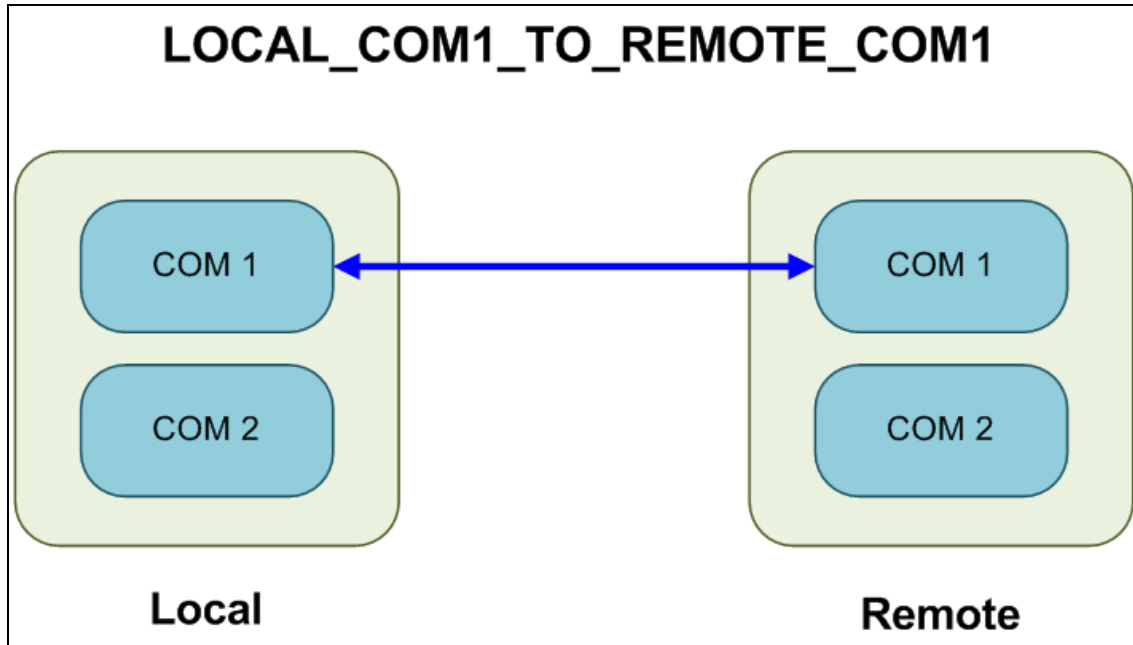
Figure 131: Terminal Server Relay command:
`LOCAL_COM1_TO_REMOTE_COM1`

30.4. LOCAL_COM2_TO_REMOTE_COM2

Figure 130 illustrates the Terminal Server Relay command:
`LOCAL_COM2_TO_REMOTE_COM2`.
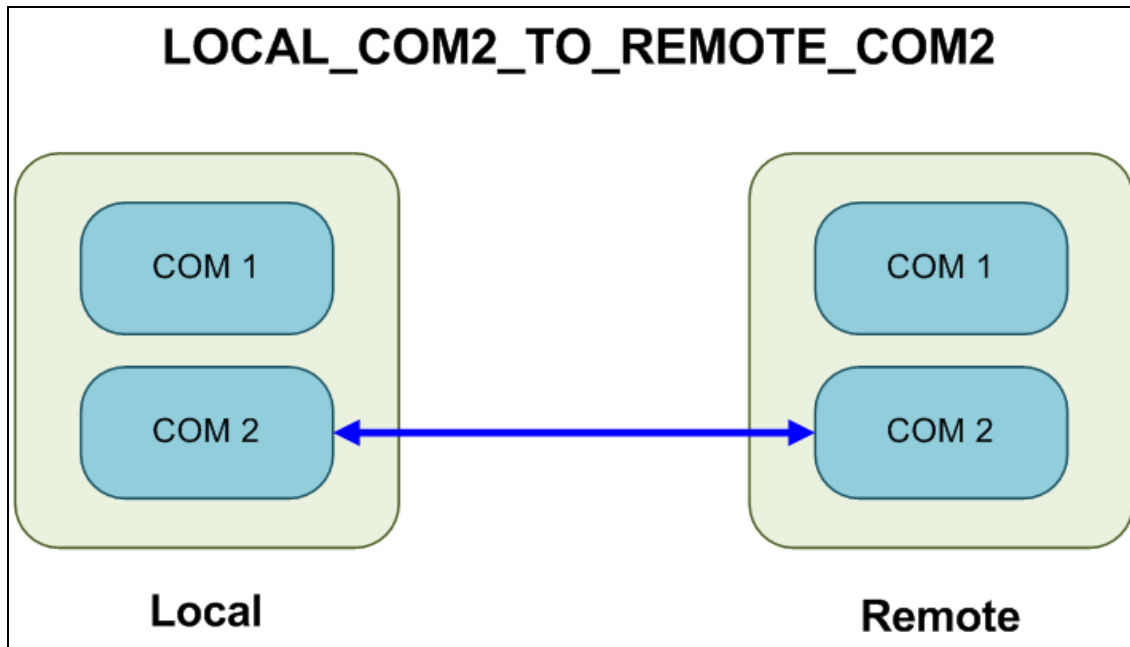
Figure 132: Terminal Server Relay command:
`LOCAL_COM2_TO_REMOTE_COM2`

30.5. LOCAL_BOTH_COM_TO_REMOTE_COM1

Figure 130 illustrates the Terminal Server Relay command:
<mark>LOCAL_BOTH_COM_TO_REMOTE_COM1</mark>.
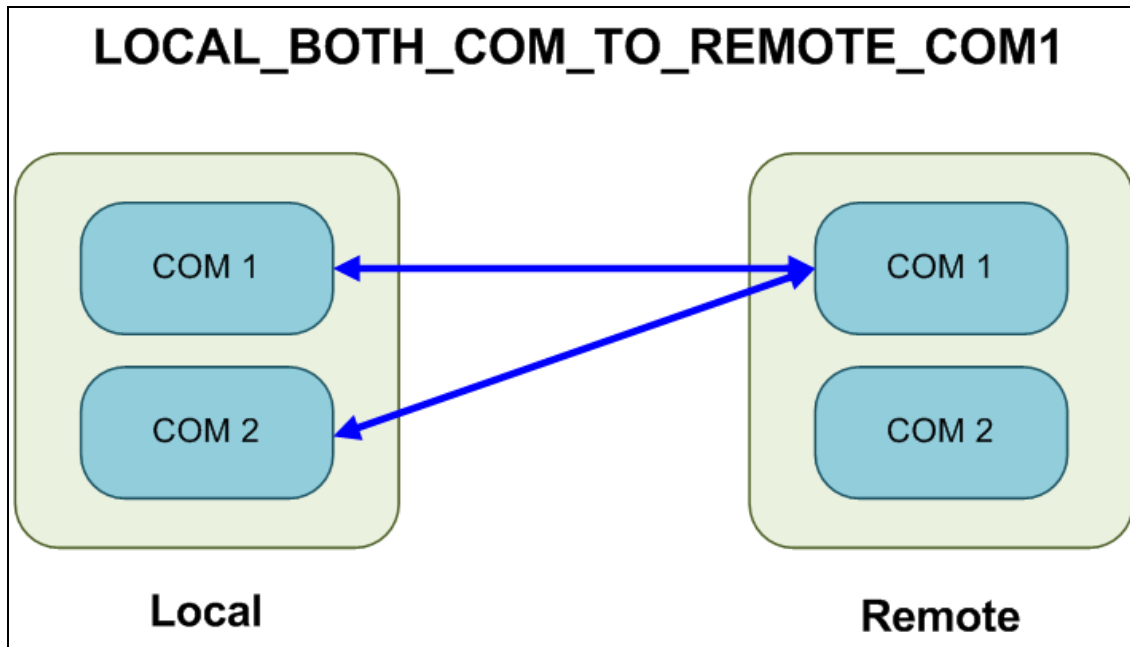
Figure 133: Terminal Server Relay command:
<mark>LOCAL_BOTH_COM_TO_REMOTE_COM1</mark>

30.6. LOCAL_BOTH_COM_TO_REMOTE_COM2

Figure 130 illustrates the Terminal Server Relay command:
LOCAL_BOTH_COM_TO_REMOTE_COM2.
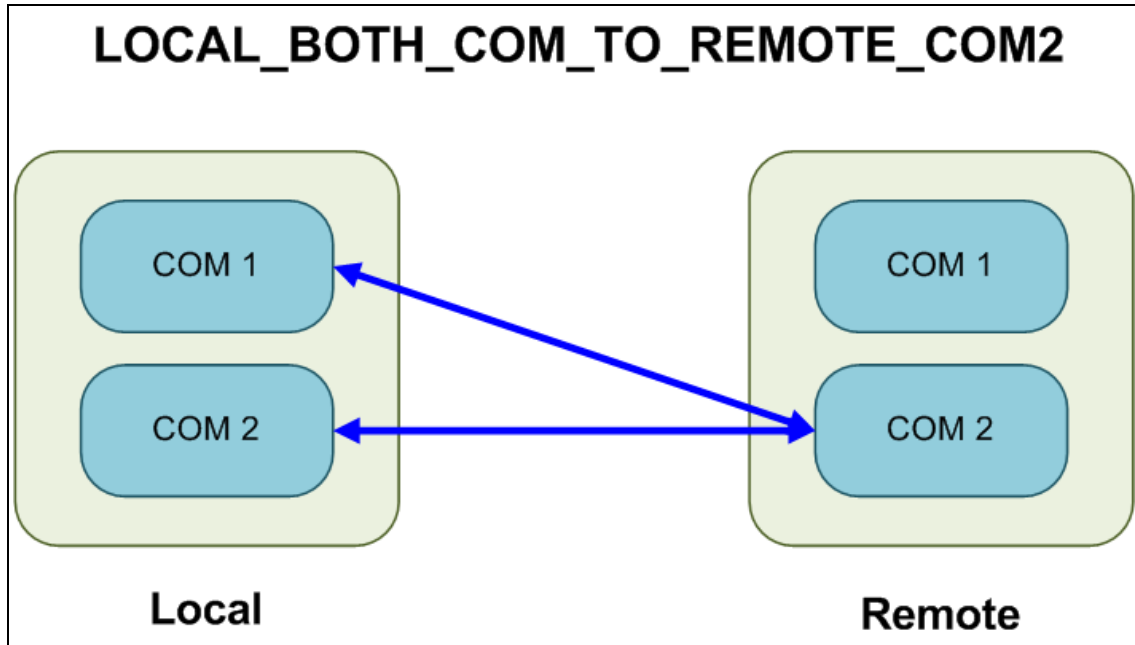
Figure 134: Terminal Server Relay command:
LOCAL_BOTH_COM_TO_REMOTE_COM2

