



ZumLink™

Covers Model: Z9-T-DEVKIT

Firmware 1.0.7.0

User & Reference Manual



Part Number: LUM0104AA

Revision: Jun-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! Verify power is OFF before connecting or disconnecting the interface or RF cables.

Warranty Information

FreeWave Technologies, Inc. warrants the FreeWave® Z9-T-DEVKIT (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.

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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-T-DEVKIT contains two Z9-Ts that are sold as a multi-board solution, assembled at the FreeWave factory. Any alteration including the separation of the individual boards voids the FreeWave warranty.

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Preface

Other 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, connection, and configuration procedures, and safety information for the Z9-T-DEVKIT.	LUM0104AA
Quick Start Guide	The Quick Start Guide provides the out-of-the-box setup of the Z9-T-DEVKIT.	QSG0055AA

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.

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: **xxxxxxxx**.



Caution: Indicates a situation that **MAY** cause damage to personnel, .

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, .

4. Overview

Thank you for purchasing the FreeWave Z9-T-DEVKIT.

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

The Z9-T-DEVKIT 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.

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.

4.1. Communication Method

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

- The Gateway broadcasts packets to all Endpoints within range.
- The Endpoints unicast packets back to the Gateway.
- The Gateway acknowledges the Endpoint packets.

FreeWave's traditional protocol has a Gateway Time Slot and a Endpoint Time Slot within a frame.

- The Gateway transmits in its slot and listens in the Endpoint slot.
- The Endpoint transmits its slot and listens in the Gateway slot.

5. Included & User-supplied Equipment

5.1. Included Equipment

Note: The **Image Letter** column corresponds to [Figure 1](#)

Included Equipment		
Qty	Description	Image Letter
2	Z9-T mounted to DEVKIT interface board	A
1	DB9 Diagnostic Cable (FreeWave Part Number: AOB1011DC)	B
2	Power Supply: 12VDC @ 800 mA (FreeWave Part Number: EMD1280UW)	C
1	DB9 Male Loopback Connector (FreeWave Part Number: ECN1609LB)	D
2	6 foot DB9 Serial Cable (FreeWave Part Number: ECD2409DM)	E
2	½ Wave 900 MHz Stub Antenna, 2 dBi, SMA Male RF connector (FreeWave Part Number: EAN0900SR)	F
1	Quick Start Guide	

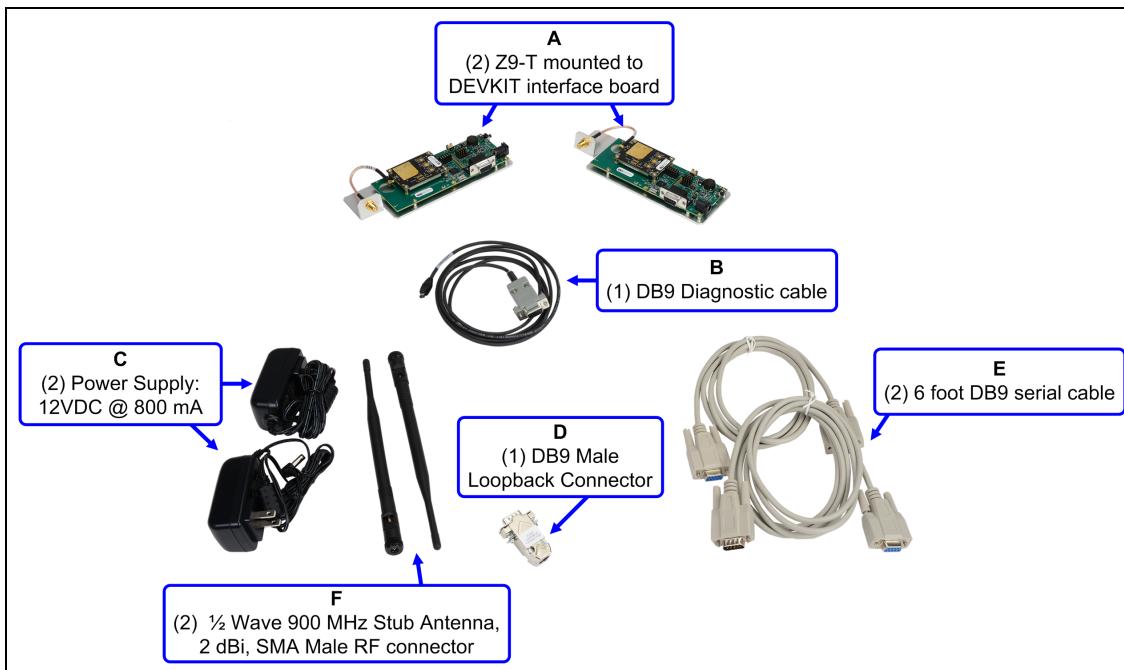


Figure 1: Included Equipment - Z9-T-DEVKIT

5.2. User-supplied Equipment

- **Z9-T Connection:** The Z9-T requires a TTL serial interface that supports a maximum of 3 Mbps over the user data / configuration serial port and 115.2 kbps over the configuration / diagnostic serial port.
- USB to micro-USB cable (Qty: 1 to 2)
- USB to DB9 serial adapter cable for diagnostics (Qty: 1 to 2)
- Computer (Qty: 1 to 2)

6. Port Connections and Pinout Assignments

Port Connections

- [Z9-T-DEVKIT Ports and Pinout Connections \(on page 13\)](#)

Pinout Assignments

- [Z9-T-DEVKIT J4 - TTL Serial Port Pinout Assignments \(on page 14\)](#)

6.1. Z9-T-DEVKIT Ports and Pinout Connections

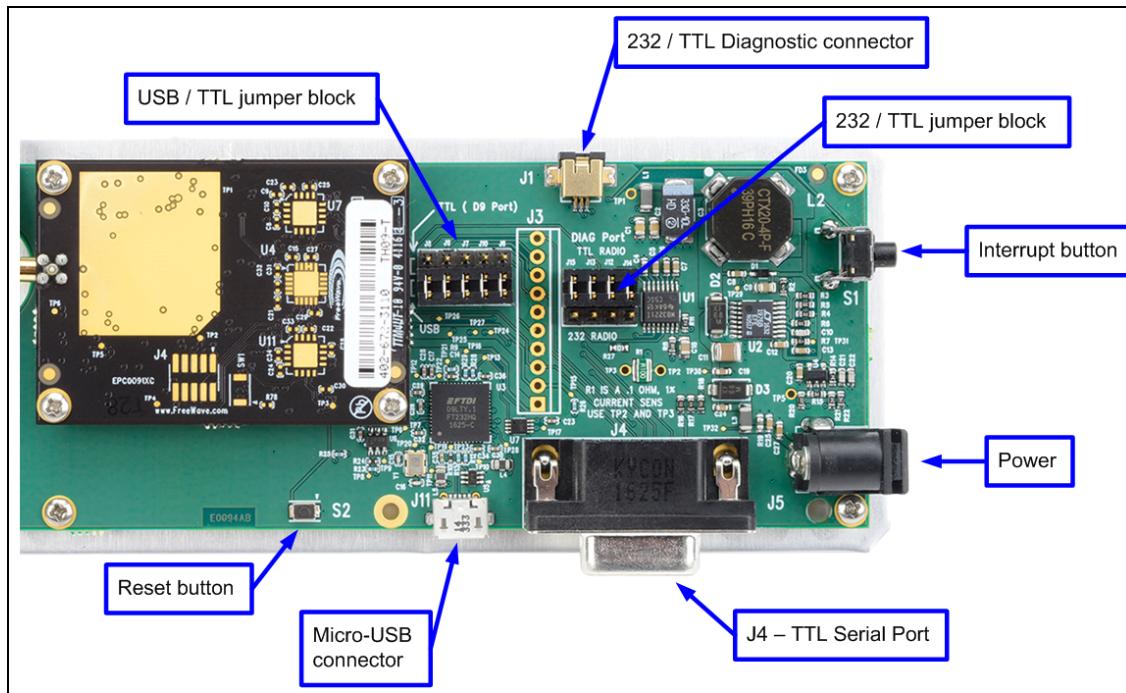


Figure 2: Z9-T-DEVKIT Port Connections

6.2. Diagnostics Port Connector

These are the pins for the **232 / TTL** Diagnostic connector in [Figure 2](#):

- (J1) – depending on the jumper setting, signals are either routed through just traces or through an RS232 level shifter:
- J1-2 Transmit (output)
- J1-3 Receive (input)

6.3. Z9-T-DEVKIT J4 - TTL Serial Port Pinout Assignments

Important!: These pin assignments for the J4 - TTL Serial Port are ONLY applicable if the **USB / TTL** jumper block is in the TTL position.

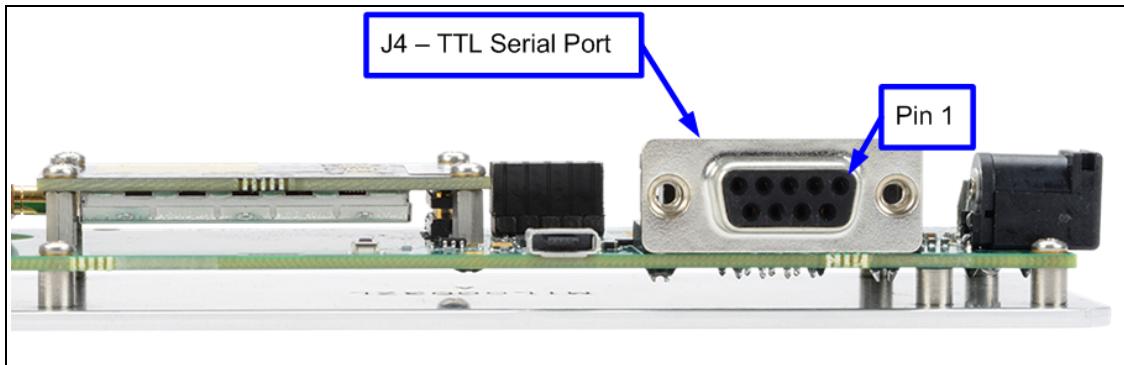


Figure 3: Z9-T-DEVKIT J4 - TTL Serial Port Pinout Assignments

Note: The information in the table refers to the **Serial Ports** in [Figure 3](#).

(I) - Input

(O) - Output

Z9-T-DEVKIT J4 - TTL Serial Port Pinout Assignments		
Pin Number	TTL***	Description
1	CD --- (O)	Carrier detect output
2	TXD --- (O)	Transmit data output
3	RXD --- (I)	Receive data input
4	DTR --- (I)	Data terminal ready input
5	GND	Ground
6	DSR --- (O) **	Data set ready output
7	RTS --- (I)	Request to send input
8	CTS --- (O)	Clear to send output
9	GND	Ground

Notes

- **Pin 6 is DSR --- (O) at +5VDC and is asserted at bootup.
- ***The J4 - TTL Serial Port signal levels are TTL **NOT** RS232.

7. Installation

- [Power Setup \(on page 16\)](#)
- [Signal Level Pin Placement \(on page 16\)](#)
 - [Routing to the Primary Port \(USB or TTL\) \(on page 17\)](#)
 - [Diagnostic Signal Level Connection \(on page 17\)](#)
- [Installation \(on page 17\)](#)

7.1. Power Setup

- The Z9-T-DEVKIT is approved to operate with an input voltage range of +3 to +5VDC ($\pm 10\%$) that can supply at least 0.8 Amps.
- See the [Technical Specifications \(on page 97\)](#) for additional information.

FREEWAVE Recommends: All input power supply wires should be at least **20AWG** wires.

A dedicated and stable 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 mA at 12V)



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

7.2. Signal Level Pin Placement

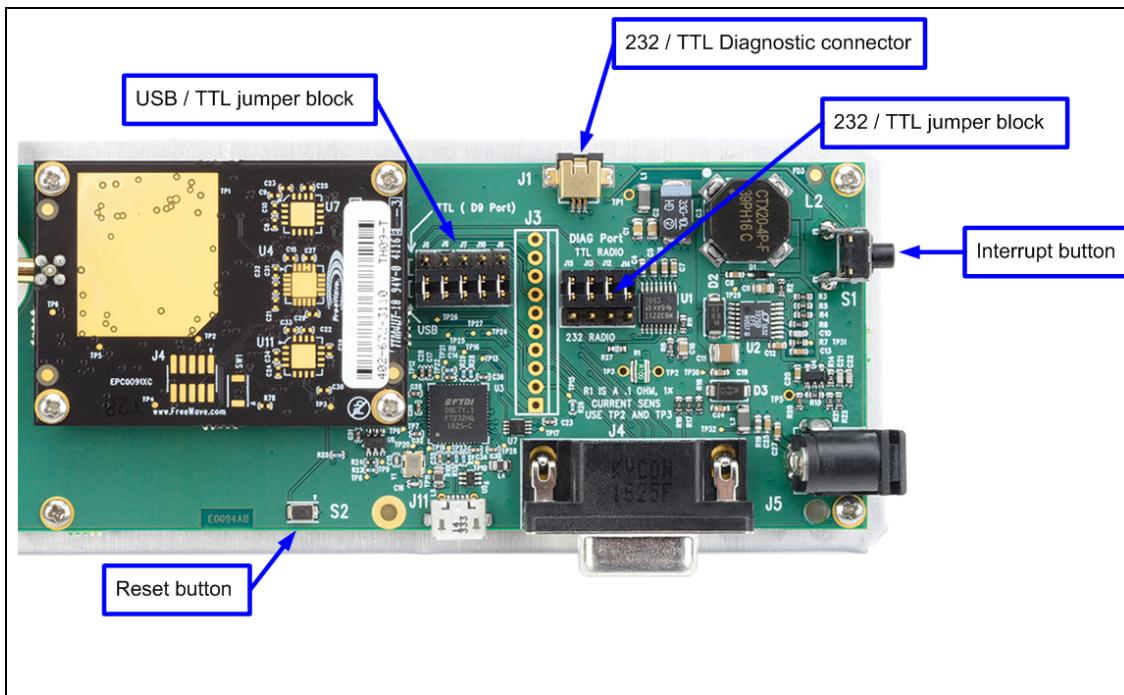


Figure 4: Z9-T-DEVKIT Signal Level Pin Placement

7.2.1. Routing to the Primary Port (USB or TTL)

- Move ONLY the **USB / TTL** jumper block to the:
 - **Lower and middle pins** to have the signals sent to the Micro-USB connector.
 - **Upper and middle pins** to have the signals sent to the J4 - TTL Serial Port.
 - See Ports and Pinouts.
- Press the **Interrupt** button to ground Pin 2 on the Z9-T, then use the CLI to configure the Z9-T.
- Press the **Reset** button to ground Pin 6 and reset the Z9-T.