30.7. LOCAL_COM1_TO_REMOTE_BOTH_COM

Figure 130 illustrates the Terminal Server Relay command:
LOCAL_COM1_TO_REMOTE_BOTH_COM.
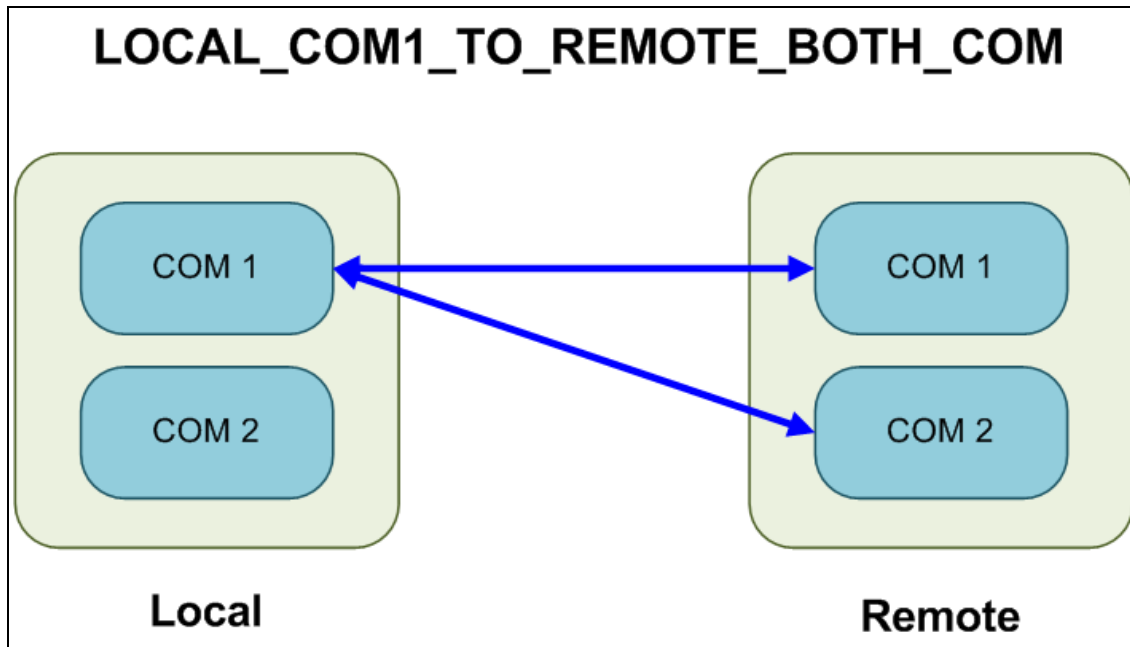
Figure 135: Terminal Server Relay command:
LOCAL_COM1_TO_REMOTE_BOTH_COM

30.8. LOCAL_COM2_TO_REMOTE_BOTH_COM

Figure 130 illustrates the Terminal Server Relay command:
LOCAL_COM2_TO_REMOTE_BOTH_COM.
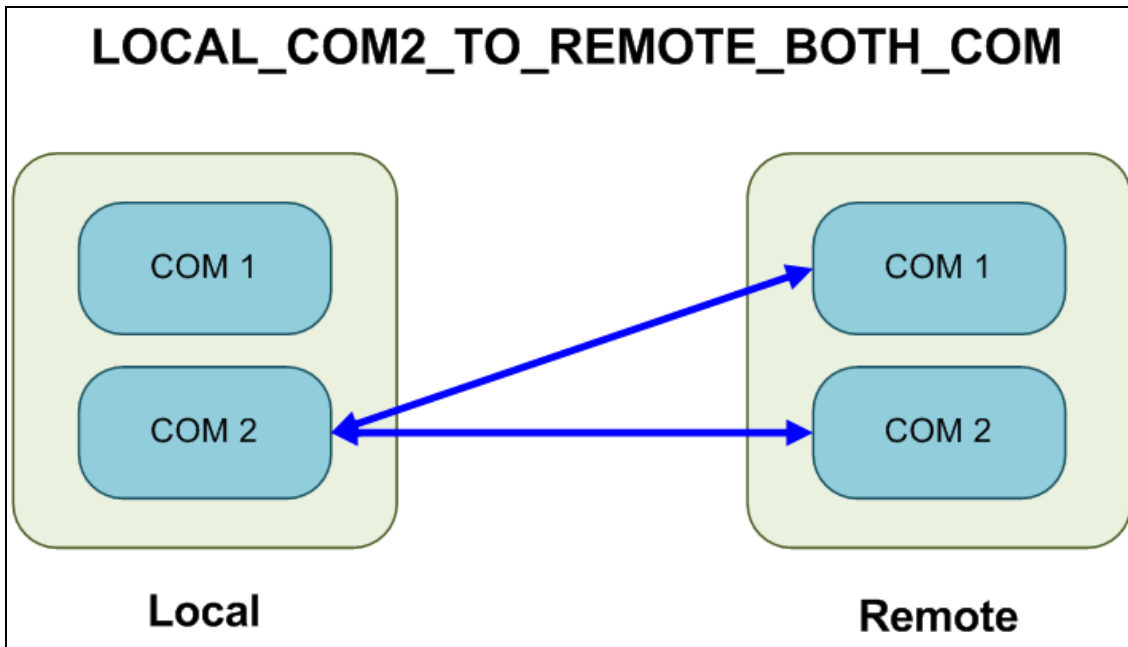
Figure 136: Terminal Server Relay command:
LOCAL_COM2_TO_REMOTE_BOTH_COM

30.9. Example: Multicast
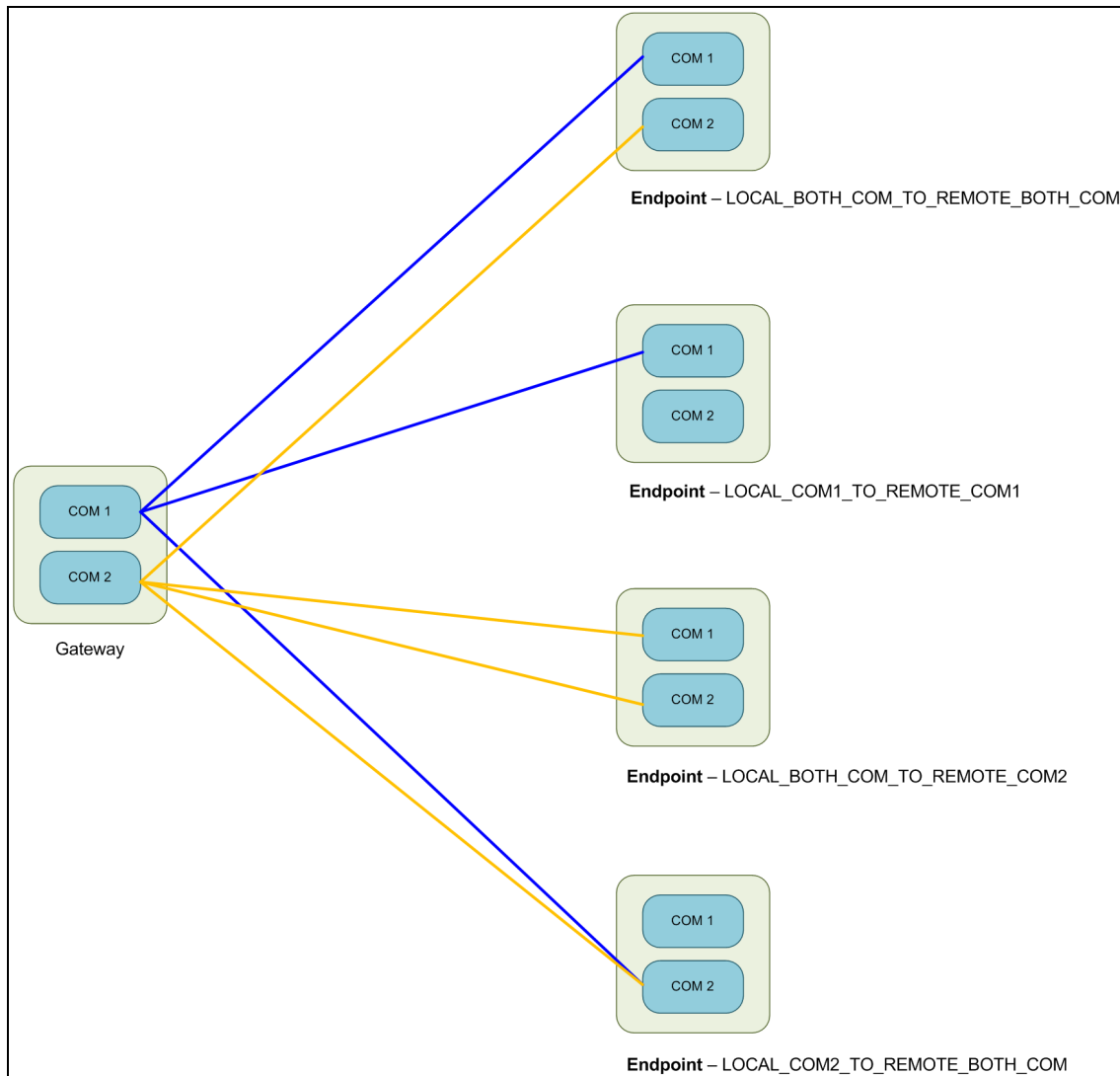
Figure 137: Example: Multicast

31. Release Notes

These sections describe the additions, changes, known limitations, and workarounds in each software version. The most recent version is listed first.

> 💡 **Tip** The latest software versions and the most recent list of known limitations and workarounds are available on www.freewave.com.

31.1. Version 1.0.7.0

Release Date: January 2018

🛑 **STOP**

Warning! DO NOT remove power from the Z9-P / Z9-PE during or immediately after this process!
Wait until the Home window (on page 116) Web Interface is accessible before removing power from the ZumLink device (approximately 6-8 minutes).

If power was removed prematurely during the upgrade process, the Web Interface pages may not be accessible.
Reinstall the **.pkg** file and **WAIT for the file upgrade process to complete**.

v1.0.7.0 Upgrade Notes for Z9-P / Z9-PE

> **Important!**: Inside the downloaded **Z9-P-and-Z9-PE-v1070-Firmware.zip** file, there are **TWO .pkg** files.
> The **CORRECT .pkg** file to use depends on the ZumLink version you're upgrading from.

- When upgrading **from v1.0.4.2 or LATER** firmware, use the file named:
  - **1_Device_Firmware_v1_0_7_0_____when_upgrading_from_v1042_or_later.pkg**.
- When upgrading from a version **EARLIER than v1.0.4.2**, use the file named:
  - **1_Device_Firmware_v1_0_7_0_____when_upgrading_from_a_version_earlier_than_v10402.pkg**.
- For all firmware versions, use the **.fcf** file for the second part of the upgrade.

Additions and Changes

- Support has been added for:
  - Multiple Repeaters using a maximum of 3 Repeater slots.

    > **FREEWAVE Recommends**: Set the beaconBurstCount (on page 178) to 2 or more for optimal throughput when Repeaters are used and the RF environment is noisy.
    > This increases the number of beacons sent in a beacon interval.

  - The **Terminal Server Relay Client** provides radio-to-radio serial communication.
- Hopping data rates from the Gateway to Endpoint and the Endpoint to Gateway are now more symmetric.
- Improved sensitivity, noise filtering, and interference avoidance for 250 and 500 kbps rates. Throughput rates between the Gateway and Endpoint have been rebalanced.

  > **Important!**: Data rates 250K and 500K are NOT compatible with previous releases of the ZumLink radio firmware.

- When `network.netmaskFilterEnabled=true`, VLAN tagged packets are filtered out because the radio is not considered on the VLAN and therefore VLAN packets cannot be on the same subnet.
- Multiple FEC-related corrections have been implemented.
- A problem where the Ethernet interface does not work due to pings at boot time has been fixed.

Beta Features

> **Important!**: Beta Features have not been fully tested by FreeWave. The intent is to expose the feature and receive early feedback from customers.

- 1.5 Mbps RF Data Rate
  - Sensitivity -90dBm
- MacTableEntryAgeTimeout
  - The MacTableEntryAgeTimeout is the number of seconds before an inactive entry in the radio MAC Table ages out and expires.
  - This feature:

- Allows the optimization of the time it takes a unit to learn a new path to allow for Repeater redundancy.
  - Is used to adjust fail-over times with parallel Repeaters.
- User field sets MacTableEntryAgeTimeout period.
  - The default is 120 seconds, with a Minimum of 30 seconds and a Maximum of 86400 seconds.

Known Limitations and Workarounds

> ⚠️ **Caution**: **config.restore** can give inconstant results if the **radioMode** was changed.

- When using the USB, the CLI may lock up on units with termserv_relay_mapping enabled. Resolution for this issue is either:
  - Re-seat the cable.
  - Reconfigure the termserv_relay_mapping using either of these procedures:
    - Drag and Drop Configuration (on page 21) or
    - Web Interface Configuration (on page 40).
- COM ports temporarily stop functioning when passing traffic with certain **Terminal Server Relay** settings enabled.
- When the termserv_relay_mapping is in use, the **terminalServerDrop count** should be ignored.
- When operating at rfDataRate = `RATE_4M` and beaconBurstCount = `1`:
  - Endpoint-Repeaters may lose synchronization with the Gateway and reset themselves.
  - TCP traffic can be intermittent when operating multiple Repeaters.
- When operating at rfDataRate = `RATE_4M` and with multiple Repeaters, if a **short** beaconInterval and a **high** beaconBurstCount are designated, throughput is very low.
  - Use either a **longer** beaconInterval or a **lower** beaconBurstCount to resolve this issue.
- As Repeaters are chained in the network, round trip delay will increase.
  - When issuing pings of large packet sizes at the lower data rates, such as 115.2K, and a beaconInterval = `TWENTY_FIVE_MS`, the latency can increase causing the pings to fail.
  - Allowing appropriate delay between pings resolves this issue.

> **FREEWAVE Recommends**: Set the `beaconBurstCount=2` or more and `beaconInterval=ONE_HUNDRED_MS` or more for optimal throughput when extended Repeater networks are used.

- Frequency Mask is not working properly.

31.2. Version 1.0.4.2

Release Date: June 2017

Additions and Changes

- Allows for the passing of VLAN tagged traffic.
- Packet Aggregation is now working properly.
- Resolved the **otaMaxFragementSize** performance issues when set to 64.
- When `network.netmaskFilterEnabled=true`, VLAN tagged packets are filtered out because the radio is not considered on the VLAN and therefore VLAN packets cannot be on the same subnet.

Known Limitations and Workarounds

- When changing the COM port to **Terminal Server**, the ZumLink must be power cycled after making the change.
- In **Local Diagnostics**, the RF data rate 1 Mbps reports a maximum signal level of -42 dBm.

Notes

- If the password was changed from the default, the password is changed back to **admin** after upgrading the radio firmware.
- Firmware v1.0.4.2 and v1.0.4.1 are over-the-air compatible but are NOT compatible with firmware v1.0.3.2 when the **radioSettings.radioHoppingMode** setting is set to **On** (enabled).

31.3. Version 1.0.4.1

Release Date: May 2017

Additions and Changes

Additions and Changes	
Feature	**Description**
IP Filtering	Prevents IP addresses NOT within the IP subnet from being transmitted over the air.
Repeater	Allows a single radio to repeat (store and forward) traffic from one radio to another.
Terminal Server Activity Timeout	Provides a settable time that closes the port when no data is received through the socket connection for longer than the timeout period.
Diagnostic Support Bundle	Generates a zip file containing all the configuration and diagnostics information when IP address followed by /support is typed in a web browser.

Additions and Changes	
Feature	**Description**
Radio Settings	Displays parameters that are required for radio mode, frequency hopping, and so forth. **Example**: The **radioSettings.beaconInterval** is not available for radios configured as Endpoints.
Throughput	Increases in user data throughput in most RF data rates for single channel and frequency hopping when operating unidirectional or bidirectional.
RF Rate 250 kbps	Unexpected packet losses when **radioSettings.beaconInterval** set to 50 msec has been resolved.
Help	Additional details included in the radios help function.
COM port	COM port LEDs are now functional as described in this manual.
USB COM Port	Changed so that each time a ZumLink device is plugged into a Windows based computer a unique port number is NOT enumerated.

Notes

- If the password was changed from the default, the password is changed back to **admin** after upgrading the radio firmware.
- Firmware v1.0.4.1 is NOT over-the-air compatible with firmware v1.0.3.2 when the **radioSettings.radioHoppingMode** setting is set to On (enabled) or with FEC enabled.

Known Limitations and Workarounds

- Packet Aggregation is currently not working properly.
- When **otaMaxFragementSize** is set to 64, disruptions and failures occur in a ping test with payload size of 20.
- When changing the COM port to **Terminal Server**, the ZumLink must be power cycled after making the change.
- In **Local Diagnostics**, the RF data rate 1 Mbps reports a maximum signal level of -42 dBm.

31.4. Version 1.0.3.2 (Initial Release)

Release Date: October 2016

Known Limitations and Workarounds

- When changing the COM port to **Terminal Server**, the ZumLink must be power cycled after making the change.
- Unexpected packet losses when the **radioSettings.beaconInterval** is set to 50 msec.

32. Available Accessories

These are the Z9-P / Z9-PE accessories available from FreeWave.

- Z9-P and Z9-PE Accessories (on page 236)
- Z9-P Only Accessories (on page 237)
- Z9-PE Only Accessories (on page 237)

32.1. Z9-P and Z9-PE Accessories

Available Accessories - Z9-P / Z9-PE	
Part Number	**Description**
EAN0900SQ	¼ Wave Omni-directional 900 MHz Stub Antenna 0 (zero) dBi gain, straight, SMA Male RF connector
EAN0900SR	½ Wave Omni-directional 900 MHz Stub Antenna 2 dBi gain, right-angle 360 degree swivel, SMA Male RF connector
EAN0900WC	Open coil Omni-directional 896-940 MHz Antenna 5.15 dBi gain. Does not include mounting hardware or cable
EAN0905WC	Closed coil Omni-directional 896-970 MHz Antenna 5 dBi gain
EAN0906YC	3 Element 890-960 MHz Yagi antenna 8.65 dBi gain, 24" feedline terminated with N female connector
ECD0324ER	3' long RJ-45 to DB-9 cable adapter
ECD0658EB	6.5' long shielded Ethernet cable

Available Accessories - Z9-P / Z9-PE	
Part Number	**Description**
EMD1280UX	12 VDC @ 800mA AC-to-DC power supply with phoenix connector **Note**: This connector is used with the ASC0003ZL power cable included with the Z9-P / Z9-PE. See Included Equipment (on page 15).

32.2. Z9-P Only Accessories

Available Accessories - Z9-PE Only	
Part Number	**Description**
AOH0001HT	Multi-position DIN rail bracket kit

32.3. Z9-PE Only Accessories

Available Accessories - Z9-PE Only	
Part Number	**Description**
EMD1280UW	12 VDC @ 800mA AC-to-DC power supply with DC plug.
ASC0002ZL	12 inch power adapter with jack. **Note**: For use with EMD1280UW Power Supply.
AOH4003SP	Reversible DIN rail bracket kit