7.2.2. Diagnostic Signal Level Connection

- Move ONLY the **232 / TTL** jumper block to the:
 - **Lower and middle pins** to set the signal levels of the **232 / TTL** Diagnostic connector to be RS232.
 - **Upper and middle pins** to set the signal levels of the **232 / TTL** Diagnostic connector to be TTL.
- Press the **Interrupt** button to ground Pin 2 on the Z9-T, then use the CLI to configure the Z9-T.
- Press the **Reset** button to ground Pin 6 and reset the Z9-T.

Note: See Connections for additional information.

7.3. Installation

Important! The Z9-T-DEVKIT is approved to operate with an input voltage range of +3 to +5VDC ($\pm 10\%$) that can supply at least 0.8 Amps.

1. Connect the provided antenna to the SMA connector on the Z9-T-DEVKIT interface board.



Warning! Only FCC approved antennas may be used.

2. Connect the provided power supply to the Z9-T-DEVKIT interface board.

FREEWAVE Recommends: All input power supply wires should be at least **20AWG** wires. A dedicated and stable 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 \(on page 100\)](#) for more information.

3. Connect the USB cable to the computer and the micro-USB end to the Z9-T-DEVKIT interface board.

Important! The USB does NOT power the Z9-T-DEVKIT interface board. It only provides a configuration interface.

4. Continue with:
 - [Firmware Upgrade \(on page 19\)](#)
 - [CLI Configuration \(on page 32\)](#)

8. Firmware Upgrade

Important!: The [Download](#) procedure must be completed first.

These are the basic steps to upgrade the Z9-T-DEVKIT firmware:

- A. [Download the Upgrade File \(on page 20\)](#)
- B. [Upgrade the Z9-C or Z9-T \(on page 25\)](#)

8.1. Download the Upgrade File

Note: The Z9-C and Z9-T use the ZumLink Z9-C and Z9-T Programmer Tool to install the firmware upgrade file.

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.

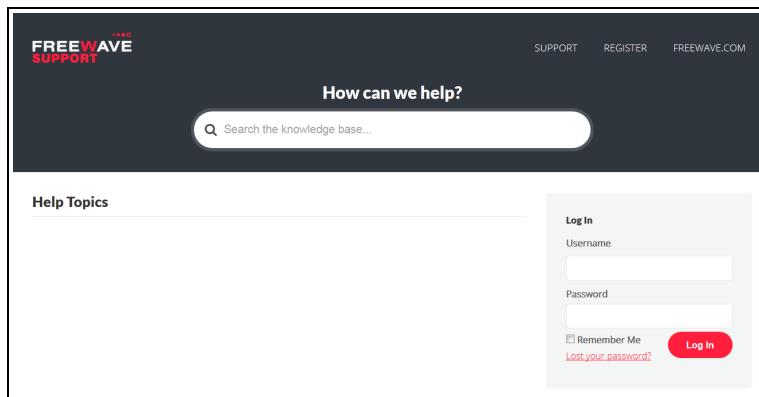


Figure 5: FreeWave Login window

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

3. Click .

A successful Login message briefly appears.

The **Help Topics** window opens.

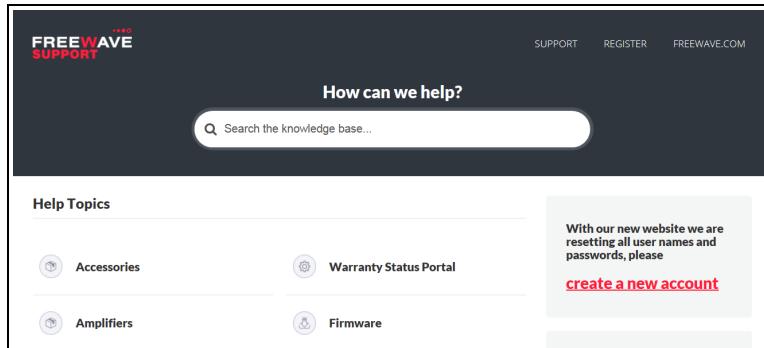


Figure 6: Help Topics window

4. Click the **Firmware** link.

The **Firmware** window opens.

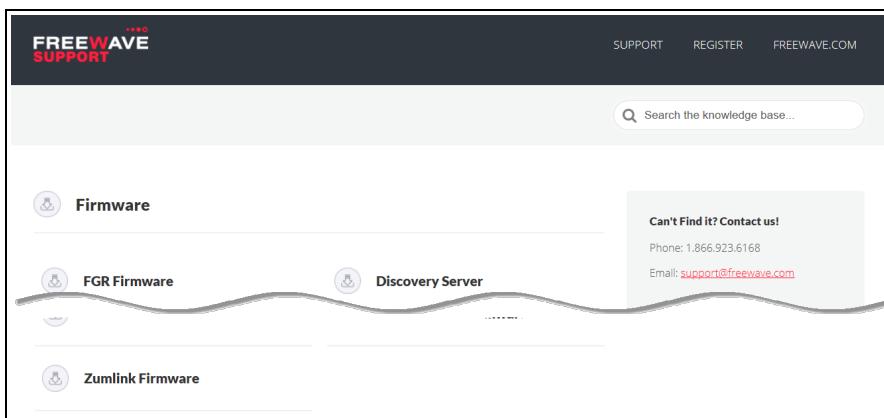


Figure 7: Firmware window

5. Click the **ZumLink Firmware** link.

The available firmware/software appears in the window.

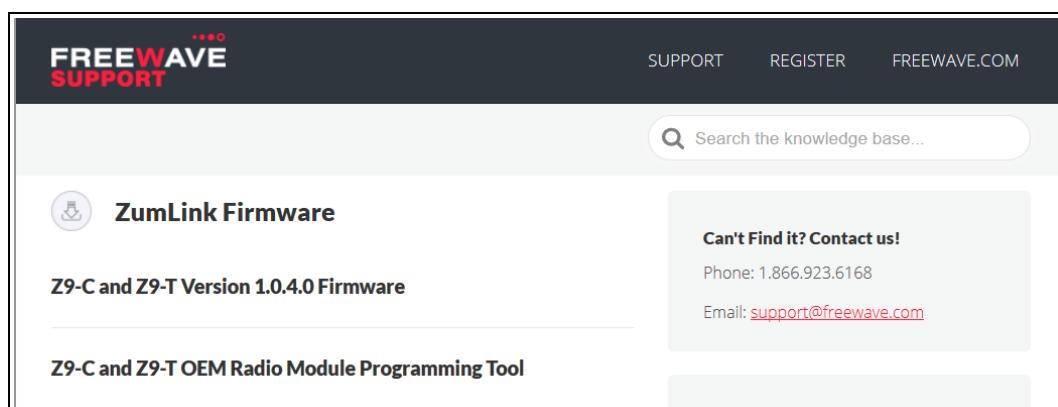


Figure 8: ZumLink Firmware window

6. Click the firmware/software link.
The **Firmware Upgrade** window opens.
7. Select and click the attachment.

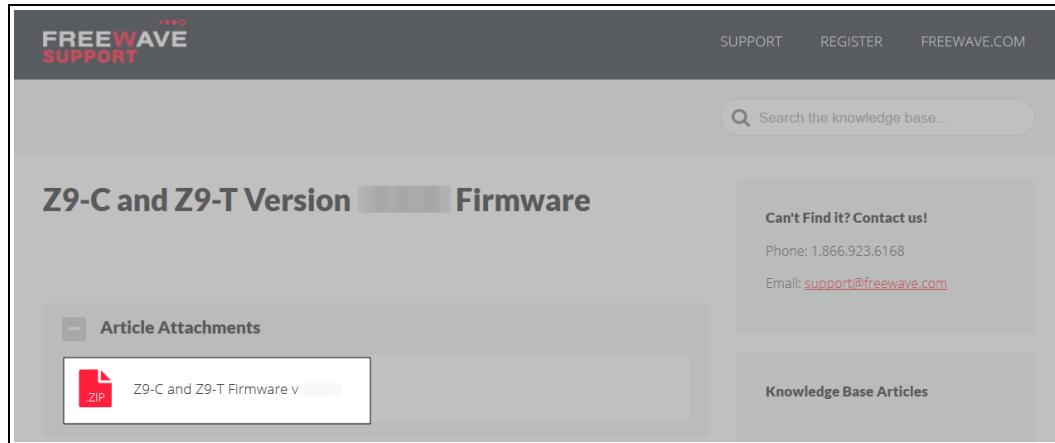


Figure 9: Z9-C / Z9-T Firmware Upgrade window with selected attachment

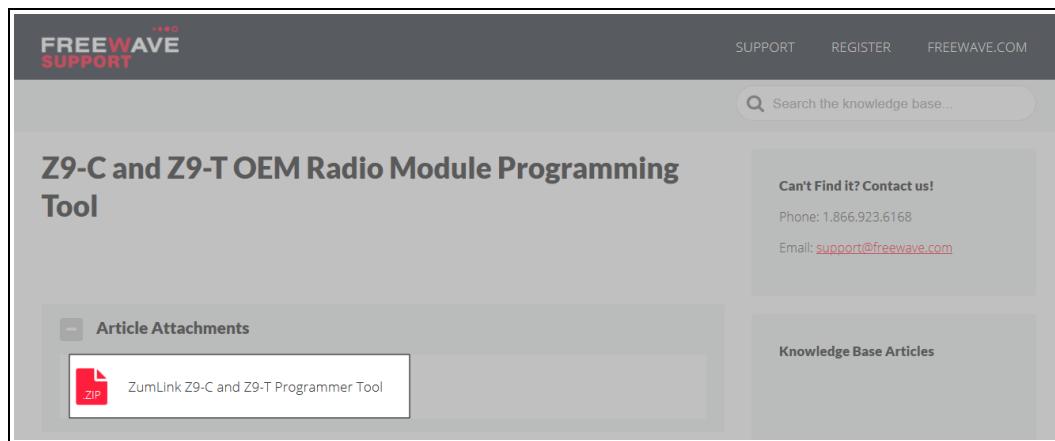


Figure 10: ZumLink Z9-C and Z9-T Programmer Tool Firmware Upgrade window with selected attachment

The **Opening** dialog box opens.

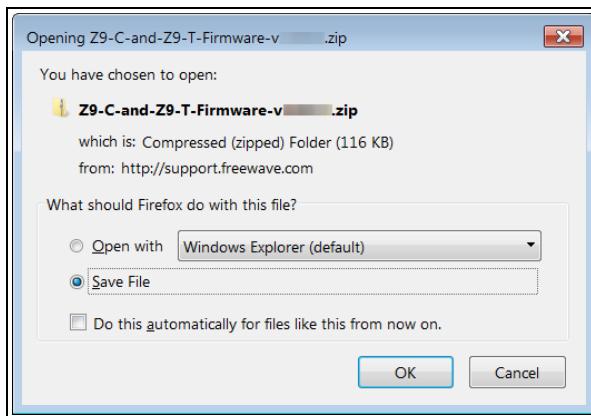


Figure 11: Z9-C / Z9-T Opening dialog box

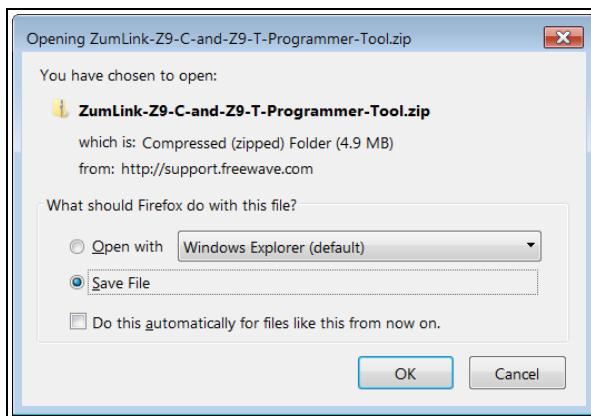


Figure 12: ZumLink Z9-C and Z9-T Programmer Tool Opening dialog box

8. Click OK.

The Enter name of file to save to dialog box opens.

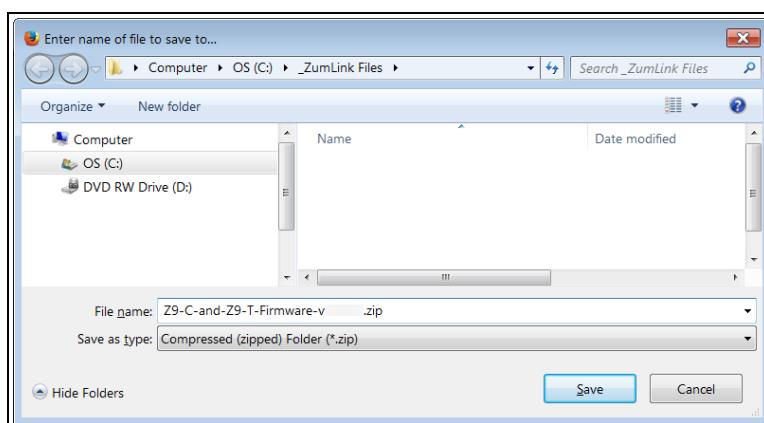


Figure 13: Z9-C / Z9-T Enter name of file to save to dialog box

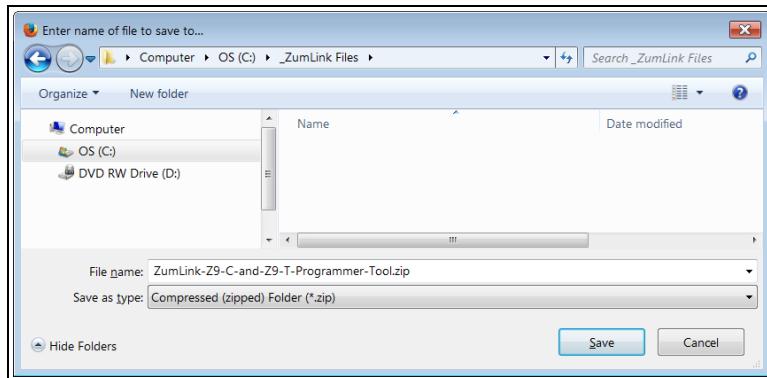


Figure 14: ZumLink Z9-C and Z9-T Programmer Tool Enter name of file to save to dialog box

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 **.fcf** and **.exe** from their respective **.zip** file into the same location.

Note: The Z9-C / Z9-T **.zip** file has only the **.fcf** file used in the upgrade process.

Note: The ZumLink Z9-C and Z9-T Programmer Tool **.zip** file has only the **.exe** file used in the upgrade process.

13. Continue with [Upgrade the Z9-C or Z9-T \(on page 25\)](#) procedure.

8.2. Upgrade the Z9-C or Z9-T

This procedure describes using drag and drop to upgrade the Z9-C or Z9-T firmware.