33. Mechanical Drawing - Z9-P

33.1. Z9-P - Top and Sides
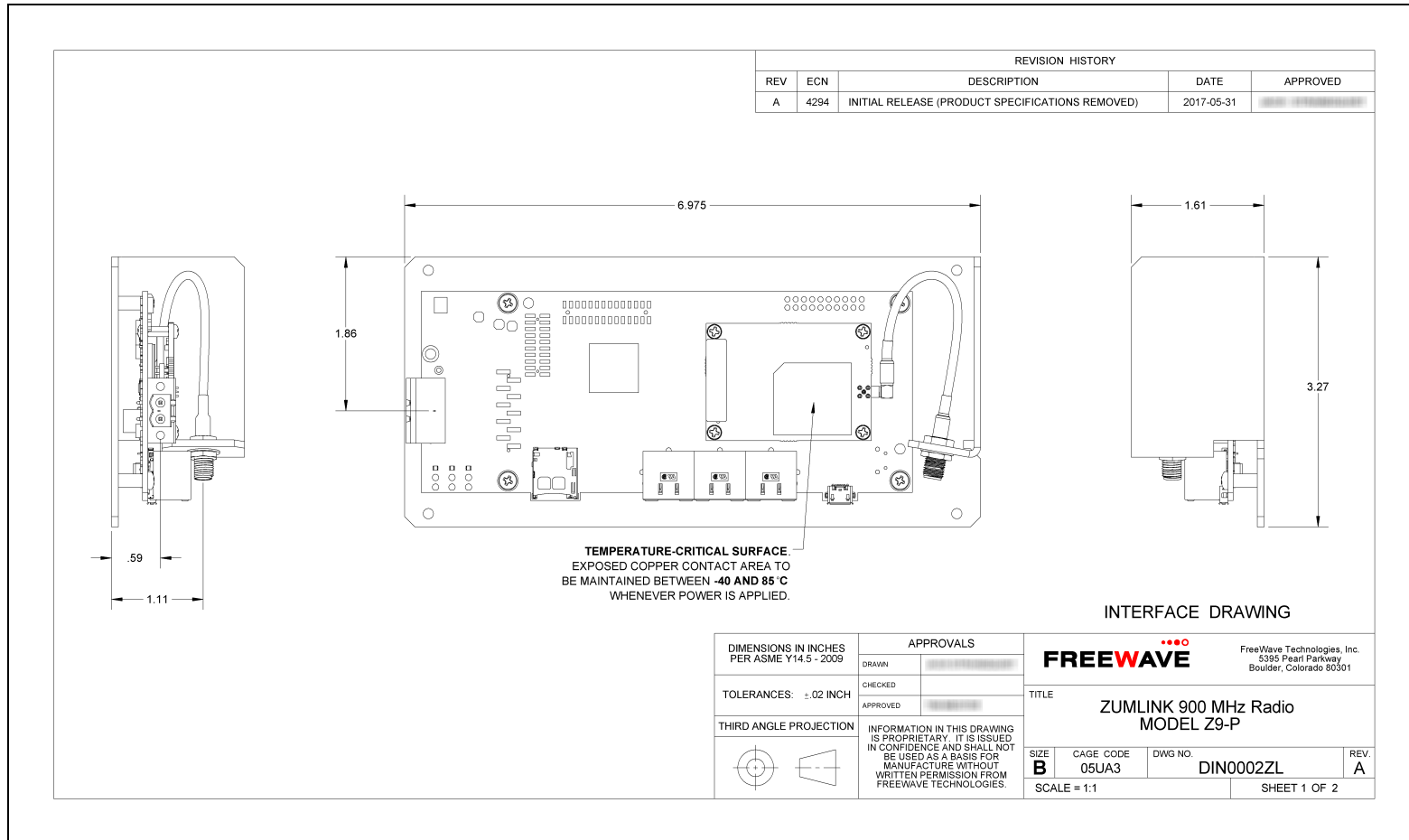
Figure 138: Z9-P Mechanical Drawing - Top and Sides

33.2. Z9-P - Back and Sides
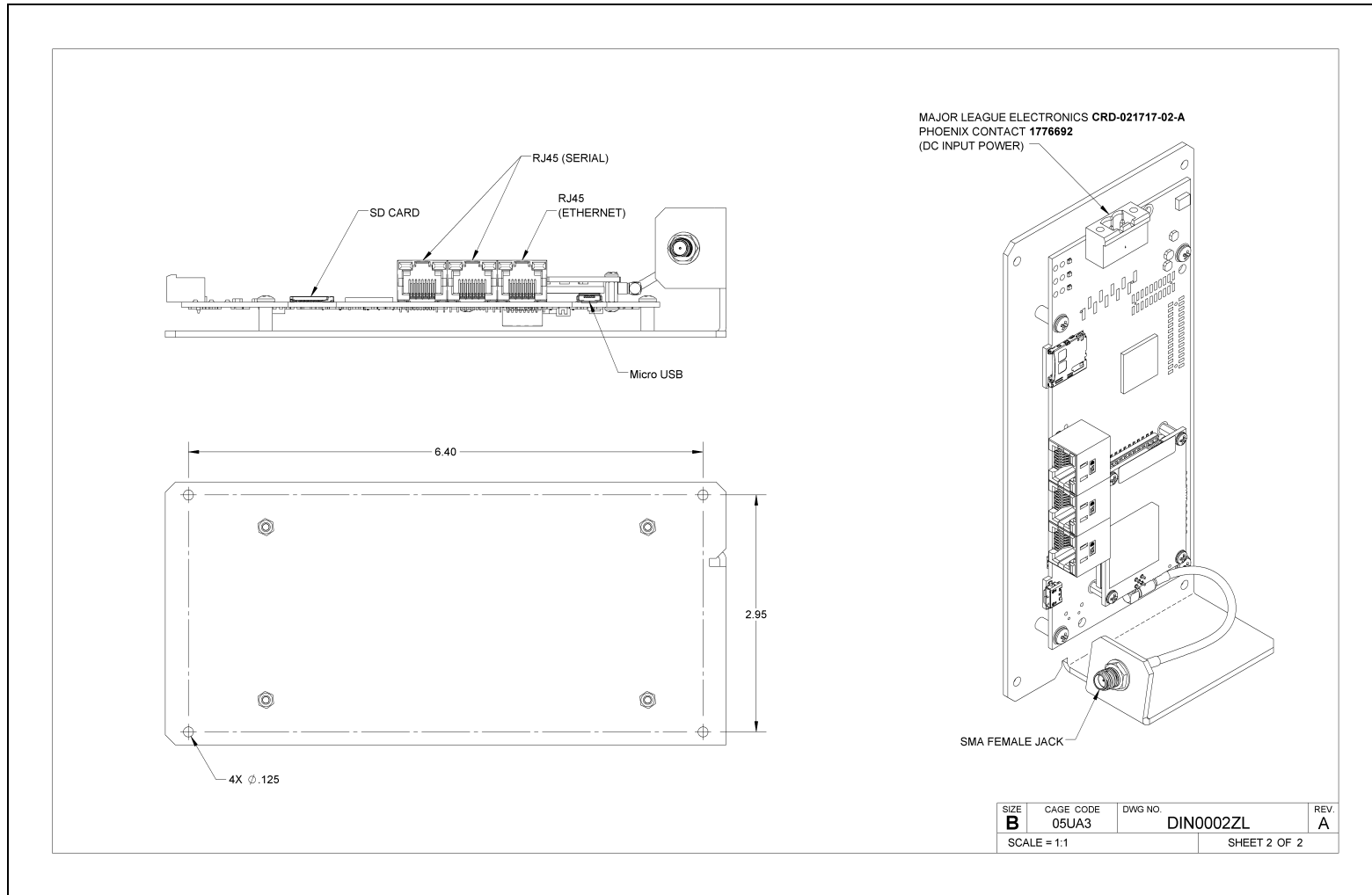
Figure 139: Z9-P Mechanical Drawing - Back and Sides

34. Mechanical Drawing - Z9-PE

34.1. Z9-PE - Top and Sides
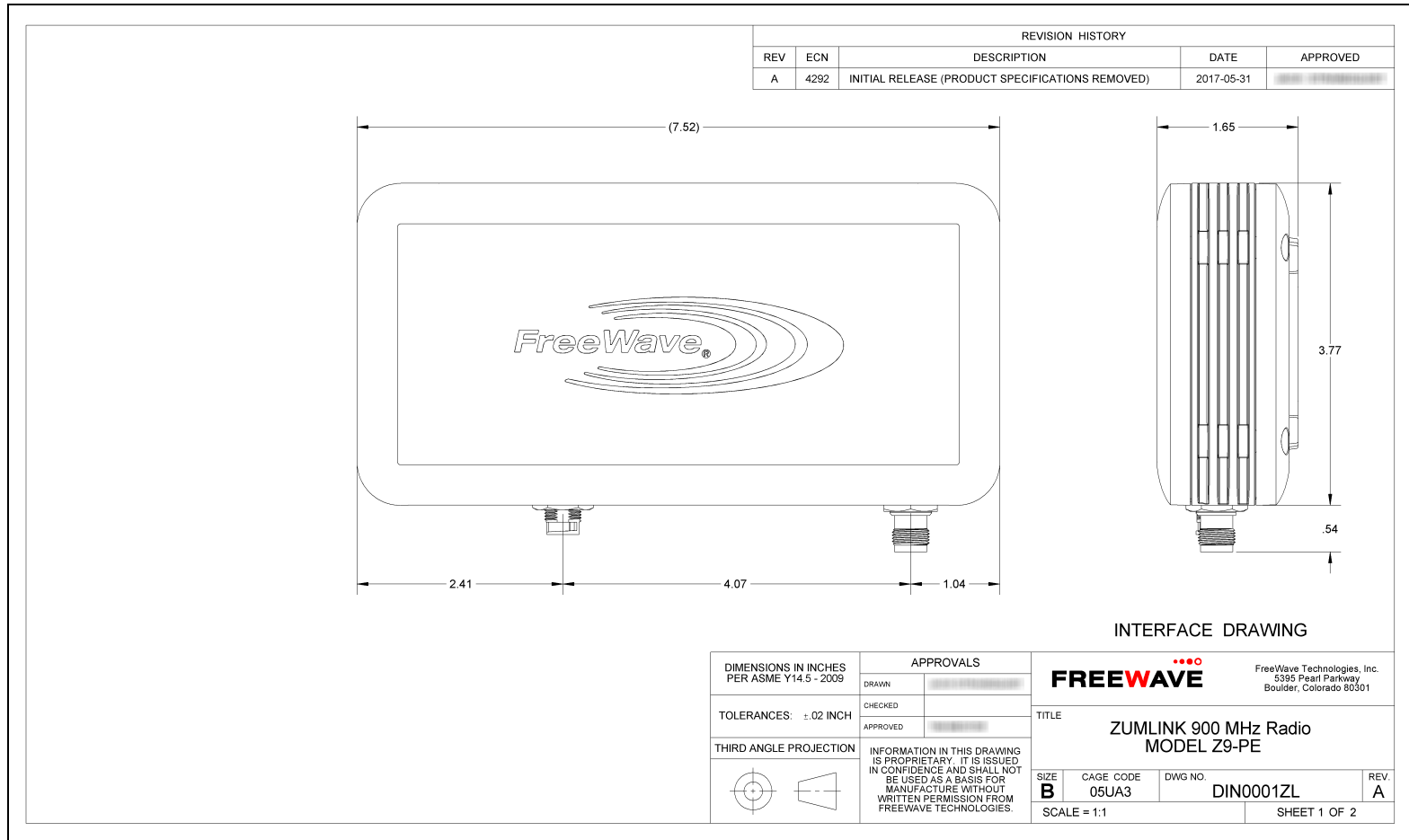
Figure 140: Z9-PE Mechanical Drawing - Top and Sides

34.2. Z9-PE - Back and Sides
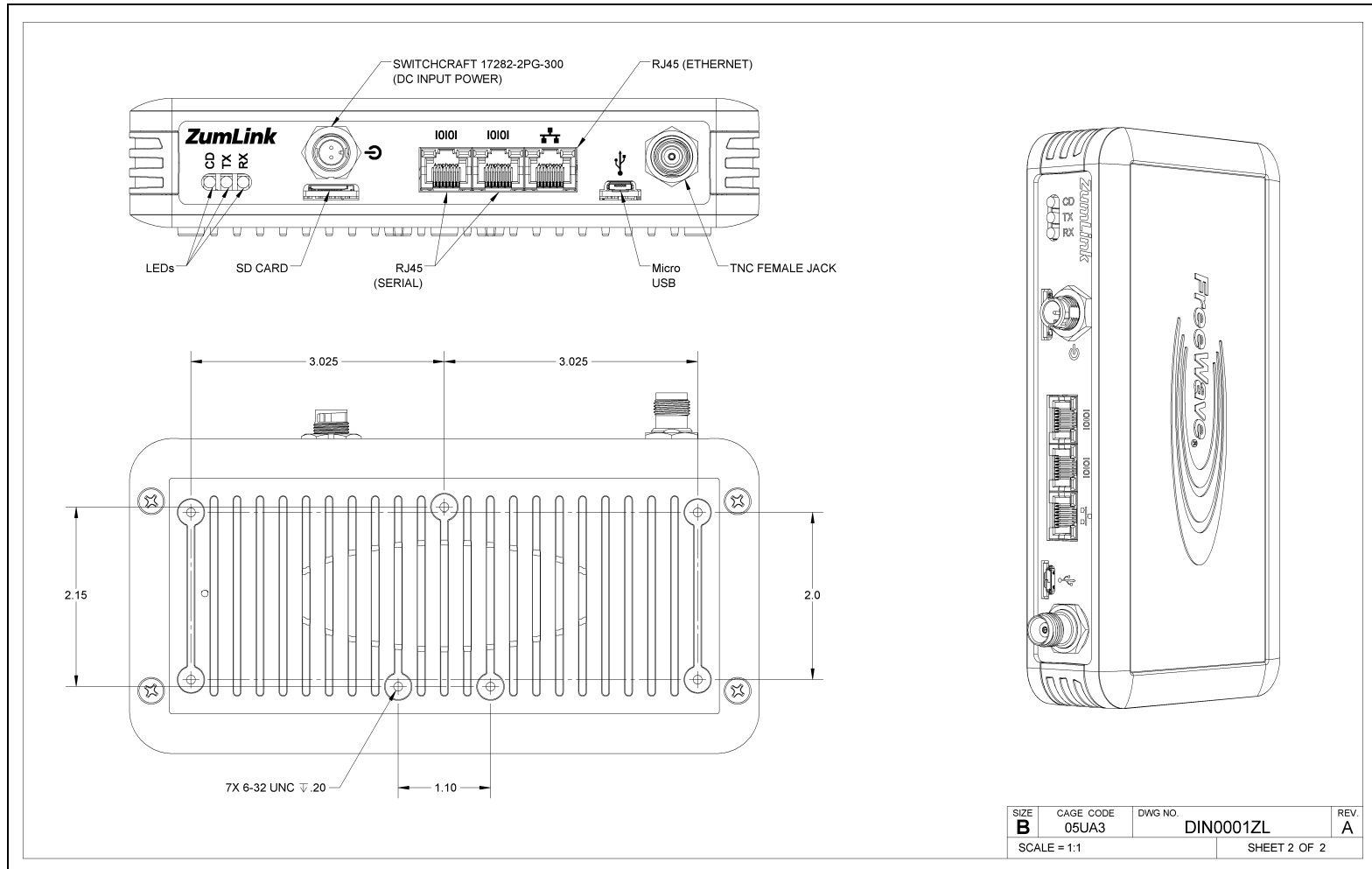
Figure 141: Z9-PE Mechanical Drawing - Back and Sides

35. Hop Tables

35.1. Standard Hop Set - ZumLink 900MHz Channels

These are the standard channels supported when the radioSettings.radioHoppingMode is **Enabled**.

> **Note**: When the **Radio Hopping Mode** is **Disabled**, the frequency can be set manually.

- RF Data Rate: 115.2 kbps (on page 243)
- RF Data Rate: 250 kbps (on page 244)
- RF Data Rate: 500 kbps (on page 244)
- RF Data Rate: 1 Mbps (on page 245)
- RF Data Rate: 4 Mbps (on page 245)

35.1.1. RF Data Rate: 115.2 kbps

Channel Size (MHz): 0.2304

Number of Channels: 110

Standard Hop Set - ZumLink 900MHz Channels										
RF Data Rate: 115.2 kbps										
Frequency		Frequency		Frequency		Frequency		Frequency		Frequency
MHz		MHz		MHz		MHz		MHz		MHz
902.4768		907.0848		911.6928		916.3008		920.9088		925.5168
902.7072		907.3152		911.9232		916.5312		921.1392		925.7472
902.9376		907.5456		912.1536		916.7616		921.3696		925.9776
903.1680		907.7760		912.3840		916.9920		921.6000		926.2080
903.3984		908.0064		912.6144		917.2224		921.8304		926.4384
903.6288		908.2368		912.8448		917.4528		922.0608		926.6688
903.8592		908.4672		913.0752		917.6832		922.2912		926.8992
904.0896		908.6976		913.3056		917.9136		922.5216		927.1296
904.3200		908.9280		913.5360		918.1440		922.7520		927.3600
904.5504		909.1584		913.7664		918.3744		922.9824		927.5904
904.7808		909.3888		913.9968		918.6048		923.2128		
905.0112		909.6192		914.2272		918.8352		923.4432		
905.2416		909.8496		914.4576		919.0656		923.6736		
905.4720		910.0800		914.6880		919.2960		923.9040		
905.7024		910.3104		914.9184		919.5264		924.1344		
905.9328		910.5408		915.1488		919.7568		924.3648		
906.1632		910.7712		915.3792		919.9872		924.5952		
906.3936		911.0016		915.6096		920.2176		924.8256		
906.6240		911.2320		915.8400		920.4480		925.0560		
906.8544		911.4624		916.0704		920.6784		925.2864		

35.1.2. RF Data Rate: 250 kbps

Channel Size (MHz): 0.3456

Number of Channels: 73

Standard Hop Set - ZumLink900MHz Channels										
RF Data Rate: 250 kbps										
Frequency		Frequency		Frequency		Frequency		Frequency		Frequency
MHz		MHz		MHz		MHz		MHz		MHz
902.5344		907.0272		911.5200		916.0128		920.5056		924.9984
902.8800		907.3728		911.8656		916.3584		920.8512		925.3440
903.2256		907.7184		912.2112		916.7040		921.1968		925.6896
903.5712		908.0640		912.5568		917.0496		921.5424		926.0352
903.9168		908.4096		912.9024		917.3952		921.8880		926.3808
904.2624		908.7552		913.2480		917.7408		922.2336		926.7264
904.6080		909.1008		913.5936		918.0864		922.5792		927.0720
904.9536		909.4464		913.9392		918.4320		922.9248		927.4176
905.2992		909.7920		914.2848		918.7776		923.2704		
905.6448		910.1376		914.6304		919.1232		923.6160		
905.9904		910.4832		914.9760		919.4688		923.9616		
906.3360		910.8288		915.3216		919.8144		924.3072		
906.6816		911.1744		915.6672		920.1600		924.6528		

35.1.3. RF Data Rate: 500 kbps

Channel Size (MHz): 0.6912

Number of Channels: 36

Standard Hop Set - ZumLink 900MHz Channels										
RF Data Rate: 500 kbps										
Frequency		Frequency		Frequency		Frequency		Frequency		Frequency
MHz		MHz		MHz		MHz		MHz		MHz
902.7072		906.8544		911.0016		915.1488		919.2960		923.4432
903.3984		907.5456		911.6928		915.8400		919.9872		924.1344
904.0896		908.2368		912.3840		916.5312		920.6784		924.8256
904.7808		908.9280		913.0752		917.2224		921.3696		925.5168
905.4720		909.6192		913.7664		917.9136		922.0608		926.2080
906.1632		910.3104		914.4576		918.6048		922.7520		926.8992

35.1.4. RF Data Rate: 1 Mbps

Channel Size (MHz): 1.3824

Number of Channels: 18

Standard Hop Set - ZumLink 900MHz Channels		
RF Data Rate: 1 Mbps		
Frequency		Frequency
MHz		MHz
903.0528		915.4944
904.4352		916.8768
905.8176		918.2592
907.2000		919.6416
908.5824		921.0240
909.9648		922.4064
911.3472		923.7888
912.7296		925.1712
914.1120		926.5536

35.1.5. RF Data Rate: 4 Mbps

Channel Size (MHz): 3.2256

Number of Channels: 7

Standard Hop Set - ZumLink 900MHz Channels
RF Data Rate: 4 Mbps
Frequency
MHz
904.5504
907.7760
911.0016
914.2272
917.4528
920.6784
923.9040

35.2. Australia Hop Set - ZumLink 900MHz Channels

These are the standard channels supported when the radioSettings.radioHoppingMode is **Enabled**.

Note: When the **Radio Hopping Mode** is **Disabled**, the frequency can be set manually.