Notes

- This procedure is for a Z9-T-DEVKIT module interfaced to a computer. If interfaced to a device other than a computer, some of these procedure steps may not be used.
- The images in this procedure are for Windows® 7 and/or Firefox®. The dialog boxes and windows appear differently on each computer.
- This procedure provides a Tera Term terminal connection to the Z9-T-DEVKIT CLI. Other terminal emulators (e.g., HyperTerminal, PuTTY) may be used.

Procedure

1. Verify the [Download the Upgrade File \(on page 20\)](#) procedure is complete.
2. Connect the USB cable to the computer and the micro-USB end to the Z9-T-DEVKIT.
 - The Z9-T model has a TTL interface and does NOT work directly with RS232.
 - If connecting to a device or circuit that is RS232, a circuit is required to adapt between the two interfaces.

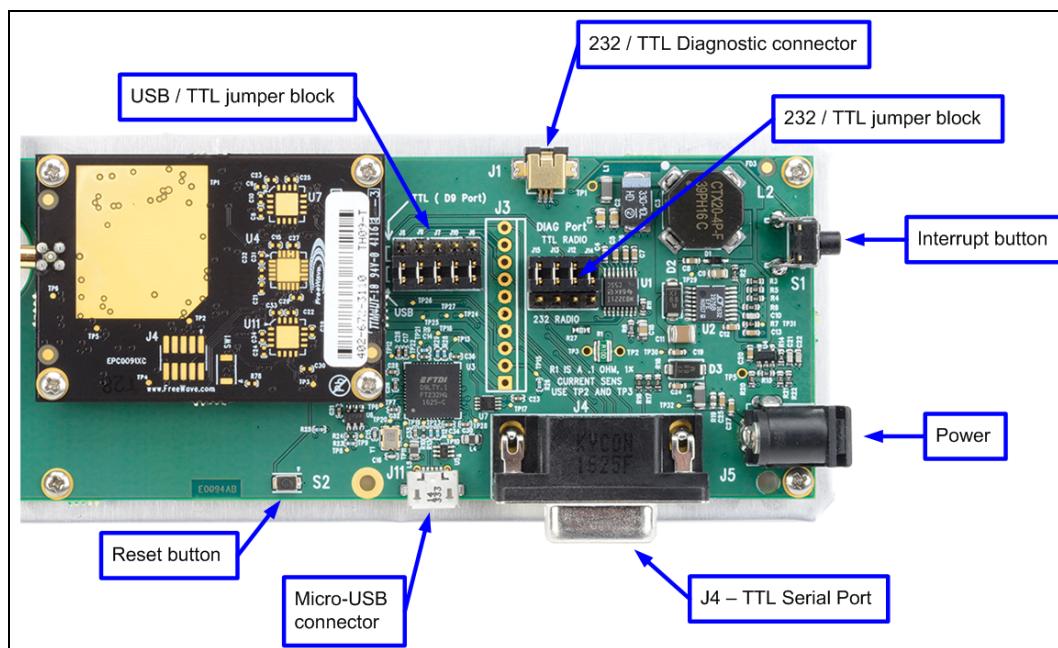


Figure 15: Z9-T-DEVKIT Connections

3. On the computer connected to the Z9-T-DEVKIT, open a terminal program (e.g., Tera Term).

Note: This procedure provides a Tera Term terminal connection to the Z9-T-DEVKIT 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.

4. In Tera Term, click the **File** menu and select **New Connection**.

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

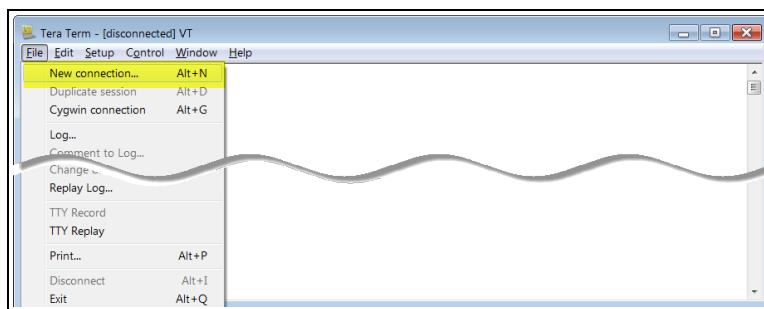


Figure 16: File menu > New Connection

5. Click the **Port** list box arrow and select the COM port the Z9-T-DEVKIT is connected to.

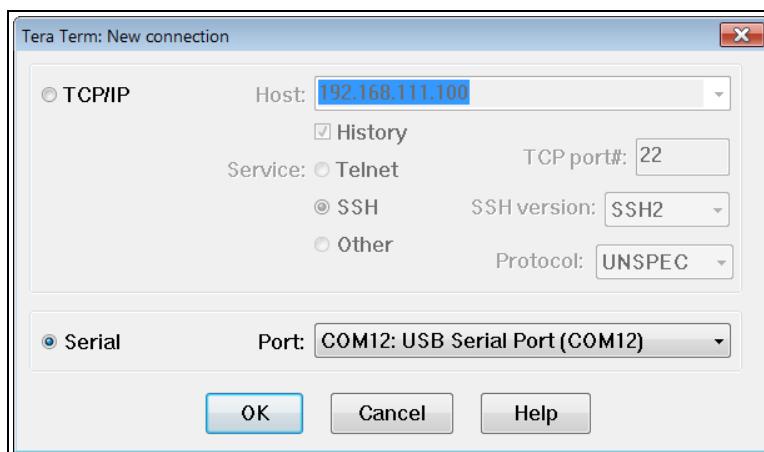


Figure 17: Select the ZumLink COM port

6. 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.
7. In the Tera Term window, click the **Setup** menu and select **Serial Port**.

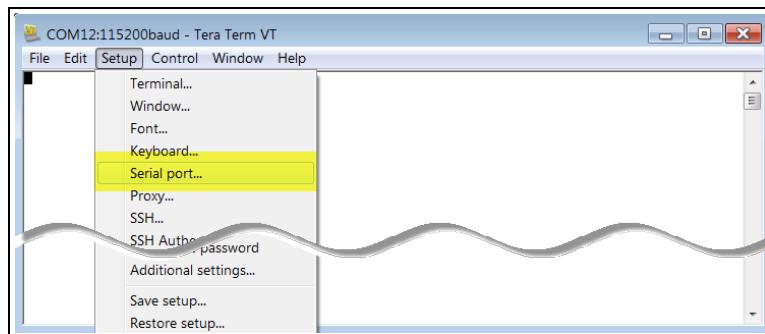


Figure 18: Serial menu > Setup Port

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

Note: The image shows the default Z9-T-DEVKIT settings.

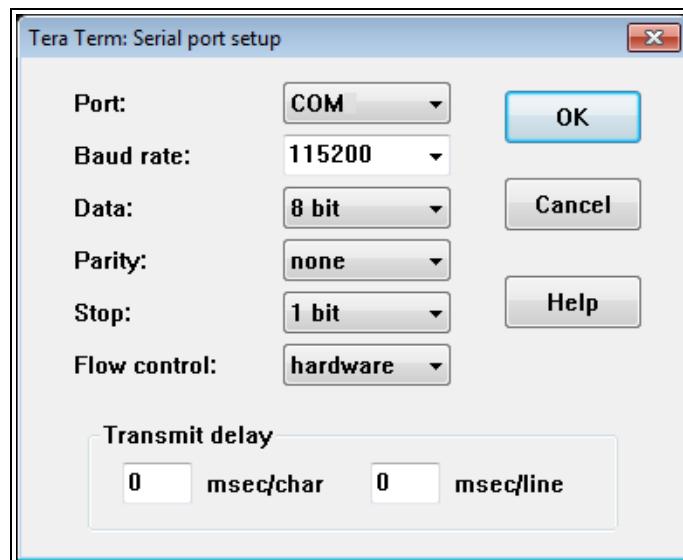


Figure 19: Tera Term: Serial Port Setup dialog box with default settings

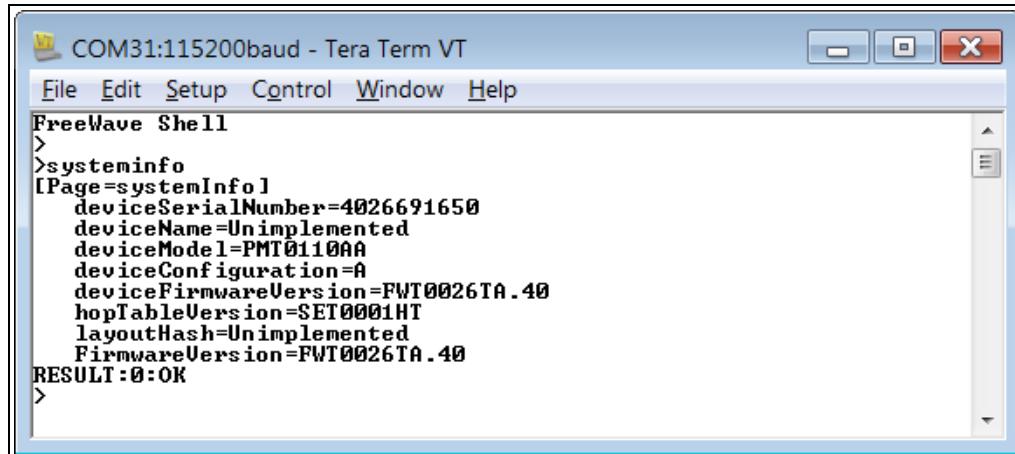
8. **Important:** Verify, and change if required, the Tera Term serial port settings (except the **Port** setting) of the connected Z9-T-DEVKIT so the settings are the same as the defaults shown in [Figure 19](#).

Example: If the **Baud Rate** is 9600, click the list box arrow and select 115200.

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

Note: If using the ASC2414DJ cable purchased from FreeWave, push the **Reset** button. Otherwise complete Step 10.

10. Press the **Interrupt** button to ground Pin 2 on the Z9-T, then use the CLI to configure the Z9-T.
11. In Tera Term, press <Enter>. The **FreeWave Shell** returns.
12. Optional: At the > prompt, type **systeminfo** and press <Enter> to view the current firmware version on the Z9-C or Z9-T (Figure 20).



```
COM31:115200baud - Tera Term VT
File Edit Setup Control Window Help
FreeWave Shell
>
>systeminfo
[Page=systemInfo]
  deviceSerialNumber=4026691650
  deviceName=Unimplemented
  deviceModel1=PMT0110AA
  deviceConfiguration=A
  deviceFirmwareVersion=FWT0026TA.40
  hopTableVersion=SET0001HT
  layoutHash=Unimplemented
  FirmwareVersion=FWT0026TA.40
RESULT:0:OK
>
```

Figure 20: Existing Firmware Version Installed on the Z9-C / Z9-T

13. At the > prompt, type **serialPortConfig.cliBaudRate=230400**.
14. At the > prompt, type **serialPortConfig.flowControl=Off**.
15. At the > prompt, type **save** and press <Enter>.
16. At the > prompt, type **exit** and press <Enter>.
17. Press the **Interrupt** button to ground Pin 2 on the Z9-T, then use the CLI to configure the Z9-T.
18. Open the Microsoft® Windows® **Device Manager**.
19. Locate and identify the COM port for the Z9-T-DEVKIT.
20. Locate the designated folder for the ZumLink Z9-C and Z9-T Programmer Tool .exe file and double-click the .exe file.

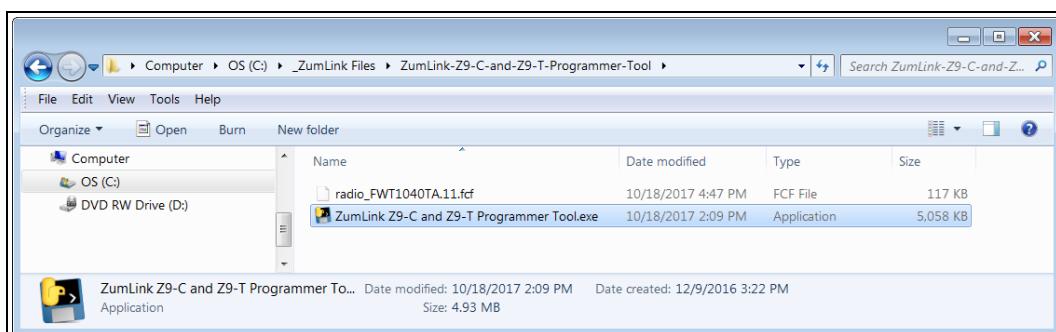


Figure 21: Double-click the .exe File

The ZumLink Z9-C and Z9-T Programmer Tool opens.