- RF Data Rate: 115.2 kbps (on page 246)
- RF Data Rate: 250 kbps (on page 247)
- RF Data Rate: 500 kbps (on page 247)
- RF Data Rate: 1 Mbps (on page 248)
- RF Data Rate: 4 Mbps (on page 248)

35.2.1. RF Data Rate: 115.2 kbps

Channel Size (MHz): 0.2304

Number of Channels: 54

Australia Hop Set - ZumLink 900MHz Channels										
RF Data Rate: 115.2 kbps										
Frequency		Frequency		Frequency		Frequency		Frequency		Frequency
MHz		MHz		MHz		MHz		MHz		MHz
915.3792		917.6832		919.9872		922.2912		924.5952		926.8992
915.6096		917.9136		920.2176		922.5216		924.8256		927.1296
915.8400		918.1440		920.4480		922.7520		925.0560		927.3600
916.0704		918.3744		920.6784		922.9824		925.2864		927.5904
916.3008		918.6048		920.9088		923.2128		925.5168		
916.5312		918.8352		921.1392		923.4432		925.7472		
916.7616		919.0656		921.3696		923.6736		925.9776		
916.9920		919.2960		921.6000		923.9040		926.2080		
917.2224		919.5264		921.8304		924.1344		926.4384		
917.4528		919.7568		922.0608		924.3648		926.6688		

35.2.2. RF Data Rate: 250 kbps

Channel Size (MHz): 0.3456

Number of Channels: 35

Australia Hop Set - ZumLink 900MHz Channels						
RF Data Rate: 250 kbps						
Frequency		Frequency		Frequency		Frequency
MHz		MHz		MHz		MHz
915.6672		919.1232		922.5792		926.0352
916.0128		919.4688		922.9248		926.3808
916.3584		919.8144		923.2704		926.7264
916.7040		920.1600		923.6160		927.0720
917.0496		920.5056		923.9616		927.4176
917.3952		920.8512		924.3072		
917.7408		921.1968		924.6528		
918.0864		921.5424		924.9984		
918.4320		921.8880		925.3440		
918.7776		922.2336		925.6896		

35.2.3. RF Data Rate: 500 kbps

Channel Size (MHz): 0.6912

Number of Channels: 17

Australia Hop Set - ZumLink 900MHz Channels		
RF Data Rate: 500 kbps		
Frequency		Frequency
MHz		MHz
915.8400		922.0608
916.5312		922.7520
917.2224		923.4432
917.9136		924.1344
918.6048		924.8256
919.2960		925.5168
919.9872		926.2080
920.6784		926.8992
921.3696		

35.2.4. RF Data Rate: 1 Mbps

Channel Size (MHz): 1.3824

Number of Channels: 8

Australia Hop Set - ZumLink 900MHz Channels
RF Data Rate: 1 Mbps
Frequency
MHz
916.8768
918.2592
919.6416
921.0240
922.4064
923.7888
925.1712
926.5536

35.2.5. RF Data Rate: 4 Mbps

Channel Size (MHz): 3.2256

Number of Channels: 3

Australia Hop Set - ZumLink 900MHz Channels
RF Data Rate: 4 Mbps
Frequency
MHz
917.4528
920.6784
923.9040

35.3. Brazil Hop Set - ZumLink 900MHz Channels

These are the standard channels supported when the radioSettings.radioHoppingMode is Enabled.

> **Note**: When the **Radio Hopping Mode** is Disabled, the frequency can be set manually.

- RF Data Rate: 115.2 kbps (on page 249)
- RF Data Rate: 250 kbps (on page 250)
- RF Data Rate: 500 kbps (on page 250)
- RF Data Rate: 1 Mbps (on page 251)
- RF Data Rate: 4 Mbps (on page 251)

35.3.1. RF Data Rate: 115.2 kbps

Channel Size (MHz): 0.2304

Number of Channels: 75

Brazil Hop Set - ZumLink 900MHz Channels								
RF Data Rate: 115.2 kbps								
Frequency		Frequency		Frequency		Frequency		Frequency
MHz		MHz		MHz		MHz		MHz
902.4768		905.9328		917.4528		920.9088		924.3648
902.7072		906.1632		917.6832		921.1392		924.5952
902.9376		906.3936		917.9136		921.3696		924.8256
903.1680		906.6240		918.1440		921.6000		925.0560
903.3984		906.8544		918.3744		921.8304		925.2864
903.6288		907.0848		918.6048		922.0608		925.5168
903.8592		915.3792		918.8352		922.2912		925.7472
904.0896		915.6096		919.0656		922.5216		925.9776
904.3200		915.8400		919.2960		922.7520		926.2080
904.5504		916.0704		919.5264		922.9824		926.4384
904.7808		916.3008		919.7568		923.2128		926.6688
905.0112		916.5312		919.9872		923.4432		926.8992
905.2416		916.7616		920.2176		923.6736		927.1296
905.4720		916.9920		920.4480		923.9040		927.3600
905.7024		917.2224		920.6784		924.1344		927.5904

35.3.2. RF Data Rate: 250 kbps

Channel Size (MHz): 0.3456
Number of Channels: 49

Brazil Hop Set - ZumLink 900MHz Channels									
RF Data Rate: 250 kbps									
Frequency		Frequency		Frequency		Frequency		Frequency	
MHz		MHz		MHz		MHz		MHz	
902.5344		905.9904		917.7408		921.1968		924.6528	
902.8800		906.3360		918.0864		921.5424		924.9984	
903.2256		906.6816		918.4320		921.8880		925.3440	
903.5712		907.0272		918.7776		922.2336		925.6896	
903.9168		915.6672		919.1232		922.5792		926.0352	
904.2624		916.0128		919.4688		922.9248		926.3808	
904.6080		916.3584		919.8144		923.2704		926.7264	
904.9536		916.7040		920.1600		923.6160		927.0720	
905.2992		917.0496		920.5056		923.9616		927.4176	
905.6448		917.3952		920.8512		924.3072			

35.3.3. RF Data Rate: 500 kbps

Channel Size (MHz): 0.6912
Number of Channels: 24

Brazil Hop Set - ZumLink 900MHz Channels					
RF Data Rate: 500 kbps					
Frequency		Frequency		Frequency	
MHz		MHz		MHz	
902.7072		916.5312		922.0608	
903.3984		917.2224		922.7520	
904.0896		917.9136		923.4432	
904.7808		918.6048		924.1344	
905.4720		919.2960		924.8256	
906.1632		919.9872		925.5168	
906.8544		920.6784		926.2080	
915.8400		921.3696		926.8992	

35.3.4. RF Data Rate: 1 Mbps

Channel Size (MHz): 1.3824

Number of Channels: 11

Brazil Hop Set - ZumLink 900MHz Channels		
RF Data Rate: 1 Mbps		
Frequency		**Frequency**
MHz		**MHz**
903.0528		921.0240
904.4352		922.4064
905.8176		923.7888
916.8768		925.1712
918.2592		926.5536
919.6416		

35.3.5. RF Data Rate: 4 Mbps

Channel Size (MHz): 3.2256

Number of Channels: 4

Brazil Hop Set - ZumLink 900MHz Channels
RF Data Rate: 4 Mbps
Frequency
MHz
904.5504
917.4528
920.6784
923.9040

36. ZumIQ App Server Software

ZumIQ is a Linux-based app development environment within ZumLink, FreeWave's existing 900MHz industrial radio platform. It combines wireless telemetry with app development and deployment for intelligent monitoring and control of remote sensors and devices.

36.1. Getting ZumIQ

- ZumIQ is an optional feature of the ZumLink Z9-P Series radios.
- Typically, it is factory-installed when the ZumIQ order option is selected.
- Once installed, it must be activated (See Activating ZumIQ (on page 254)).

> **Note**: ZumIQ can be added after purchase. The radio must be a Z9-P, Z9-PE, or Z9-PC model and must be manufactured after December, 2017.
> Contact FreeWave Technical Support (on page 12) for the firmware and tools to upgrade.

36.2. Verification ZumIQ is Installed

To verify the ZumLink radio supports ZumIQ, two conditions must be checked:

- A. The ZumLink device is licensed for ZumIQ functionality.
- B. The installed firmware on the ZumLink device supports ZumIQ functionality.

To verify that ZumIQ is installed on the radio, verify these settings:

Verification Settings	
Setting	**Value**
radioFirmwareVersion	FWT1040TA.11
deviceFirmwareVersion	FWT1060TB.68
rteVersion	(blank)
rteTemplateVersion	FWT1060TB.68
licenses	Custom Apps

> **Important!**: If the **rteVersion** field is NOT empty, then ZumIQ has already been activated, the Activating ZumIQ (on page 254) procedure can be skipped.
> If the **rteVersion** or **rteTemplateVersion** fields are NOT visible, ZumIQ has NOT been installed on the radio.
> Contact FreeWave Technical Support (on page 12) to install ZumIQ.

The settings can be verified in these locations:

- Website (on page 253)
- sys_info.txt (on page 254)
- CLI (on page 254)

Website

1. Go to the **Home** window.
2. Verify that the **Licenses** field contains this text: **Custom Apps**.

3. Verify that the **Rte Template Version** field exists and has a firmware version listed (e.g.,FWT1060TB.68).

4. Verify that the **Rte Version** field exists and is empty.

5. Go to Activating ZumIQ (on page 254) to activate ZumIQ.

> **Note**: If the **Rte Version** field is NOT empty, then ZumIQ has already been activated, the Activating ZumIQ (on page 254) procedure can be skipped.

sys_info.txt

1. Open the ZumLink device folder in Windows® Explorer.

2. Open the **sys_info.txt** file in a text editor.

3. Verify the **systemInfo.licenses** property contains this text: **Custom Apps**.

4. Verify the **systemInfo.rteTemplateVersion** property exists and has a firmware version listed (e.g.,FWT1060TB.68).

5. Verify the **systemInfo.rteVersion** property exists and is empty.

6. Go to Activating ZumIQ (on page 254) to activate ZumIQ.

> **Note**: If the **systemInfo.rteVersion** field is NOT empty, then ZumIQ has already been activated, the Activating ZumIQ (on page 254) procedure can be skipped.

CLI

1. Open a connection to the ZumLink CLI.

2. Type `systemInfo` to see all of the system information settings.

3. Verify the **licenses** property contains this text: **Custom Apps**.

4. Verify the **rteTemplateVersion** property exists and has a firmware version listed (e.g.,FWT1060TB.68).

5. Verify the **rteVersion** property exists and is empty.

6. Go to Activating ZumIQ (on page 254) to activate ZumIQ.

> **Note**: If the **rteVersion** field is NOT empty, then ZumIQ has already been activated, the Activating ZumIQ (on page 254) procedure can be skipped.

36.3. Activating ZumIQ

Warning! The process of activating ZumIQ will install a fresh copy of the Linux development environment that supports ZumIQ.
If ZumIQ has already been activated, this procedure will erase any user-created files, directories, configurations, or data in the existing Linux development environment.

1. Log in to the ZumLink CLI as **admin**.
2. Execute the **rteReset hard** command.
   This will stage the development runtime environment to be applied on the next reboot.
3. Execute the **reset now** command to reboot the radio and copy the Linux development environment into the runtime location.
   This will take ~3-4 minutes to complete.