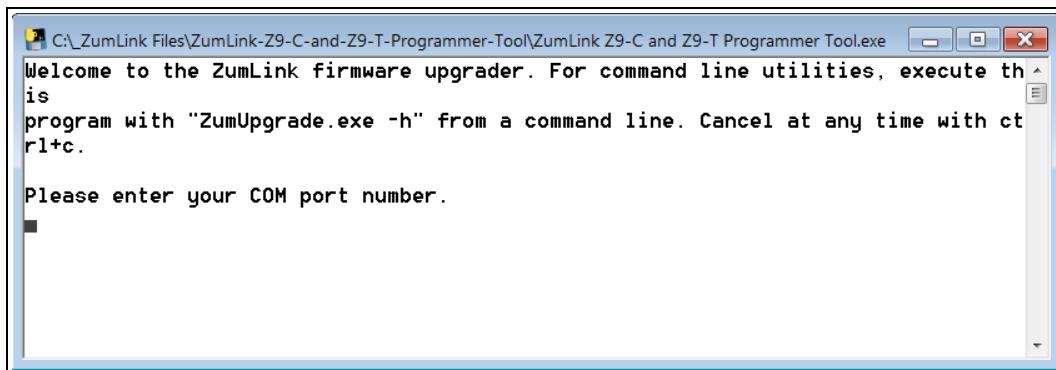


Figure 22: Opened ZumLink Z9-C and Z9-T Programmer Tool

21. Enter the COM port for the Z9-T-DEVKIT and press <Enter>.

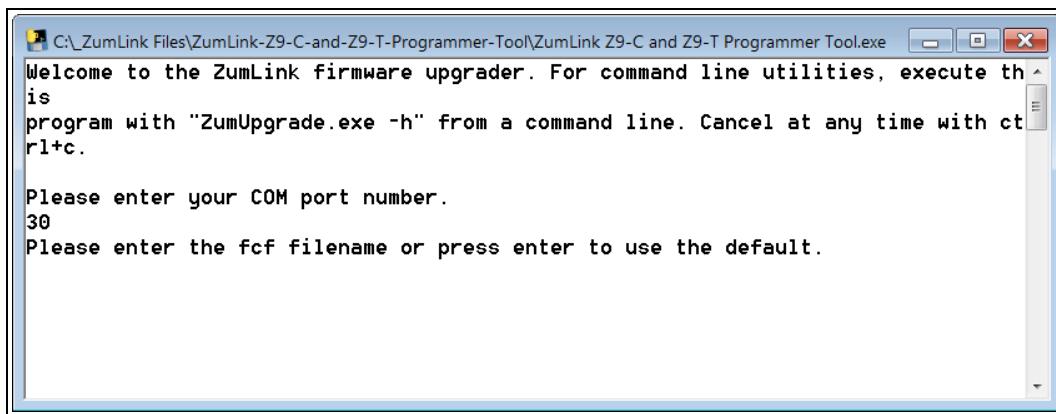


Figure 23: Opened ZumLink Z9-C and Z9-T Programmer Tool

22. Enter the name of the **.fcf** file in the designated download folder and press <Enter>.

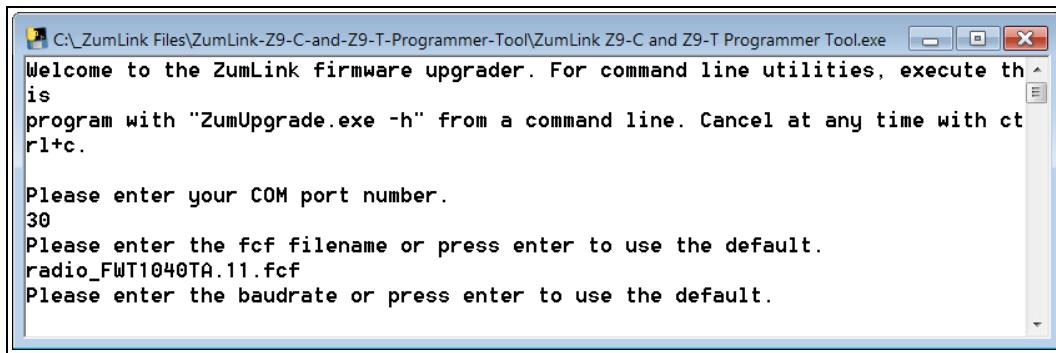
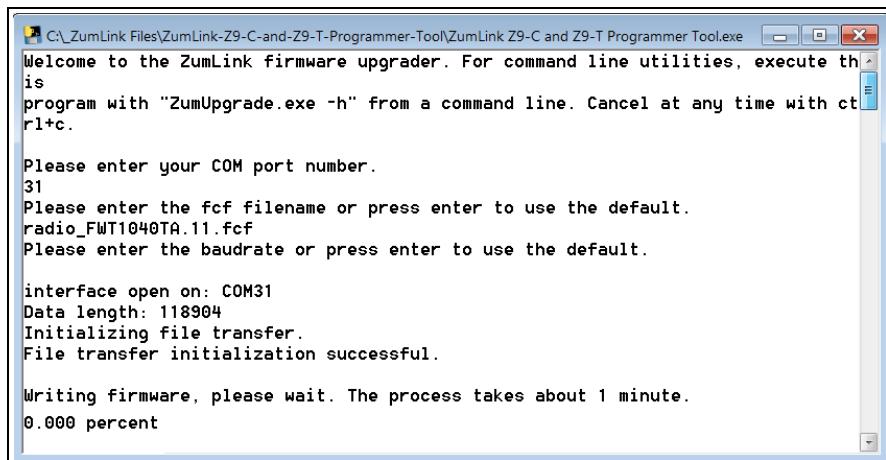


Figure 24: Opened ZumLink Z9-C and Z9-T Programmer Tool

23. Type **230400** for the baudrate and press <Enter>.



```
C:\ZumLink Files\ZumLink-Z9-C-and-Z9-T-Programmer-Tool\ZumLink Z9-C and Z9-T Programmer Tool.exe
Welcome to the ZumLink firmware upgrader. For command line utilities, execute this
program with "ZumUpgrade.exe -h" from a command line. Cancel at any time with ct
rl+c.

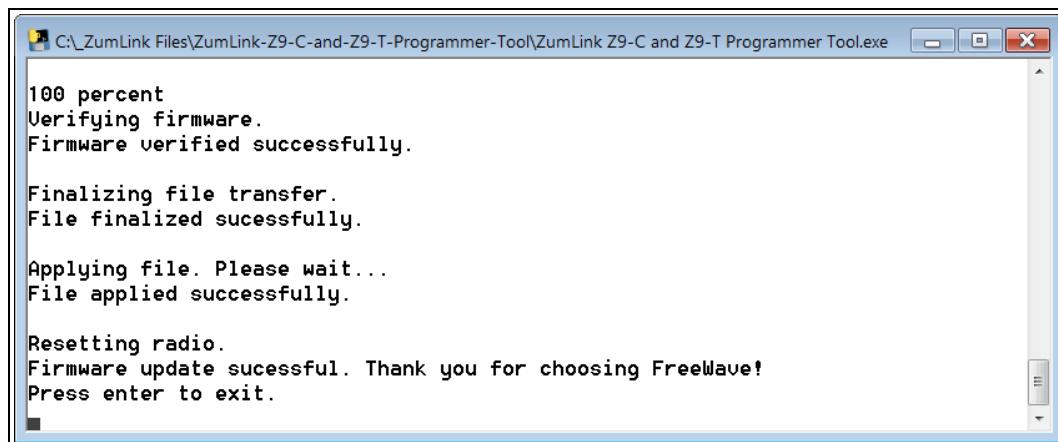
Please enter your COM port number.
31
Please enter the fcf filename or press enter to use the default.
radio_FW1040TA.11.fcf
Please enter the baudrate or press enter to use the default.

interface open on: COM31
Data length: 118904
Initializing file transfer.
File transfer initialization successful.

Writing firmware, please wait. The process takes about 1 minute.
0.000 percent
```

Figure 25: Initialed Upgrade Process

A successful upgrade message appears when the upgrade process is complete. ([Figure 26](#))



```
C:\ZumLink Files\ZumLink-Z9-C-and-Z9-T-Programmer-Tool\ZumLink Z9-C and Z9-T Programmer Tool.exe

100 percent
Verifying firmware.
Firmware verified successfully.

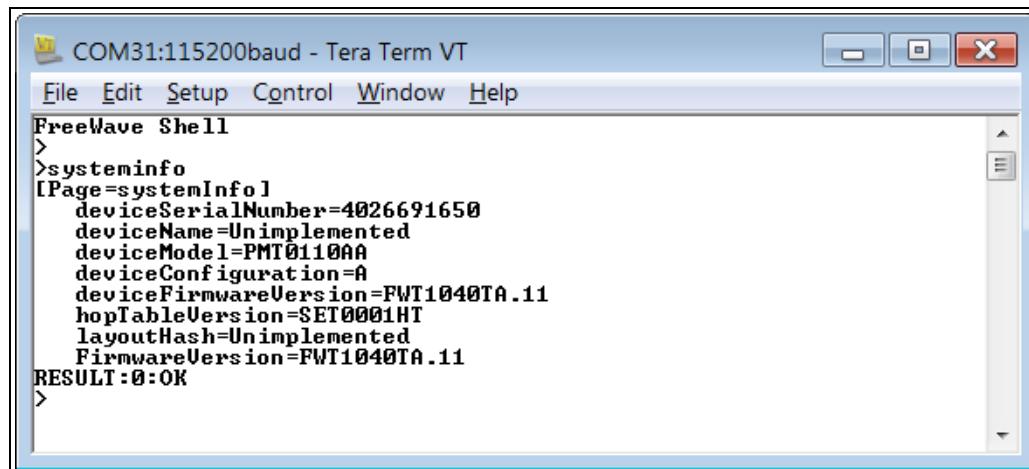
Finalizing file transfer.
File finalized sucessfully.

Applying file. Please wait...
File applied successfully.

Resetting radio.
Firmware update sucessful. Thank you for choosing FreeWave!
Press enter to exit.
```

Figure 26: Successful Upgrade Process

24. Optional: Open Tera Term to view the upgraded firmware version on the [systeminfo](#) page ([Figure 27](#)):



The screenshot shows a window titled "COM31:115200baud - Tera Term VT". The menu bar includes File, Edit, Setup, Control, Window, and Help. The main window displays the FreeWave Shell prompt (>) followed by the output of the systeminfo command. The output details the device's serial number (4026691650), name (Unimplemented), mode (PMT0110AA), configuration (A), firmware version (FWT1040TA.11), hop table version (SET0001HT), and layout hash (Unimplemented). The final line shows the result as "RESULT : 0:OK".

Figure 27: systeminfo page Showing Upgraded Firmware Version

25. Use the [CLI Configuration \(on page 32\)](#) procedure to configure the ZumLink.

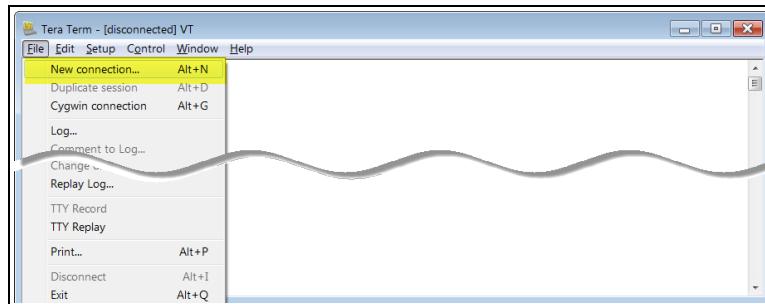
9. CLI Configuration

Important!: A Serial Port on the computer is required for this procedure.

Procedure

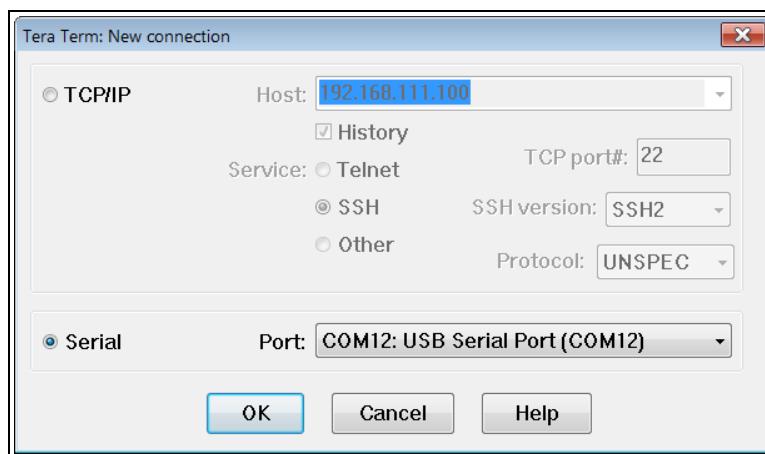
Note: The images in this procedure are for Windows® 7 and/or Firefox®.
The dialog boxes and windows appear differently on each computer.
This procedure provides a Tera Term terminal connection to the Z9-T-DEVKIT CLI. Other terminal emulators (e.g., HyperTerminal, PuTTY) may be used.

1. Using the **Data Interface Connector** (see Ports for location):
 - a. Connect to the Serial Interface of the ZumLink device.
 - The Z9-C model has an RS232 interface and can be connected directly to an RS232 device.
 - FreeWave offers a cable (FreeWave Part Number: ASC2414DJ) from the radio to a DB9 connector that includes a reset button and power input jack.
 - The Z9-T model has a TTL interface and does NOT work directly with RS232.
 - If connecting to a device or circuit that is RS232, a circuit is required to adapt between the two interfaces.
 - b. Apply power to the ZumLink device.
2. On the computer connected to the Z9-T-DEVKIT, open a terminal program (e.g., Tera Term).
3. In Tera Term, click the **File** menu and select **New Connection**.

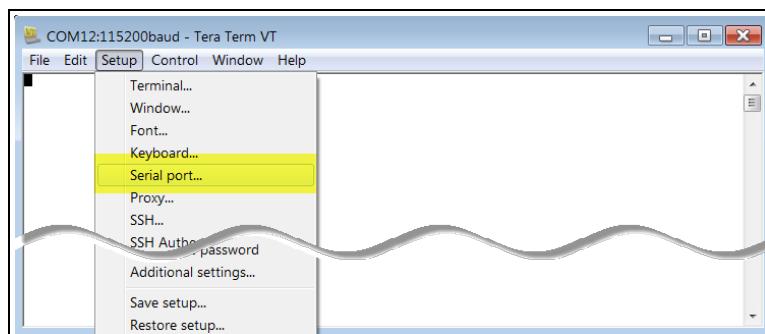
**Figure 28: File menu > New Connection**

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

4. Click the **Port** list box arrow and select the COM port the Z9-T-DEVKIT is connected to.

**Figure 29: Select the ZumLink COM port**

5. 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.
6. In the Tera Term window, click the **Setup** menu and select **Serial Port**.

**Figure 30: Serial menu > Setup Port**

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

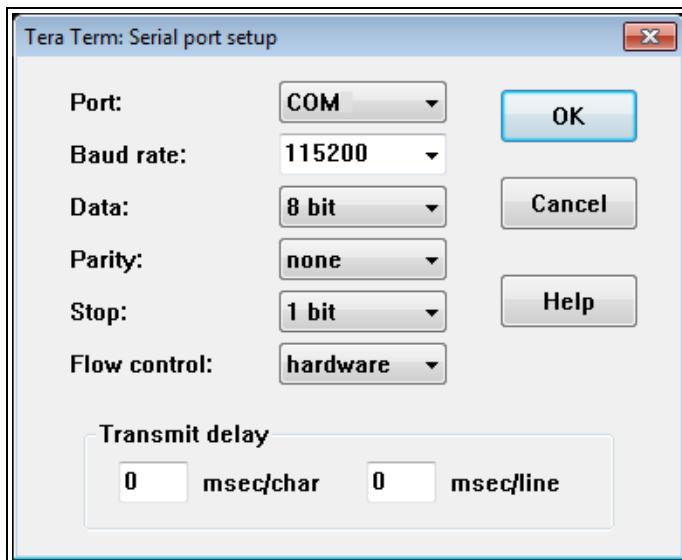


Figure 31: Tera Term: Serial Port Setup dialog box with Default Z9-T-DEVKIT Settings

7. **Important:** Verify, and change if required, the Tera Term serial port settings (except the **Port** setting) of the connected Z9-T-DEVKIT so the settings are the same as the defaults shown in [Figure 31](#).

Example: If the **Baud Rate** is 9600, click the list box arrow and select 115200.

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

Note: If using the ASC2414DJ cable purchased from FreeWave, push the **Reset** button. Otherwise complete Step 9.

9. Press the **Interrupt** button to ground Pin 2 on the Z9-T, then use the CLI to configure the Z9-T.
10. In Tera Term, press <Enter>. The **FreeWave Shell** returns.

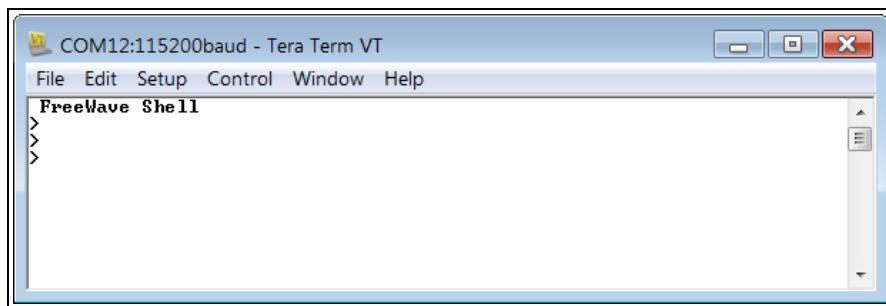


Figure 32: FreeWave Shell in Tera Term

11. Continue with [Creating a Basic ZumLink Gateway and Endpoint Network \(on page 35\)](#).

10. Creating a Basic ZumLink Gateway and Endpoint Network

1. Connect and apply power to the ZumLink devices in the network.
2. Complete the [CLI Configuration \(on page 32\)](#) procedure.
3. Select one radio and, at the > prompt, type `radioSettings.radioMode=Gateway` and press <Enter>.
4. At the > prompt, type a setting between **10 and 30** for the `radioSettings.txPower` and press <Enter>.

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



Tip Entering `txpower=0` or `radiosettings.txpower=0` changes the output power to the minimum or 10 dB.

Note: See [radioSettings Parameters \(on page 57\)](#) for detailed information.

5. For the other radio in the network, at the > prompt, type `radioSettings.radioMode=Endpoint` and press <Enter>.
6. Verify the `radioSettings.networkId` setting is the same on ALL radios in the network.

Note: For Endpoints, the `radioSettings.nodeID` is set automatically.

Important!: The Gateway `radioSettings.nodeID` defaults to 1 and CANNOT be changed.

7. At the > prompt, type **save** and press <Enter>. A solid green D1 LED indicates that the radios are linked.

Note: See [LEDs \(on page 100\)](#) for additional information.

8. Verify the [serialMode \(on page 81\)](#) parameter is set to **system.serialMode=Passthru_Data**.

Important! The **serialMode** setting MUST be set to **Passthru_Data** for the Z9-T-DEVKIT to connect.

9. Type **exit** and press <Enter> to exit the FreeWave Shell.
10. If **exit** is entered, press and release the **Reset** button to return to CLI mode.
11. Optional: Continue with [Z9-T-DEVKIT Data Test Procedure \(on page 37\)](#).

11. Z9-T-DEVKIT Data Test Procedure

The Z9-T-DEVKIT Data Test Procedure allows the user to support higher COM port data rates for the Serial Port on the Z9-T-DEVKIT.

Important!: This procedure requires 2 Z9-T-DEVKIT devices.

This section includes:

- [Data Test Procedure \(on page 38\)](#)
 - [Verify the Data Flows between the Z9-T-DEVKIT Devices \(on page 38\)](#)
- [Z9-T-DEVKIT Gateway Settings \(on page 39\)](#)
- [Z9-T-DEVKIT Endpoint Settings \(on page 40\)](#)

11.1. Data Test Procedure

Important!: This procedure requires 2 Z9-T-DEVKIT devices.

1. Download the latest FTDI drivers at http://www.ftdichip.com/Drivers/CDM/CDM21228_Setup.zip.
2. Uncompress the files.
3. Run the **Setup** program.
4. Wait for the driver installation to finish.

Note: The drivers are automatically updated to the current Windows® driver versions.

5. Connect to the first Z9-T-DEVKIT using the USB to micro-USB cable and configure the radio as a Gateway using a Serial Port of 3000000 baud (see [Z9-T-DEVKIT Gateway Settings \(on page 39\)](#)).
6. Connect to the second Z9-T-DEVKIT using the USB to micro-USB cable and configure the radio as an Endpoint using a Serial Port of 3000000 baud (see [Z9-T-DEVKIT Endpoint Settings \(on page 40\)](#)).
7. Open Tera Term.
8. Connect to the Gateway, with the baud rate of 3000000 (manually entered), 8-N-1, and a **serialPortConfig.flowControl=Hardware**.
9. Open a second instance of Tera Term.
10. Connect to the Endpoint, with the baud rate of 3000000 (manually entered), 8-N-1, and a **serialPortConfig.flowControl=Hardware**

11.1.1. Verify the Data Flows between the Z9-T-DEVKIT Devices

1. On the Endpoint, use the **File > Log** menu to enable Tera Term logging.
 2. Log to a file titled **z9test.txt**.
 3. On the Gateway, use the Tera Term Send command (**File** menu > **Send File**) to send **TestFile.txt** out to the Gateway.
 4. Observe text appearing in the Endpoint Tera Term window.
 5. Once the send was finished, click **Close** on the Log File for the Endpoint.
 6. Download and install Notepad++ from <https://notepad-plus-plus.org/download/v7.5.4.html>.
 7. Open the **TestFile.txt** file in Notepad++.
 8. Using the **Search/Replace** function, replace the CR and LF at the end of the lines with a blank.
- Note:** This is necessary because the CR and LF are not interpreted by the log file.
9. Save this edited file as **TestFile_Compare.txt**.
 10. Copy **z9test.txt** and **TestFile.txt** to a computer running **Ubuntu Linux**.

11. In a terminal window on **Ubuntu**, run the command `diff -q z9test.txt TestFile_Compare.txt`.

Note: This command compares the two text files for differences.
If the command returns with a blank readout, it means the two files are the same.

11.2. Z9-T-DEVKIT Gateway Settings

```
radiosettings
[Page=radioSettings]
    radioMode=Gateway
    rfDataRate=RATE_1M
    txPower=10
    networkId=43981
    nodeId=1
    frequencyKey=0
    radioFrequency=915.0000
    radioHoppingMode=Hopping_On
    beaconInterval=ONE_HUNDRED_MS
    beaconBurstCount=1
    lnaBypass=0
    maxLinkDistanceInMiles=5
    maxPacketSize=900
    frequencyMasks=
RESULT:0:OK
>serialportconfig
[Page=serialPortConfig]
    cliBaudRate=115200
    packetizedBaudRate=3000000
    passthruBaudRate=3000000
    databits=8
    parity=None
    stopbits=1
    flowControl=Hardware
    passthruLatencyMode=Auto
    passthruLatencyTimer=16
RESULT:0:OK
>system
[Page=system]
```

```
exit
serialMode=Passthru_Data
pages
tags
filter
RESULT:0:OK
>
```

11.3. Z9-T-DEVKIT Endpoint Settings

```
radiosettings
[Page=radioSettings]
    radioMode=Endpoint
    rfDataRate=RATE_1M
    txPower=10
    networkId=43981
    nodeId=29628
    frequencyKey=0
    radioFrequency=915.0000
    radioHoppingMode=Hopping_On
    beaconInterval=ONE_HUNDRED_MS
    beaconBurstCount=1
    lnaBypass=0
    maxLinkDistanceInMiles=5
    maxPacketSize=900
    frequencyMasks=
RESULT:0:OK
>serialPortConfig
[Page=serialPortConfig]
    cliBaudRate=115200
    packetizedBaudRate=3000000
    passthruBaudRate=3000000
    databits=8
    parity=None
    stopbits=1
    flowControl=Hardware
    passthruLatencyMode=Auto
    passthruLatencyTimer=16
RESULT:0:OK
```

```
>system
[Page=system]
exit
serialMode=Passthru_Data
pages
tags
filter
RESULT:0:OK
>
```

12. config Parameters

- [factoryDefaults \(on page 43\)](#)
- [reset \(on page 43\)](#)
- [restore \(on page 43\)](#)
- [save \(on page 44\)](#)



Tip At the > prompt, type **PARAMETER_NAME=** and press <Tab> to view other options for the designated parameter.

Example: Type **diagPortConfig.cliBaudrate=** press <Tab> to view the options for **cliBaudRate** (on page 46).

Note: In the CLI, 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 .

12.1. factoryDefaults

factoryDefaults	
Setting	Description
CLI / Web Page	[Page=config]
CLI Command	config.factoryDefaults=set
Default Setting	N/A
Options	Set
Description	The config.factoryDefaults command restores the Z9-T-DEVKIT to its factory default configuration.

12.2. reset

reset	
Setting	Description
CLI / Web Page	[Page=config]
CLI Command	config.reset=now
Default Setting	N/A
Options	N/A
Description	The config.reset command resets the Z9-C or Z9-T.

12.3. restore

restore	
Setting	Description
CLI / Web Page	[Page=config]
CLI Command	<ul style="list-style-type: none"> • config.restore=now • config.restore • restore
Default Setting	N/A
Options	N/A
Description	<p>The config.restore command reloads a previously saved setting configuration of the Z9-T-DEVKIT.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> Note: Restore happens automatically when the Z9-T-DEVKIT starts. </div>

12.4. save

save	
Setting	Description
CLI / Web Page	[Page=config]
CLI Command	<ul style="list-style-type: none">• config.save=now• config.save• save
Default Setting	N/A
Options	N/A
Description	The config.save command saves changes made to the Z9-T-DEVKIT configuration.

13. diagPortConfig Parameters

- [cliBaudRate \(on page 46\)](#)
- [databits \(on page 46\)](#)
- [diagBaudRate \(on page 46\)](#)
- [diagMode \(on page 47\)](#)
- [parity \(on page 47\)](#)
- [stopbits \(on page 48\)](#)



At the > prompt, type **PARAMETER_NAME=** and press <Tab> to view other options for the designated parameter.

Example: Type **diagPortConfig.cli baudrate=** press <Tab> to view the options for [cliBaudRate \(on page 46\)](#).

Note: In the CLI, 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 .

13.1. cliBaudRate

cliBaudRate	
Setting	Description
CLI / Web Page	[Page=diagPortConfig]
CLI Command	<ul style="list-style-type: none"> • diagPortConfig.cliBaudRate=9600 • diagPortConfig.cliBaudRate=19200 • diagPortConfig.cliBaudRate=115200
Default Setting	115200
Options	<ul style="list-style-type: none"> • 9600 • 19200 • 115200
Description	The diagPortConfig.cliBaudRate setting designates the baud rate of the diagnostic port.

13.2. databits

databits	
Setting	Description
CLI / Web Page	[Page=diagPortConfig]
CLI Command	<ul style="list-style-type: none"> • diagPortConfig.databits=7 • diagPortConfig.databits=8
Default Setting	8
Options	<ul style="list-style-type: none"> • 7 • 8
Description	The diagPortConfig.databits setting designates the byte length for the diagnostic port.

13.3. diagBaudRate

diagBaudRate	
Setting	Description
CLI / Web Page	[Page=diagPortConfig]
CLI Command	<ul style="list-style-type: none"> • diagPortConfig.cliBaudRate=9600 • diagPortConfig.cliBaudRate=19200 • diagPortConfig.cliBaudRate=115200

diagBaudRate	
Setting	Description
Default Setting	115200
Options	<ul style="list-style-type: none"> • 9600 • 19200 • 115200
Description	The diagPortConfig.diagBaudRate setting designates the baud rate for the diagnostics port.

13.4. diagMode

diagMode	
Setting	Description
CLI / Web Page	[Page=diagPortConfig]
CLI Command	<ul style="list-style-type: none"> • diagPortConfig.diagMode=CLI • diagPortConfig.diagMode=Diag
Default Setting	Diag
Options	<ul style="list-style-type: none"> • CLI • Diag
Description	The diagPortConfig.diagMode setting designates whether the diagnostic port is supporting the command line interface (CLI) or diagnostics.

13.5. parity

parity	
Setting	Description
CLI / Web Page	[Page=diagPortConfig]
CLI Command	<ul style="list-style-type: none"> • diagPortConfig.parity=None • diagPortConfig.parity=Even • diagPortConfig.parity=Odd
Default Setting	None
Options	<ul style="list-style-type: none"> • None • Even • Odd
Description	The diagPortConfig.parity setting designates the parity for the diagnostic port.

13.6. stopbits

stopbits	
Setting	Description
CLI / Web Page	[Page=diagPortConfig]
CLI Command	<ul style="list-style-type: none">• diagPortConfig.stopbits=1• diagPortConfig.stopbits=2
Default Setting	1
Options	<ul style="list-style-type: none">• 1• 2
Description	The diagPortConfig.stopbits setting designates the number of stop bits for the diagnostic port.

14. fileHandler Parameters

Important!: All **fileHandler** parameters are FreeWave internal use only.

15. localDiagnostics Parameters

- signalLevel (on page 51)
- clearStats (on page 51)
- noiseLevel (on page 51)
- RadioAckTx (on page 52)
- RadioBadAckRx (on page 52)
- RadioBadCRC (on page 52)
- RadioBadSync (on page 53)
- RadioContentionDrop (on page 53)
- RadioLLRx (on page 53)
- RadioLLTx (on page 54)
- RadioNoAckTx (on page 54)
- RadioReliableRx (on page 54)
- RadioReliableTx (on page 54)
- RadioRexmit (on page 55)
- RadioRx (on page 55)
- RadioSendingDrop (on page 55)
- RadioTimedOut (on page 55)
- RadioTooLong (on page 55)
- RadioTooShort (on page 55)
- RadioTx (on page 56)

15.1. signalLevel

Important!: The **localDiagnostics** are read-only and are dependent upon the connected Z9-T-DEVKIT device.

signalLevel	
Setting	Description
CLI / Web Page	[Page=localDiagnostics]
CLI Command	<ul style="list-style-type: none"> • localDiagnostics.signalLevel • signalLevel
Default Setting	-128.00
Options	N/A
Description	<p>The localDiagnostics.signalLevel command reports the Signal Level of the radio in dBm of the last received packet.</p> <p>Note: This setting shows -128.00 if no packet has been received since the stats were cleared.</p>

15.2. clearStats

Important!: The **localDiagnostics** are read-only and are dependent upon the connected Z9-T-DEVKIT device.

clearStats	
Setting	Description
CLI / Web Page	[Page=localDiagnostics]
CLI Command	<ul style="list-style-type: none"> • localDiagnostics.clearStats • clearStats
Default Setting	N/A
Options	N/A
Description	The localDiagnostics.clearStats setting clears diagnostic information.

15.3. noiseLevel

Important!: FreeWave internal use only.

15.4. RadioAckTx

Important!: FreeWave internal use only.