36.3.1. Verify Activation

1. Log in to the ZumLink CLI as **devuser**.
   The default password is **devuser**.
   A Linux Bash prompt appears.
2. Type **cliBridge systemInfo** to see all of the system information settings.
   The **rteTemplateVersion** and **rteVersion** values should match.

Verify Activation Settings	
Setting	**Value**
radioFirmwareVersion	FWT1040TA.11
deviceFirmwareVersion	FWT1060TB.68
rteVersion	FWT1060TB.68
rteTemplateVersion	FWT1060TB.68
licenses	Custom Apps

36.4. Using ZumIQ

Usage of ZumIQ functionality is beyond the scope of this document.

ZumIQ developer documentation and sample code is available online at the FreeWave ZumIQ GitHub repository here: https://github.com/FreeWaveTechnologies/ZumIQ.

Appendix A: Technical Specifications

Note: Specifications may change at any time without notice. For the most up-to-date specifications information, see the product's data sheet available at www.freewave.com.

Technical Specifications	
Specification	**Description**
Transmitter	
Frequency Range	902 to 928MHz
Output Power Range	• 10mW to 1W • User selectable
Data Link Range	60 miles with clear Line of Sight
Modulation	• GFSK • 8-ary FSK (4000 kbps data rate only)
Channel Sizes and RF Data Rates	User selectable **Channel Size** / **RF Data Rate** 230.4 kHz / 115.2 kbps 345.6 kHz / 250 kbps 691.2 kHz / 500 kbps 1382.4 kHz / 1000 kbps 3225.6 kHz / 4000 kbps

Technical Specifications	
Specification	**Description**
Hopping Channels	• Maximum of 112 channels • Dependent on the **RFDataRate** setting • User selectable <table><tr><td>**Data Rate (kbps)**</td><td>**Number of Hopping Channels**</td></tr><tr><td>115.2</td><td>112</td></tr><tr><td>250</td><td>73</td></tr><tr><td>500</td><td>36</td></tr><tr><td>1000</td><td>18</td></tr><tr><td>4000</td><td>7</td></tr></table>
Hopping Patterns	• Maximum of 16 patterns • Dependent on the **RFDataRate** setting • User selectable **Note**: There are fewer patterns available with larger channel bandwidths.
Hopping Rates	• 25ms • 50ms • 100ms • 200ms • 400ms • User selectable
Protocol	Adaptive Spectrum Learning
Receiver	
IF Selectivity	> 40 dB
System Gain	136 dB
Sensitivity	<table><tr><td>**RF Data Rate**</td><td>**Without FEC**</td><td>**With FEC**</td></tr><tr><td>115.2 kbps</td><td>-105 dBm</td><td>-108 dBm</td></tr><tr><td>250 kbps</td><td>-102 dBm</td><td>-105 dBm</td></tr><tr><td>500 kbps</td><td>-99 dBm</td><td>-102 dBm</td></tr><tr><td>1 Mbps</td><td>-95 dBm</td><td>-98 dBm</td></tr><tr><td>4 Mbps</td><td>-83 dBm</td><td>-86 dBm</td></tr></table>

Technical Specifications	
Specification	**Description**
Data Transmission	
Error Detection	CRC, FEC, and ARQ
Link Throughput	- Maximum of 1.6 Mbps 4 Mbps with Compression
User Interface Rate	- Ethernet Rate: 10/100 Mbps - Serial Rate: Maximum of 250 kbps
Data Encryption	128-bit and 256-bit AES Counter Mode 128-bit and 256-bit AES Counter Mode with message integrity check
Advanced Features	- Packet Compression - Packet Aggregation • Forward Error Correction - User selectable
Interfaces	
Data Connector	- Three RJ-45 1 Ethernet 2 Serial
USB Connector	Micro USB
RF Connector	TNC
Power Connectors	**Z9-P**: Phoenix (Part # 1776692) **Z9-PE**: Circular (Part # CRD-021717-02-A)
Inputs / Outputs	
Serial	- RS232 - RS485 - RS422 - User selectable
Ethernet	10/100 Base-T - Auto sensing and auto-crossover detecting
Power Requirements	
Operating Voltage	+6 to +30VDC
Tx Current	355 mA @ 12 VDC
Rx Current	100 mA @ 12 VDC
Idle Current	100 mA @ 12 VDC

Technical Specifications	
Specification	**Description**
General Information	
Operating Temperature	-40°C to +85°C -104°F to +185°F ⚠ **Caution**: This is the Z9-P temperature as defined for the exposed copper heat sink surface of the ZumLink radio PCB shown in the Z9-P: Exposed Copper Heat Sink (on page 260) , Figure 142. See Mechanical Drawing - Z9-P (on page 238). **Z9-PE** -40°C to +75°C -104°F to +167°F **Note**: This is the Z9-PE temperature as defined for the local ambient air in contact with the product enclosure and assumes no solar radiation.
Humidity	0 to 95% non-condensing
Dimensions	**Z9-P** 177.29 L x 83.06 W x 40.89 H (mm) 6.98 L x 3.27 W x 1.61 H (in) **Z9-PE** 191.04 L x 109.47 W x 41.91 H (mm) 7.52 L x 4.31 W x 1.65 H (in)
Weight	**Z9-P** 172.37g 0.38 lb **Z9-PE** 750g 1.65 lbs
Reliability	62,000 hour MTBF

Z9-P: Exposed Copper Heat Sink

Figure 142: Exposed copper heat sink surface of the ZumLink Z9-P radio PCB.

Appendix B: LEDs

These are the Z9-P / Z9-PE LEDs.

> **Note**: See Ports and Pinouts (on page 100) for additional information.

Normal Operation

LEDs - Normal Operation				
CD	TX	RX	Condition	Notes
Red ▬			Not Linked	While operating with Frequency Hopping enabled, this LED indicates the radio has NOT received the beacon within the last 60 seconds.
Green ▬			Radio linked	The radio is linked with a margin of 20dB or greater above sensitivity or noise level, whichever is highest.
Green or Alternate Green / Red		Green ▬	Receiving Data	The radio is actively receiving data over the wireless RF link.
Green or Alternate Green / Red	Green ▬		Transmitting Data	The radio is actively transmitting data over the wireless RF link.

LEDs - Normal Operation				
CD	**TX**	**RX**	**Condition**	**Notes**
Alternate Green ▪ / Red ▪		Green ▪	Receiving Data	• There are 4 blink rates for levels 15dB, 10dB, 5dB, and 0dB above sensitivity or noise level, whichever is highest. • The blink rates are faster as the levels increase from the sensitivity / noise point. • The RSSI level is based on the last packet received. • The pattern continues for 60 seconds after the last received packet before turning back to Red if the link has dropped.
Amber ▪	Blink Red ⊖	Blink Red ⊖	Upgrading firmware or changing the configuration.	TX and RX blink in unison at a slow rate.
Blink Red ▪ 5 Times	Off	Off	Upgrade or update failed.	
Blink Green ▪ 5 Times	Off	Off	Upgrade or update succeeded.	

COM LEDs

LEDs - COM		
LED	**Description**	**LED Color**
COM1 Left	Blinking LED when transmitting Data on COM1.	Blinking Green ⊖
COM1 Right	Blinking LED when receiving Data on COM1.	Blinking Green ⊖
COM2 Left	Blinking LED when transmitting Data on COM2.	Blinking Green ⊖
COM2 Right	Blinking LED when receiving Data on COM2.	Blinking Green ⊖

Ethernet LEDs

LEDs - Ethernet		
LED	**LED Color**	**Description**
Ethernet Left	Solid Green ■	• Shows Power. • LED is lit while power is applied to the Ethernet module.
Ethernet Right	Solid Green ■ Blinking Green ⊖	Shows Ethernet link but no activity. • Shows Activity. • LED will blink / flicker while sending and receiving data on the Ethernet port.

Appendix C: Z9-P / Z9-PE Files and Descriptions

When the Windows® Explorer window of the Z9-P / Z9-PE is opened, there are default files that appear.

This is a list of those files and descriptions of their purpose.

> **Note**: If the Z9-P / Z9-PE has been upgraded or rebooted, other files may appear.
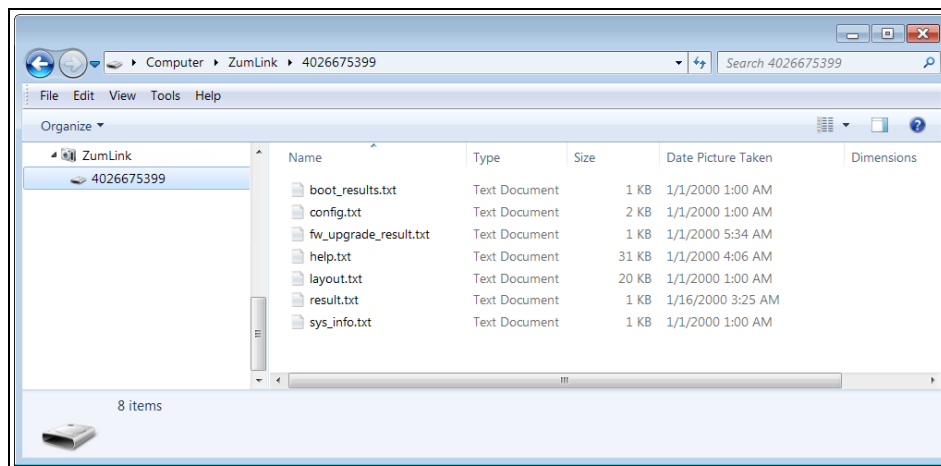
Figure 143: Z9-P / Z9-PE Files shown in Windows® Explorer

Files and Descriptions - Z9-P / Z9-PE	
File Name	**Description**
boot_results.txt	The **boot_results.txt** file shows the firmware version the device is currently running.
config.txt	The **config.txt** file contains all of the configuration parameters of the Z9-P / Z9-PE. These parameters determine how the device functions and connects to other devices in the network.
fw_upgrade_result.txt	The **fw_upgrade_result.txt** file shows the status of the upgrade procedure for the device firmware. **Note**: This file appears after the ZumLink has been upgraded to a newer version of firmware.
help.txt	The **help.txt** file contains online user assistance information using the CLI commands. **Example**: In a CLI window, enter **help=txPower** or **help txpower** to see the help information for the **radioSetting.txpower** setting.
layout.txt	The **layout.txt** file is used for management applications to provide the CLI and **config.cfg** with a format description of the commands.
modbuslayout.txt	**Note**: The **modbuslayout.txt** file is not used.
result.txt	The **result.txt** is used to verify the acceptance or rejection of each parameter change applied to the **config.txt** file. **Note**: This file appears after the **config.txt** file of the ZumLink has been changed.
sys_info.txt	The **sys_info.txt** file provides information about the radio including serial number, model number, firmware versions, and device name.