15.5. RadioBadAckRx

Important!: The **localDiagnostics** are read-only and are dependent upon the connected Z9-T-DEVKIT device.

RadioBadAckRx	
Setting	Description
CLI / Web Page	[Page=localDiagnostics]
CLI Command	<ul style="list-style-type: none">• localDiagnostics.RadioBadAckRx• RadioBadAckRx
Default Setting	N/A
Options	N/A
Description	The localDiagnostics.RadioBadAckRx command reports the number of received ACKs missed in unicast transmissions.

15.6. RadioBadCRC

Important!: The **localDiagnostics** are read-only and are dependent upon the connected Z9-T-DEVKIT device.

RadioBadCRC	
Setting	Description
CLI / Web Page	[Page=localDiagnostics]
CLI Command	<ul style="list-style-type: none">• localDiagnostics.RadioBadCRC• RadioBadCRC
Default Setting	N/A
Options	N/A
Description	The localDiagnostics.RadioBadCRC command reports the number of radio packets received with data corruption.

15.7. RadioBadSync

Important!: The **localDiagnostics** are read-only and are dependent upon the connected Z9-T-DEVKIT device.

RadioBadSync	
Setting	Description
CLI / Web Page	[Page=localDiagnostics]
CLI Command	<ul style="list-style-type: none"> • localDiagnostics.RadioBadSync • RadioBadSync
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 radiosettings.radioHoppingMode=Hopping_On .

15.8. RadioContentionDrop

Important!: The **localDiagnostics** are read-only and are dependent upon the connected Z9-T-DEVKIT device.

RadioContentionDrop	
Setting	Description
CLI / Web Page	[Page=localDiagnostics]
CLI Command	<ul style="list-style-type: none"> • localDiagnostics.RadioContentionDrop • RadioContentionDrop
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.

15.9. RadioLLRx

Important!: The **localDiagnostics** are read-only and are dependent upon the connected Z9-T-DEVKIT device.

RadioLLRx	
Setting	Description
CLI / Web Page	[Page=localDiagnostics]
CLI Command	<ul style="list-style-type: none"> • localDiagnostics.RadioLLRx • RadioLLRx
Default Setting	N/A
Options	N/A
Description	The localDiagnostics.RadioLLRx command reports the number of packets received over the air without data corruption.

15.10. RadioLLTx

Important!: The **localDiagnostics** are read-only and are dependent upon the connected Z9-T-DEVKIT device.

RadioLLTx	
Setting	Description
CLI / Web Page	[Page=localDiagnostics]
CLI Command	<ul style="list-style-type: none"> • localDiagnostics.RadioLLTx • RadioLLTx
Default Setting	N/A
Options	N/A
Description	The localDiagnostics.RadioLLTx command reports the number of packets transmitted over the air.

15.11. RadioNoAckTx

Important!: FreeWave internal use only.

15.12. RadioReliableRx

Important!: FreeWave internal use only.

15.13. RadioReliableTx

Important!: FreeWave internal use only.

15.14. RadioRexmit

Important!: FreeWave internal use only.

15.15. RadioRx

Important!: The **localDiagnostics** are read-only and are dependent upon the connected Z9-T-DEVKIT device.

RadioRx	
Setting	Description
CLI / Web Page	[Page=localDiagnostics]
CLI Command	<ul style="list-style-type: none">• localDiagnostics.RadioRx• RadioRx
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.

15.16. RadioSendingDrop

Important!: FreeWave internal use only.

15.17. RadioTimedOut

Important!: FreeWave internal use only.

15.18. RadioTooLong

Important!: FreeWave internal use only.

15.19. RadioTooShort

Important!: FreeWave internal use only.

15.20. RadioTx

Important!: The **localDiagnostics** are read-only and are dependent upon the connected Z9-T-DEVKIT device.

RadioTx	
Setting	Description
CLI / Web Page	[Page=localDiagnostics]
CLI Command	<ul style="list-style-type: none">• localDiagnostics.RadioTx• RadioTx
Default Setting	N/A
Options	N/A
Description	The localDiagnostics.RadioTx command reports the number of data packets scheduled to be transmitted.

16. radioSettings Parameters

- beaconBurstCount (on page 58)
- beaconInterval (on page 59)
- frequencyKey (on page 60)
- frequencyMasks (on page 62)
- InaBypass (on page 64)
- maxLinkDistanceinMiles (on page 64)
- networkId (on page 65)
- nodeId (on page 65)
- radioFrequency (on page 66)
- radioHoppingMode (on page 68)
- radioMode (on page 67)
- rfDataRate (on page 70)
- txPower (on page 72)



At the > prompt, type **PARAMETER_NAME** and press <Tab> to view other options for the designated parameter.

Example: Type **diagPortConfig.cliBaudrate**=press<Tab> to view the options for **cliBaudRate** (on page 46).

Note: In the CLI, 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 .

16.1. beaconBurstCount

beaconBurstCount	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<ul style="list-style-type: none"> • <code>radioSettings.beaconBurstCount=n</code> • <code>beaconBurstCount=n</code> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> Note: Where n is any number between 1 and 7. </div>
Default Setting	1
Options	Any number between 1 and 7.
Description	<p>The <code>radioSettings.beaconBurstCount</code> setting designates the number of consecutive beacons to send per <code>beaconInterval</code>Beacon Interval time.</p> <p>Notes</p> <ul style="list-style-type: none"> • The <code>radioSettings.beaconBurstCount</code> is set on the Gateway device. • The Endpoint radios obtain this value from a Gateway with the same <code>networkId</code> via the beacon frame. • This setting is only used when <code>radiosettings.radioHoppingMode=Hopping_On</code>. • Increasing the number of beacons may improve RF link reliability in noisy environments. • Decreasing the number of beacons may improve throughput in environments where interference is minimal. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> FREEWAVE Recommends: Set the <code>beaconBurstCount</code> (on page 58) to 2 or more. This increases the number of beacons sent in a beacon interval. </div>

16.2. beaconInterval

beaconInterval	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<ul style="list-style-type: none"> radioSettings.beaconInterval=TWENTY_FIVE_MS radioSettings.beaconInterval=FIFTY_MS radioSettings.beaconInterval=ONE_HUNDRED_MS radioSettings.beaconInterval=TWO_HUNDRED_MS radioSettings.beaconInterval=FOUR_HUNDRED_MS
Default Setting	ONE_HUNDRED_MS
Options	<ul style="list-style-type: none"> TWENTY_FIVE_MS FIFTY_MS ONE_HUNDRED_MS TWO_HUNDRED_MS FOUR_HUNDRED_MS
Description	<p>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.</p> <p>Notes</p> <ul style="list-style-type: none"> 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 radiosettings.radioHoppingMode=Hopping_On. A shorter Beacon Interval may improve the RF link reliability in noisy environments. <div style="border: 1px solid #ccc; padding: 5px; margin-top: 10px;">  A longer Beacon Interval may improve throughput in environments where interference is minimal. </div>

16.3. frequencyKey

frequencyKey																			
Setting	Description																		
CLI / Web Page	[Page=radioSettings]																		
CLI Command	<ul style="list-style-type: none"> radioSettings.frequencyKey=Key0 radioSettings.frequencyKey=Key1 to Key16 																		
Default Setting	Key0 (zero)																		
Options	<ul style="list-style-type: none"> Key0 (zero) Key1 to Key16 <p>Valid frequencyKey Values</p> <table border="1"> <thead> <tr> <th colspan="2">Data Rate of 115.2K</th></tr> <tr> <th>Frequency Key Values</th><th>Description</th></tr> </thead> <tbody> <tr> <td>0 to 14</td><td>Select classic hop tables.</td></tr> <tr> <td>15</td><td>Select standard randomized hop table.</td></tr> <tr> <td>16</td><td>Select sequential hop table in reverse order of center frequencies.</td></tr> </tbody> </table> <table border="1"> <thead> <tr> <th colspan="2">All Other Data Rates</th></tr> <tr> <th>Frequency Key Values</th><th>Description</th></tr> </thead> <tbody> <tr> <td>0</td><td>Select standard randomized hop table.</td></tr> <tr> <td>1</td><td>Select sequential hop table in reverse order of center frequencies.</td></tr> </tbody> </table>	Data Rate of 115.2K		Frequency Key Values	Description	0 to 14	Select classic hop tables.	15	Select standard randomized hop table.	16	Select sequential hop table in reverse order of center frequencies.	All Other Data Rates		Frequency Key Values	Description	0	Select standard randomized hop table.	1	Select sequential hop table in reverse order of center frequencies.
Data Rate of 115.2K																			
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All Other Data Rates																			
Frequency Key Values	Description																		
0	Select standard randomized hop table.																		
1	Select sequential hop table in reverse order of center frequencies.																		

frequencyKey	
Setting	Description
Description	<p>The radioSettings.frequencyKey setting designates the number used as an index to select a hopping table.</p> <p>Notes</p> <ul style="list-style-type: none"> • Use a unique Frequency Key setting to use different hop patterns for each ZumLink network. • This setting is only used when radiosettings.radioHoppingMode=Hopping_On. <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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. <ul style="list-style-type: none"> • In this instance, the radioSettings.frequencyKey is set to Key0 (zero). <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>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.</p> </div> <div style="border: 1px solid black; padding: 10px; margin-top: 10px;">  When using different hop patterns on each network, interference caused by neighboring ZumLink networks can be minimized. </div>

16.4. frequencyMasks

frequencyMasks	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<p>radioSettings.frequencyMasks=nnnn</p> <p>Note: Where nnnn is the specified format of the frequency range to mask shown in: A. Single Channel Format, B. Range of Channels Format, or C. Combination of Channels Format.</p> <p>Important!: Hop table frequency masking masks the channels that fall within the range plus or minus one-half ($\frac{1}{2}$) the channel bandwidth.</p>
Default Setting	Blank
Options	<p> Caution: ONLY A comma MUST separate the values - NOT a comma with a space.</p> <p>Use this information in examples A to C:</p> <ul style="list-style-type: none"> • xxx is a value between 902-927 MHz. • yyyy is a value between .0000-.9999 MHz. <p>A. Single Channel Format</p> <ul style="list-style-type: none"> • 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 <p>B. Range of Channels Format</p> <p>Important!: If a radio channel intersects with the mask limits, it will be masked and not used.</p> <ul style="list-style-type: none"> • frequencyMasks=xxx.yyyy-xxx.yyyy,xxx.yyyy-xxx.yyyy <p>C. Combination of Channels Format</p> <ul style="list-style-type: none"> • frequencyMasks=xxx.yyyy-xxx.yyyy,xxx.yyyy

frequencyMasks	
Setting	Description
Description	<p>The radioSettings.frequencyMasks setting designates specific frequencies or a set of frequencies in the hopping pattern to be removed from usage.</p> <div style="border: 1px solid #ccc; padding: 5px; margin-top: 10px;"> <p>Caution: radioSettings.frequencyMasks entries MUST BE less than 128 bytes. ONLY A comma MUST separate the values - NOT a comma with a space.</p> </div> <p>Notes</p> <ul style="list-style-type: none"> This setting is only used when radiosettings.radioHoppingMode=Hopping_On. All radios in the network MUST use the same value for this setting. When Frequency Masks is enabled, interference fixed at certain frequencies within the spectrum can be avoided by the transmitter. Least significant zeros are NOT required. <ul style="list-style-type: none"> .9, .09, .009 are valid entries as well as .9000, .0900, .0090. <div style="border: 1px solid #ccc; padding: 5px; margin-top: 10px;">  Tip Type frequencyMasks= and press <Enter> to clear all Frequency Mask entries. </div>

16.5. InaBypass

InaBypass	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<ul style="list-style-type: none"> Enable LNA: <ul style="list-style-type: none"> radioSettings.lnaBypass=0 lnaBypass=0 Bypass LNA: <ul style="list-style-type: none"> radioSettings.lnaBypass=1 lnaBypass=1
Default Setting	0 (zero)
Options	<ul style="list-style-type: none"> 0 1
Description	<p>The radioSettings.InaBypass setting enables the Low Noise Amplifier (LNA) used to boost the radio module receive signal by 10dB.</p> <div style="border: 1px solid #ccc; padding: 5px; margin-top: 10px;">  It can be useful to bypass the LNA if there is a presence of strong signals in band and packet reception is not good. </div>

16.6. maxLinkDistanceinMiles

maxLinkDistanceinMiles	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<ul style="list-style-type: none"> radioSettings.maxLinkDistanceinMiles=nnn maxLinkDistanceinMiles=nnn <div style="border: 1px solid #ccc; padding: 10px; margin-top: 10px;"> Note: Where nnn is the maximum one-way distance (in miles) between any nodes in the network. </div>
Default Setting	20 miles
Options	<ul style="list-style-type: none"> The minimum value is miles. The maximum value is 120 miles.
Description	<p>The radioSettings.maxLinkDistanceinMiles setting designates the maximum one-way distance (in miles) between any nodes in the network.</p> <div style="border: 1px solid #ccc; padding: 10px; margin-top: 10px;"> FREEWAVE Recommends: All nodes in the network that communicate with each other should use the same distance value. </div>

16.7. networkId

networkId	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<ul style="list-style-type: none"> radioSettings.networkId=nnnn networkId=nnnn <p>Note: Where nnnn is the network identifier which subdivides traffic on radio units.</p>
Default Setting	
Options	<ul style="list-style-type: none"> The maximum value is 65535.
Description	<p>The radioSettings.networkId setting designates the network identifier which subdivides traffic on radio units.</p> <p>Notes</p> <ul style="list-style-type: none"> Radio units can only communicate with other units that have the same radioSettings.networkId setting. <p>Important!: If radios are on the same frequency, they still receive data from radios of a different networkId, but the data is dropped.</p>

16.8. nodeld

nodeld	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<ul style="list-style-type: none"> radioSettings.nodeId=nnnn nodeId=nnnn <p>Note: Where nnnn is a user-designated nodeld instead of the auto-generated nodeld.</p>
Default Setting	Predetermined by the Z9-T-DEVKIT, this is an auto-generated, unique number from 2 through 65533.
Options	N/A

nodeId	
Setting	Description
Description	<p>The radioSettings.nodeId setting designates the unique ID of the device.</p> <p>Notes</p> <ul style="list-style-type: none"> Each radio with the same networkId must have a UNIQUE nodeId. <ul style="list-style-type: none"> Otherwise 2 or more nodes will unicast an acknowledgement which may collide. The Gateway device ALWAYS has a nodeId of value 1. It cannot be changed.