Appendix D: ZumLink MIB

These are the supported item groups in the ZumLink MIB file:

CPU Usage

ZumLink MIB - CPU Usage					
Objective Type	**Syntax**	**MAX Access**	**Status**	**Description**	**::=**
ssCpuUser	Integer32	Read-only	Deprecated	The percentage of CPU time spent processing user-level code, calculated over the last minute.	{ systemStats 9 }
ssCpuSystem	Integer32	Read-only	Deprecated	The percentage of CPU time spent processing system-level code, calculated over the last minute.	{ systemStats 10 }
ssCpuIdle	Integer32	Read-only	Deprecated	The percentage of processor time spent idle, calculated over the last minute.	{ systemStats 11 }
ssCpuNice	Integer32	Read-only	Deprecated	The percentage of processor time spent nice, calculated over the last minute.	{ systemStats 12 }

Memory Usage

ZumLink MIB - Memory Usage						
Objective Type	**Syntax**	**Units**	**MAX Access**	**Status**	**Description**	**::=**
memTotalSwap	Integer32	kB	Read-only	Current	The total amount of swap space configured for this host.	{ memory 3 }
memAvailSwap	Integer32	kB	Read-only	Current	The amount of swap space currently unused or available.	{ memory 4 }
memTotalReal	Integer32	kB	Read-only	Current	The total amount of real / physical memory installed on the host.	{ memory 5 }
memAvailReal	Integer32	kB	Read-only	Current	The amount of real / physical memory currently unused or available.	{ memory 7 }
memShared	Integer32	kB	Read-only	Current	The total amount of real or virtual memory currently allocated for use as shared memory. This object will not be implemented on hosts where the underlying operating system does not explicitly identify memory as specifically reserved for this purpose.	{ memory 13 }
memBuffer	Integer32	kB	Read-only	Current	The total amount of real or virtual memory currently allocated for use as memory buffers. This object will not be implemented on hosts where the underlying operating system does not explicitly identify memory as specifically reserved for this purpose.	{ memory 14 }
memCached	Integer32	kB	Read-only	Current	The total amount of real or virtual memory currently allocated for use as cached memory. This object will not be implemented on hosts where the underlying operating system does not explicitly identify memory as specifically reserved for this purpose.	{ memory 15 }

ZumLink MIB - Memory Usage						
Objective Type	**Syntax**	**Units**	**MAX Access**	**Status**	**Description**	**::=**
memUsedReal	Integer32	kB	Read-only	Current	The amount of real / physical memory currently used or available.	{ memory 18 }
memSpeed	Integer32	Hz	Read-only	Current	The Speed of real / physical memory.	{ memory 19 }

Disk Usage

ZumLink MIB - Disk Usage						
Objective Type	**Syntax**	**MAX Access**	**Status**	**Description**		**::=**
dskTable	Sequence of DskEntry	Not Accessible	Current	Disk watching information. Partitions to be watched are configured by the **snmpd.conf** file of the agent.		{ ucdavis 9 }
dskEntry	DskEntry	Not Accessible	Current	An entry containing a disk and its statistics. Index = { dskIndex } ``` DskEntry ::= SEQUENCE { dskPath DisplayString, dskDevice DisplayString, dskTotal Integer32, dskAvail Integer32, dskUsed Integer32, dskPercent Integer32, dskPercentNode Integer32 } ```		{ dskTable 1 }
dskPath	DisplayString	Read-only	Current	Path where the disk is mounted.		{ dskEntry 2 }
dskDevice	DisplayString	Read-only	Current	Path of the device for the partition.		{ dskEntry 3 }
dskTotal	Integer32	Read-only	Current	Total size of the disk / partition (kBytes).		{ dskEntry 6 }

ZumLink MIB - Disk Usage					
Objective Type	**Syntax**	**MAX Access**	**Status**	**Description**	**::=**
dskAvail	Integer32	Read-only	Current	Available space on the disk.	{ dskEntry 7 }
dskUsed	Integer32	Read-only	Current	Used space on the disk.	{ dskEntry 8 }
dskPercent	Integer32	Read-only	Current	Percentage of space used on disk.	{ dskEntry 9 }
dskPercentNode	Integer32	Read-only	Current	Percentage of nodes used on disk.	{ dskEntry 10 }

Appendix E: FreeWave Legal Information

Export Notification

FreeWave Technologies, Inc. products may be subject to control by the Export Administration Regulations (EAR) and/or the International Traffic in Arms Regulations (ITAR). Export, re-export, or transfer of these products without required authorization from the U.S. Department of Commerce, Bureau of Industry and Security, or the U.S. Department of State, Directorate of Defense Trade Controls, as applicable, is prohibited. Any party exporting, re-exporting, or transferring FreeWave products is responsible for obtaining all necessary U.S. government authorizations required to ensure compliance with these and other applicable U.S. laws. Consult with your legal counsel for further guidance.

FCC Notifications

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: 1) This device may not cause harmful interference and 2) this device must accept any interference received, including interference that may cause undesired operation.

The content of this guide covers FreeWave Technologies, Inc. models sold under FCC ID: KNYPMT0101AB.

All models sold under the listed FCC ID(s) must be installed professionally and are only approved for use when installed in devices produced by FreeWave Technologies or third party OEMs with the express written approval of FreeWave Technologies, Inc. Changes or modifications should not be made to the device.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC NEMA Installation and Label

Where applicable, the models described in this guide must be installed in a NEMA enclosure. When any FreeWave Technologies, Inc. module is placed inside an enclosure, a label must be placed on the outside of the enclosure. The label must include the text: "**Contains Transmitter Module with FCC ID: KNYPMT0101AB.**"

FCC Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 52 cm between the radiator and your body.

FCC Notification of Power Warning

The ZumLink Z9-P / Z9-PE covered in this document has a maximum transmitted output power of +30dBm.

The antennas used MUST provide a separation distance of at least 52 cm from all persons and MUST NOT be co-located or operate in conjunction with any other antenna or transmitter.

IC Notifications

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Ce dispositif est conforme aux normes permis-exemptes du Canada RSS d'industrie. L'opération est sujette aux deux conditions suivantes: (1) ce dispositif peut ne pas causer l'interférence, et (2) ce dispositif doit accepter n'importe quelle interférence, y compris l'interférence qui peut causer le fonctionnement peu désiré du dispositif.

The content of this documentation covers FreeWave Technologies, Inc. models sold under IC: 2329B-PMT0101AB.

IC Host Installation and Label

When any FreeWave Technologies, Inc. module is placed inside a Host, a label must be placed on the outside of the Host. The label must include the text "**Contains IC: 2329B-PMT0101AB**".

IC Radiation Exposure Statement

This system has been evaluated for RF Exposure per RSS-102 and is in compliance with the limits specified by Health Canada Safety Code 6. The system must be installed at a minimum separation distance from the antenna to a general bystander of 7.8 inches (20 cm) to maintain compliance with the General Population limits.

L'exposition aux radiofréquences de ce système a été évaluée selon la norme RSS-102 et est jugée conforme aux limites établies par le Code de sécurité 6 de Santé Canada. Le système doit être installé à une distance minimale de 7.8 pouces (20 cm) séparant l'antenne d'une personne présente en conformité avec les limites permises d'exposition du grand public.

Mexico IFETEL

Z9-P Número IFETEL: RCPFRZ917-1310-A4.

Z9-PE Número IFETEL: RCPFRZ917-1310.

La operación de este equipo está sujeta a las siguientes dos condiciones: (1) es posible que este equipo o dispositivo no cause interferencia perjudicial y (2) este equipo o dispositivo debe aceptar cualquier interferencia, incluyendo la que pueda causar su operación no deseada.

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UL Power Source

Input power shall be derived from a certified, Class 2:

- single power source or
- a limited power source (LPS) in accordance with:
  - IEC/EN 60950-1
  - CAN/CSA C22.2 No. 60950-1-07.
- Input voltage for the Z9-P / Z9-PE is +6 to +30VDC.

Z9-P Only

Z9-PE Only

When installed in a Restricted Access Location, Max ambient of +75C operating temperature is declared.

When installed in a non-Restricted Access Location, Max ambient of +69C operating temperature is declared.

Caution, Hot Surface

Note: This applies to equipment located in the Restricted Access Location where surface temperatures may reach +75C.

Standards and Editions

- HazLoc Standards
  - ANSI/ISA 12.12.01-2013
  - ANSI/ISA-12.12.01-2015

- CAN/CSA C22.2 No. 213-15
- Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Division 1 and 2 Hazardous (Classified) Locations
- Ordinary Location Standards
  - UL 60950, 2nd Edition
  - CAN/CSA-C22.2 No. 60950, 2nd Edition
  - IEC 60950, 2nd Edition
  - EN 60950, 2nd Edition
- Essential Health and Safety Requirements related to the design and construction of products intended for use in potentially explosive atmospheres given in Annex II to Directive 2014/34/EU of the European Parliament and the Council. Compliance with:
  - EN 60079-0:2012 + A11:2013
  - EN 60079-15:2010
  - **DEMKO 16 ATEX 1705X** Rev 0
  - II 3 G Ex nA IIC T6 Gc

Schedule of Limitations

- Antenna connection is internal wiring only.
- The Ex Components shall only be used in an area of not more than pollution degree 2, as defined in IEC/EN60664-1.
- The Ex Components shall be installed in an enclosure with tool removable door or cover that provides a degree of protection not less than IP 54 in accordance with IEC/EN60679-15.
- Transient protection shall be provided that is set at a level not exceeding 140% of the peak rated voltage value at the supply terminals to the equipment.
- All connectors (J1 to J4) do not have mating connectors with the devices.
- The securement of these connectors must be evaluated during end-product investigation.
- **Z9-PE Only**
- Temperature test was conducted at a rated supply voltage and the maximum surface temperature of +61°C was recorded at +60°C ambient temperature.
- All input power supply wires should be at least **20AWG** wires.
- A dedicated power supply line is preferred.
  The power supply used MUST provide more current than the amount of current drain listed in the specifications for the product and voltage.