16.9. radioFrequency

radioFrequency															
Setting	Description														
CLI / Web Page	[Page=radioSettings]														
CLI Command	<ul style="list-style-type: none"> radioSettings.radioFrequency=nnn.nnnn radioFrequency=nnn.nnnn <p>Note: Where nnn.nnnn is the operating center frequency.</p>														
Default Setting	915.0000 for the Standard Hop Set - ZumLink 900MHz Channels (on page 94)														
Options	<table border="1"> <thead> <tr> <th colspan="2">Valid Ranges</th></tr> <tr> <th>Data Rate</th><th>MHz Range</th></tr> </thead> <tbody> <tr> <td>4 Mbps</td><td>904.5504 - 925.7472</td></tr> <tr> <td>1 Mbps</td><td>903.0528 - 927.0144</td></tr> <tr> <td>500 kbps</td><td>902.7072 - 927.3600</td></tr> <tr> <td>250 kbps</td><td>902.5344 - 927.4176</td></tr> <tr> <td>115.2 kbps</td><td>902.4768 - 927.5904</td></tr> </tbody> </table>	Valid Ranges		Data Rate	MHz Range	4 Mbps	904.5504 - 925.7472	1 Mbps	903.0528 - 927.0144	500 kbps	902.7072 - 927.3600	250 kbps	902.5344 - 927.4176	115.2 kbps	902.4768 - 927.5904
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250 kbps	902.5344 - 927.4176														
115.2 kbps	902.4768 - 927.5904														

radioFrequency	
Setting	Description
Description	<p>The radioSettings.radioFrequency setting designates the operating center frequency in MHz.</p> <p>Notes</p> <ul style="list-style-type: none"> All radios in the network MUST use the same value for this setting. This setting is only used when radiosettings.radioHoppingMode=Hopping_Off. The range of this setting is dependent on the rfDataRate (on page 70) setting. The frequency interval is 100 Hz. The minimum value increases and the maximum value decreases as the radioSettings.rfDataRate increases. <ul style="list-style-type: none"> The increase in channel bandwidth affects these ranges. If the radioSettings.radioFrequency setting is set too close to the band edge for the current radioSettings.rfDataRate, the radio module rejects the setting. <p>Important!: A few seconds are needed to apply the change; allow some time prior to reading back this value.</p> <p> Tip Read back this value after setting it to determine if it was accepted by the radio module.</p>

16.10. radioMode

radioMode	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<ul style="list-style-type: none"> radioSettings.radioMode=Gateway radioSettings.radioMode=Endpoint
Default Setting	Endpoint
Options	<ul style="list-style-type: none"> Endpoint Gateway

radioMode	
Setting	Description
Description	<p>The radioSettings.radioMode setting designates the device type.</p> <p>Notes</p> <ul style="list-style-type: none"> • Each network can have only ONE Gateway device. • The remaining devices MUST be configured as Endpoints . • The Gateway 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 radiosettings.radioHoppingMode=Hopping_On. • A Gateway is NOT required when the radiosettings.radioHoppingMode=Hopping_Off.

16.11. radioHoppingMode

radioHoppingMode	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<ul style="list-style-type: none"> • Enable: <ul style="list-style-type: none"> • radiosettings.radioHoppingMode=Hopping_On • Disable: <ul style="list-style-type: none"> • radiosettings.radioHoppingMode=Hopping_Off
Default Setting	Hopping_Off
Options	<ul style="list-style-type: none"> • Hopping_Off • Hopping_On

radioHoppingMode	
Setting	Description
Description	<p>The <code>radioSettings.radioHoppingMode</code> setting enables frequency hopping.</p> <p>Notes</p> <ul style="list-style-type: none"> All radios in the network MUST use the same value for this setting. For <code>rfDataRate</code> values of 115.2 and 250 kbps, the <code>radioSettings.radioHoppingMode</code> is forced On and CANNOT be set to <code>radiosettings.radioHoppingMode=Hopping_Off</code>. For <code>rfDataRate</code> values of 500 kbps, 1 Mbps, and 4 Mbps, the choice of the selected hopping mode is based on network frequency planning and channel conditions. A Gateway is required when the <code>radiosettings.radioHoppingMode=Hopping_On</code>. A Gateway is NOT required when the <code>radiosettings.radioHoppingMode=Hopping_Off</code>. <p>Important!: Special rules must be applied for the 115.2 and 250 kbps data rates to enforce regulatory rules.</p> <ul style="list-style-type: none"> If the <code>radioSettings.rfDataRate=RATE_250K</code>: <ul style="list-style-type: none"> If the number of hopping channels in the hop table is: <ul style="list-style-type: none"> >=50, the maximum <code>txPower</code> is 30dBm and the <code>txPower</code> is NOT automatically changed. >=25 and <=49, the maximum <code>txPower</code> is 24dBm and the <code>txPower</code> is automatically reduced to 24dBm. <25, all masking is removed. All channels contained in the hop table are re-enabled. <code>txPower</code> is NOT automatically changed. If the <code>radioSettings.rfDataRate=RATE_115.2K</code>: <ul style="list-style-type: none"> If the number of hopping channels in the hop table is: <ul style="list-style-type: none"> >=50, the maximum <code>txPower</code> is 30dBm and the <code>txPower</code> is NOT automatically changed. <50, all masking is removed. All channels are re-enabled. <code>txPower</code> is NOT automatically changed.

16.12. rfDataRate

rfDataRate	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<ul style="list-style-type: none">radioSettings.rfDataRate=RATE_4MradioSettings.rfDataRate=RATE_1MradioSettings.rfDataRate=RATE_1.5M_BETA_FEATUREradioSettings.rfDataRate=RATE_500KradioSettings.rfDataRate=RATE_250KradioSettings.rfDataRate=RATE_115.2K
Default Setting	RATE_1M
Options	<ul style="list-style-type: none">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)

rfDataRate	
Setting	Description
Description	<p>The <code>radioSettings.rfDataRate</code> setting designates the RF link data rate in bits per second.</p> <p>Notes</p> <ul style="list-style-type: none"> 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., <code>rfDataRate=RATE_115.2K</code> to <code>rfDataRate=RATE_1M</code>), the <code>radioFrequency</code> (on page 66) may be set back to the default if the frequency would have been out of band. When selecting data rates of either <code>rfDataRate=RATE_115.2K</code> or <code>rfDataRate=RATE_250K</code>, <code>radioSettings.radioHoppingMode</code> is automatically forced to <code>radiosettings.radioHoppingMode=Hopping_On</code> and cannot be turned off. For all other data rates, the <code>radioSettings.radioHoppingMode</code> is left to its current setting. <div style="border: 1px solid black; padding: 5px;"> <p>Important!: Special rules must be applied for the 115.2 and 250 kbps data rates to enforce regulatory rules.</p> </div> <ul style="list-style-type: none"> If the <code>radioSettings.rfDataRate=RATE_250K</code>: <ul style="list-style-type: none"> If the number of hopping channels in the hop table is: <ul style="list-style-type: none"> >=50, the maximum <code>txPower</code> is 30dBm and the <code>txPower</code> is NOT automatically changed. >=25 and <=49, the maximum <code>txPower</code> is 24dBm and the <code>txPower</code> is automatically reduced to 24dBm. <25, all masking is removed. All channels contained in the hop table are re-enabled. <code>txPower</code> is NOT automatically changed. If the <code>radioSettings.rfDataRate=RATE_115.2K</code>: <ul style="list-style-type: none"> If the number of hopping channels in the hop table is: <ul style="list-style-type: none"> >=50, the maximum <code>txPower</code> is 30dBm and the <code>txPower</code> is NOT automatically changed. <50, all masking is removed. All channels are re-enabled. <code>txPower</code> is NOT automatically changed. <div style="border: 1px solid orange; padding: 5px; background-color: #ffffcc;">  Caution: The <code>RATE_1.5M_BETA_FEATURE</code> data rate is a Beta feature NOT recommended for production deployment. </div>

16.13. txPower

txPower	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<ul style="list-style-type: none"> radioSettings.txPower=nn txPower=nn <p>Note: Where nn is the RF output transmit power.</p> <p>Important!: Entering a decimal value changes the txpower to 0 (zero).</p> <p>FREEWAVE Recommends: Use whole numbers only.</p>
Default Setting	
Options	
Description	<p>The radioSettings.txPower setting designates the RF output transmit power, in dB, for the radio.</p> <p>Notes</p> <ul style="list-style-type: none"> Output power is limited to maximum of 30dBm or 1 Watt. 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 radioSettings.txPower can be limited if the radiosettings.radioHoppingMode=Hopping_On. <ul style="list-style-type: none"> See frequencyMasks (on page 62) for additional details. <p> Tip Entering txpower=0 or radiosettings.txpower=0 changes the output power to the minimum or 10 dB.</p>

17. radioStatus Parameters

- curPD (on page 74)
- curRssi (on page 74)



At the > prompt, type **PARAMETER_NAME=** and press <Tab> to view other options for the designated parameter.

Example: Type **diagPortConfig.cliBaudrate=** press<Tab> to view the options for **cliBaudRate** (on page 46).

Note: In the CLI, 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 .

17.1. curPD

Important!: FreeWave internal use only.

17.2. curRssi

curRssi	
Setting	Description
CLI / Web Page	[Page=radioStatus]
CLI Command	<ul style="list-style-type: none">radioStatus.curRssicurRssi
Default Setting	N/A
Options	N/A
Description	The radioStatus.curRssi command reports the value of the current RSSI ONLY when there is data being transferred. Note: This is a Read-only parameter.

18. serialPortConfig Parameters

- [cliBaudRate \(on page 76\)](#)
- [databits \(on page 76\)](#)
- [flowControl \(on page 77\)](#)
- [packetizedBaudRate \(on page 77\)](#)
- [parity \(on page 77\)](#)
- [passthruBaudRate \(on page 77\)](#)
- [passthruLatencyMode \(on page 78\)](#)
- [passthruLatencyTimer \(on page 79\)](#)
- [stopbits \(on page 79\)](#)



Tip: At the > prompt, type **PARAMETER_NAME=** and press <Tab> to view other options for the designated parameter.

Example: Type **diagPortConfig.cli baudrate=** press <Tab> to view the options for [cliBaudRate \(on page 46\)](#).

Note: In the CLI, 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 .

18.1. cliBaudRate

cliBaudRate	
Setting	Description
CLI / Web Page	[Page=serialPortConfig]
CLI Command	serialPortConfig.cliBaudRate=nnn Note: Where nnn is the baud rate of the command line interface port.
Default Setting	115200
Options	<ul style="list-style-type: none"> • 9600 • 19200 • 115200 • 230400 • 460800 • 921600 • 3000000
Description	<p>The serialPortConfig.cliBaudRate setting designates the baud rate of the command line interface port.</p> <p>Procedure</p> <ol style="list-style-type: none"> 1. Type serialPortConfig.cliBaudRate= using any of the valid options. <div style="background-color: #e0f2f1; padding: 10px; margin-top: 10px;"> Example: serialPortConfig.cliBaudRate=3000000 </div> <ol style="list-style-type: none"> 2. Press <Enter>. 3. Type save and press <Enter> to save the selection. 4. Type reset=now to apply the setting to the serial hardware.

18.2. databits

databits	
Setting	Description
CLI / Web Page	[Page=serialPortConfig]
CLI Command	<ul style="list-style-type: none"> • serialPortConfig.databits=7 • serialPortConfig.databits=8
Default Setting	8
Options	<ul style="list-style-type: none"> • 7 • 8
Description	The serialPortConfig.databits setting designates the number of data bits per byte for the serial port.

18.3. flowControl

flowControl	
Setting	Description
CLI / Web Page	[Page=serialPortConfig]
CLI Command	<ul style="list-style-type: none"> serialPortConfig.flowControl=Off serialPortConfig.flowControl=Hardware
Default Setting	Hardware
Options	<ul style="list-style-type: none"> Off Hardware
Description	The serialPortConfig.flowControl setting designates the RTS/CTS flow control of the serial port (not DTR/DSR).

18.4. packetizedBaudRate

Important!: FreeWave internal use only.

18.5. parity

parity	
Setting	Description
CLI / Web Page	[Page=serialPortConfig]
CLI Command	<ul style="list-style-type: none"> serialPortConfig.parity=None serialPortConfig.parity=Even serialPortConfig.parity=Odd
Default Setting	None
Options	<ul style="list-style-type: none"> None Even Odd
Description	The serialPortConfig.parity setting designates the parity of the serial port.

18.6. passthruBaudRate

passthruBaudRate	
Setting	Description
CLI / Web Page	[Page=serialPortConfig]

passthruBaudRate	
Setting	Description
CLI Command	serialPortConfig.passthruBaudRate=n Note: Where n is the data rate of the serial port.
Default Setting	115200
Options	<ul style="list-style-type: none"> • 9600 • 19200 • 115200 • 230400 • 460800 • 921600 • 3000000
Description	<p>The serialPortConfig.passthruBaudRate setting designates the data rate of the serial port when operating in pass through mode.</p> <p>FREEWAVE Recommends: For ALL radioSettings.rfDataRates, use: serialPortConfig.passthruBaudRate=3Mbps.</p> <p>If 3Mbps CANNOT be used, set the serialPortConfig.passthruBaudRate to be GREATER THAN the radioSettings.rfDataRate.</p>

18.7. passthruLatencyMode

passthruLatencyMode	
Setting	Description
CLI / Web Page	[Page=serialPortConfig]
CLI Command	<ul style="list-style-type: none"> • serialPortConfig.passthruLatencyMode=Auto <ul style="list-style-type: none"> • Calculated based on the rfDataRate setting. • serialPortConfig.passthruLatencyMode=Manual <ul style="list-style-type: none"> • Uses the value set in the serialPortConfig.passthruLatencyTimer= timer.
Default Setting	Auto
Options	<ul style="list-style-type: none"> • Auto • Manual
Description	The serialPortConfig.passthruLatencyMode setting designates whether the Latency Timer is automatically or manually set.

18.8. passthruLatencyTimer

passthruLatencyTimer	
Setting	Description
CLI / Web Page	[Page=serialPortConfig]
CLI Command	serialPortConfig.passthruLatencyTimer=n Note: Where n is the amount of millisecond time between transmits.
Default Setting	16
Options	<ul style="list-style-type: none"> The minimum value is 1. The maximum value is 255.
Description	<p>The serialPortConfig.passthruLatencyTimer setting designates the amount of millisecond time between transmits.</p> <p>Notes</p> <ul style="list-style-type: none"> This timer is used to prevent the Serial Input Handler from permanently going to sleep. Normally, when data is available on the Serial Input port, the Handler sets an event that awakens the Serial Input Handler. In the absence of data coming into the Input Serial port, the timer creates an event that awakens the Serial Input Handler to poll the buffer to insure all data has been retrieved from the port.

18.9. stopbits

stopbits	
Setting	Description
CLI / Web Page	[Page=serialPortConfig]
CLI Command	<ul style="list-style-type: none"> serialPortConfig.stopbits=1 serialPortConfig.stopbits=2
Default Setting	1
Options	<ul style="list-style-type: none"> 1 2
Description	The serialPortConfig.stopbits setting designates the number of stop bits of the serial port.

19. system Parameters

- [exit \(on page 81\)](#)
- [filter \(on page 81\)](#)
- [pages \(on page 81\)](#)
- [serialMode \(on page 81\)](#)
- [tags \(on page 82\)](#)



At the > prompt, type **PARAMETER_NAME=** and press <Tab> to view other options for the designated parameter.

Example: Type **diagPortConfig.cliBaudrate=** press<Tab> to view the options for [cliBaudRate \(on page 46\)](#).

Note: In the CLI, 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 .

19.1. exit

Important!: The [Page=system] parameters are only available in the CLI window.
See the [CLI Configuration \(on page 32\)](#) procedure for CLI access.

exit	
Setting	Description
CLI / Web Page	[Page=system]
CLI Command	system.exit=now
Default Setting	N/A
Options	N/A
Description	The system.exit setting is used to exit the CLI mode.

19.2. filter

Important!: FreeWave internal use only.

19.3. pages

pages	
Setting	Description
CLI / Web Page	[Page=system]
CLI Command	<ul style="list-style-type: none">• system.pages• pages
Default Setting	N/A
Options	N/A
Description	The system.pages command lists all of the pages in the ZumLink.

19.4. serialMode

Important!: The [Page=system] parameters are only available in the CLI window.
See the [CLI Configuration \(on page 32\)](#) procedure for CLI access.

serialMode	
Setting	Description
CLI / Web Page	[Page=system]
CLI Command	<ul style="list-style-type: none"> • system.serialMode=Passthru_Data <ul style="list-style-type: none"> • The serial port is used for data or configuration but not at the same time. • system.serialMode=CLI • system.serialMode=Packetized
Default Setting	Passthru_Data
Options	<ul style="list-style-type: none"> • CLI • Passthru_Data • Packetized
Description	<p>The system.serialMode setting designates the serial port mode.</p> <p>Important!: The serialMode setting MUST be set to Passthru_Data for the Z9-T-DEVKIT to connect.</p>

19.5. tags

Important!: FreeWave internal use only.

20. systemInfo Parameters

- deviceConfiguration (on page 84)
- deviceFirmwareVersion (on page 84)
- deviceModel (on page 84)
- deviceName (on page 85)
- deviceSerialNumber (on page 85)
- FirmwareVersion (on page 86)
- hopTableVersion (on page 86)
- layoutHash (on page 86)



Tip At the > prompt, type **PARAMETER_NAME=** and press <Tab> to view other options for the designated parameter.

Example: Type **diagPortConfig.cliBaudrate=** press <Tab> to view the options for **cliBaudRate** (on page 46).

Note: In the CLI, 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 .

20.1. deviceConfiguration

deviceConfiguration	
Setting	Description
CLI / Web Page	[Page=systemInfo]
CLI Command	<ul style="list-style-type: none"> • systemInfo.deviceConfiguration • deviceConfiguration
Default Setting	N/A
Options	N/A
Description	<p>The systemInfo.deviceConfiguration command reports the device configuration of the Z9-T-DEVKIT.</p> <p>Note: This is a Read-only parameter.</p>

20.2. deviceFirmwareVersion

deviceFirmwareVersion	
Setting	Description
CLI / Web Page	[Page=systemInfo]
CLI Command	<ul style="list-style-type: none"> • systemInfo.deviceFirmwareVersion • deviceFirmwareVersion
Default Setting	N/A
Options	N/A
Description	<p>The systemInfo.deviceFirmwareVersion command reports the device firmware version of the Z9-T-DEVKIT.</p> <p>Note: This is a Read-only parameter.</p>

20.3. deviceModel

deviceModel	
Setting	Description
CLI / Web Page	[Page=systemInfo]
CLI Command	<ul style="list-style-type: none"> • systemInfo.deviceModel • deviceModel
Default Setting	N/A

deviceModel	
Setting	Description
Options	N/A
Description	<p>The systemInfo.deviceModel command reports the device model.</p> <p>Note: This is a Read-only parameter.</p>

20.4. deviceName

deviceName	
Setting	Description
CLI / Web Page	[Page=systemInfo]
CLI Command	<ul style="list-style-type: none"> • <code>systemInfo.deviceName=nnnn</code> • <code>deviceName</code> <p>Note: Where nnnn is the user-defined name for the Z9-T-DEVKIT.</p>
Default Setting	N/A
Options	N/A
Description	The systemInfo.deviceName setting designates the user-defined device name.

20.5. deviceSerialNumber

deviceSerialNumber	
Setting	Description
CLI / Web Page	[Page=systemInfo]
CLI Command	<ul style="list-style-type: none"> • <code>systemInfo.deviceSerialNumber</code> • <code>deviceSerialNumber</code>
Default Setting	N/A
Options	N/A
Description	<p>The systemInfo.deviceSerialNumber command reports the device serial number.</p> <p>Note: This is a Read-only parameter.</p>

20.6. FirmwareVersion

FirmwareVersion	
Setting	Description
CLI / Web Page	[Page=systemInfo]
CLI Command	<ul style="list-style-type: none"> • systemInfo.FirmwareVersion • FirmwareVersion
Default Setting	N/A
Options	N/A
Description	<p>The systemInfo.FirmwareVersion command reports the firmware version.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> Note: This is a Read-only parameter. </div>

20.7. hopTableVersion

hopTableVersion	
Setting	Description
CLI / Web Page	[Page=systemInfo]
CLI Command	<ul style="list-style-type: none"> • systemInfo.hopTableVersion • hopTableVersion
Default Setting	N/A
Options	N/A
Description	<p>The systemInfo.hopTableVersion command reports the radio Hop Table Version of the Z9-T-DEVKIT.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> Note: This is a Read-only parameter. </div>

20.8. layoutHash

layoutHash	
Setting	Description
CLI / Web Page	[Page=systemInfo]
CLI Command	<ul style="list-style-type: none"> • systemInfo.layoutHash • layoutHash
Default Setting	N/A
Options	N/A

layoutHash	
Setting	Description
Description	<p>The systemInfo.layoutHash command reports the Unique Layout Identifier.</p> <p>Note: This is a Read-only parameter.</p>

21. Release Notes

These sections describe the additions, changes, known limitations, and workarounds in each software version. The most recent version is listed first.



The latest software versions and the most recent list of known limitations and workarounds are available on www.freewave.com.

21.1. Version 1.0.7.0

Release Date: June 2018

Warning! DO NOT remove power from the Z9-T-DEVKIT during the firmware upgrade process!



If power is removed prematurely during the upgrade process, reinstall the .pkg file and **WAIT for the file upgrade process to complete**.

Additions and Changes

- Hop table frequency masking masks the channels that fall within the range plus or minus one-half ($\frac{1}{2}$) the channel bandwidth.
- 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.

- Request To Send signal at the serial interface no longer must be active whether handshaking is enable or not for the radio to pass data wirelessly.

- Frequency Masks correction has been implemented.
- The **serialMode** default is now **Passthru_Data** (from Packetized).
 - This allows the radio to pass data wirelessly.
- LED indication for data reception.
 - D2 blinks when the radio receives data.

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

Known Limitations and Workarounds

- Significant data is lost between radios when operating in close proximity (3-6 feet) when **radioSettings.rfDataRate=RATE_4M**. (**rfDataRate** (on page 70)).
 - **Workaround:** Reduce power on radios when operating in close proximity.
- Firmware upgrade will stall more than 90% of the time when these settings are in place:
 - **radioSettings.radioMode=Gateway**
 - **serialPortConfig.cliBaudRate=115200**
 - **serialPortConfig.flowControl=Hardware** (i.e., On)
 - **Workaround:** Increase the **cliBaudRate** (on page 76).
- On rare occasions, the firmware upgrade reports **Success** but the firmware did not change.
 - **Workaround:** Re-install the firmware upgrade file.
 - See [Upgrade the Z9-C or Z9-T \(on page 25\)](#).
- The Z9-T radio draws power through the J2-2, J2-3, J2-7, J2-9, and J2-11 lines.
 - If the power line (J2-1) is disconnected from the radio and the data lines are using the same ground as the power line then the power LED (D-15) will be dimly lit.
 - **Workaround:** Disconnect all serial lines and power line.
- Power supply instability or fluctuations can cause an infinite reboot cycle in some situations.
 - This occurs when the boot process is interrupted.
 - **Workaround:** See [Power Setup \(on page 16\)](#).
- If the **rfDataRate** (on page 70) is set above **RATE_115.2K** and the user attempts to set the **frequencyKey** (on page 60) above **Key1**, the radio will lose connection to its hop table.
 - **Workaround:** The hop table is available when the **radioSettings.frequencyKey** is set to 0 (zero) or 1 for **rfDataRates** above **RATE_115.2K**.
- **Z9-T-DEVKIT ONLY:** The Diag port is not available on the Z9-T-DEVKIT when **flowControl** (on page 77) is enabled.

- **Workaround:** The Diag port is available once the USB is active and the command line is first accessed through the USB.
- The CLI will not error for all invalid input.
- The radio will respond with **RESULT:0:OK** and will either leave the current value in place or set it to something else.

These parameters **will change** the value to something else when invalid input is entered:

- [frequencyMasks \(on page 62\)](#)
 - Entering too large of range to mask **does not** send an error.
 - The value is changed to:
ERROR,ERROR,INPUT ERROR, TOO MANY FREQUENCIES MASKED OFF.
- [maxLinkDistanceinMiles \(on page 64\)](#)
 - Entering a number between -4294967295 and -4294967177 changes the value to a number between 1 and 119.
 - Entering either 150 or 121 changes the value to 120 (the maximum number of miles).
- [txPower \(on page 72\)](#)
 - Entering a decimal value changes the **txpower** to 0 (zero).

FREEWAVE Recommends: Use whole numbers only.

These parameters **will NOT change** the value or error when invalid input is entered:

- | | |
|----------------------------------------|----------------------------------------|
| • diagPortConfig.cliBaudRate | • radioSettings.rfDataRate |
| • diagPortConfig.databits | • serialPortConfig.cliBaudRate |
| • diagPortConfig.diagBaudRate | • serialPortConfig.databits |
| • diagPortConfig.parity | • serialPortConfig.flowControl |
| • diagPortConfig.stopbits | • serialPortConfig.packetizedBaudRate |
| • radioSettings.beaconInterval | • serialPortConfig.parity |
| • radioSettings.lnaBypass | • serialPortConfig.passthruBaudRate |
| • radioSettings.maxLinkDistanceInMiles | • serialPortConfig.passthruLatencyMode |
| • radioSettings.radioHoppingMode | • serialPortConfig.stopbits |

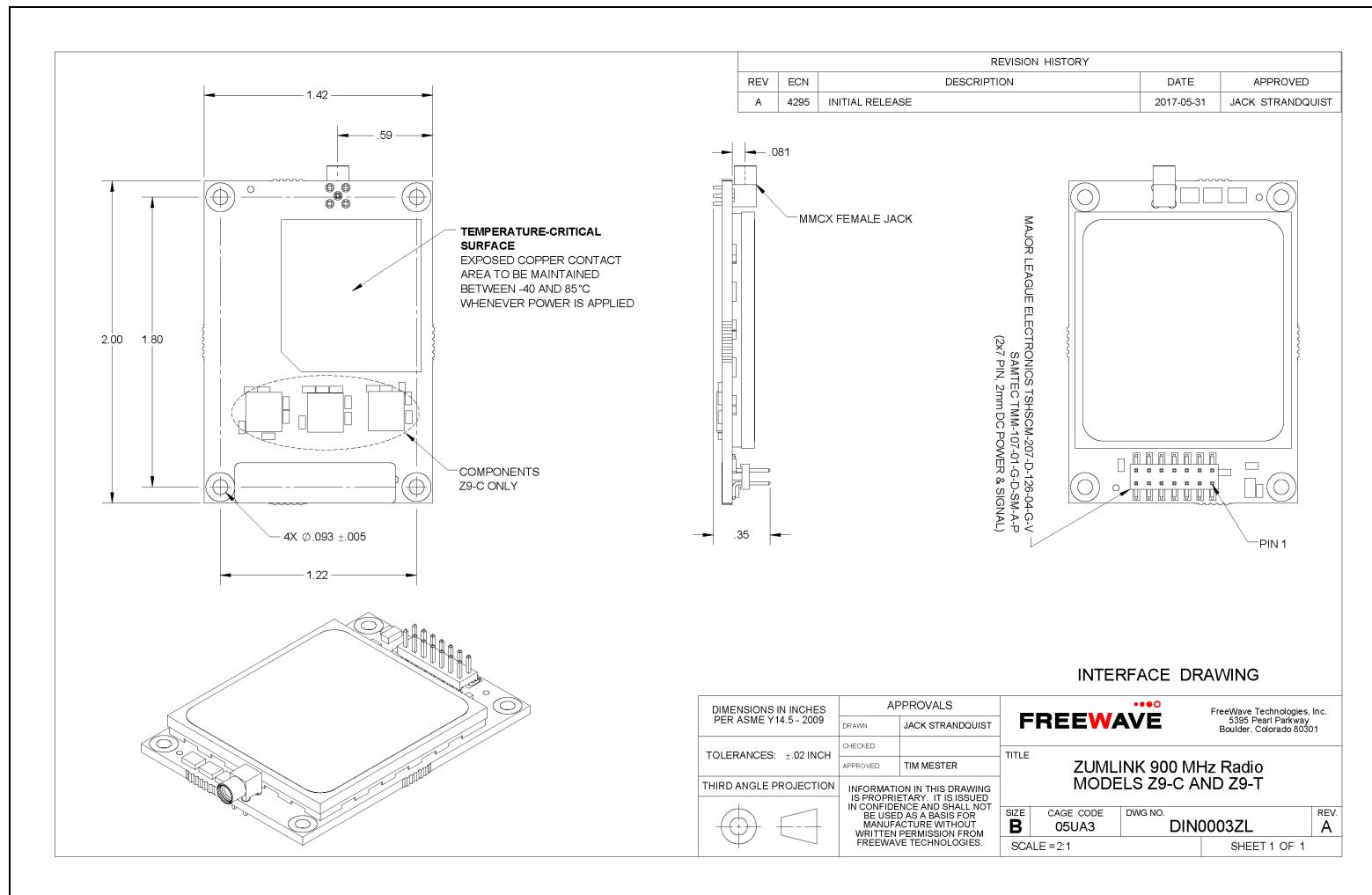
21.2. Version 1.0.4.0 (Initial Release)

Release Date: June 2017

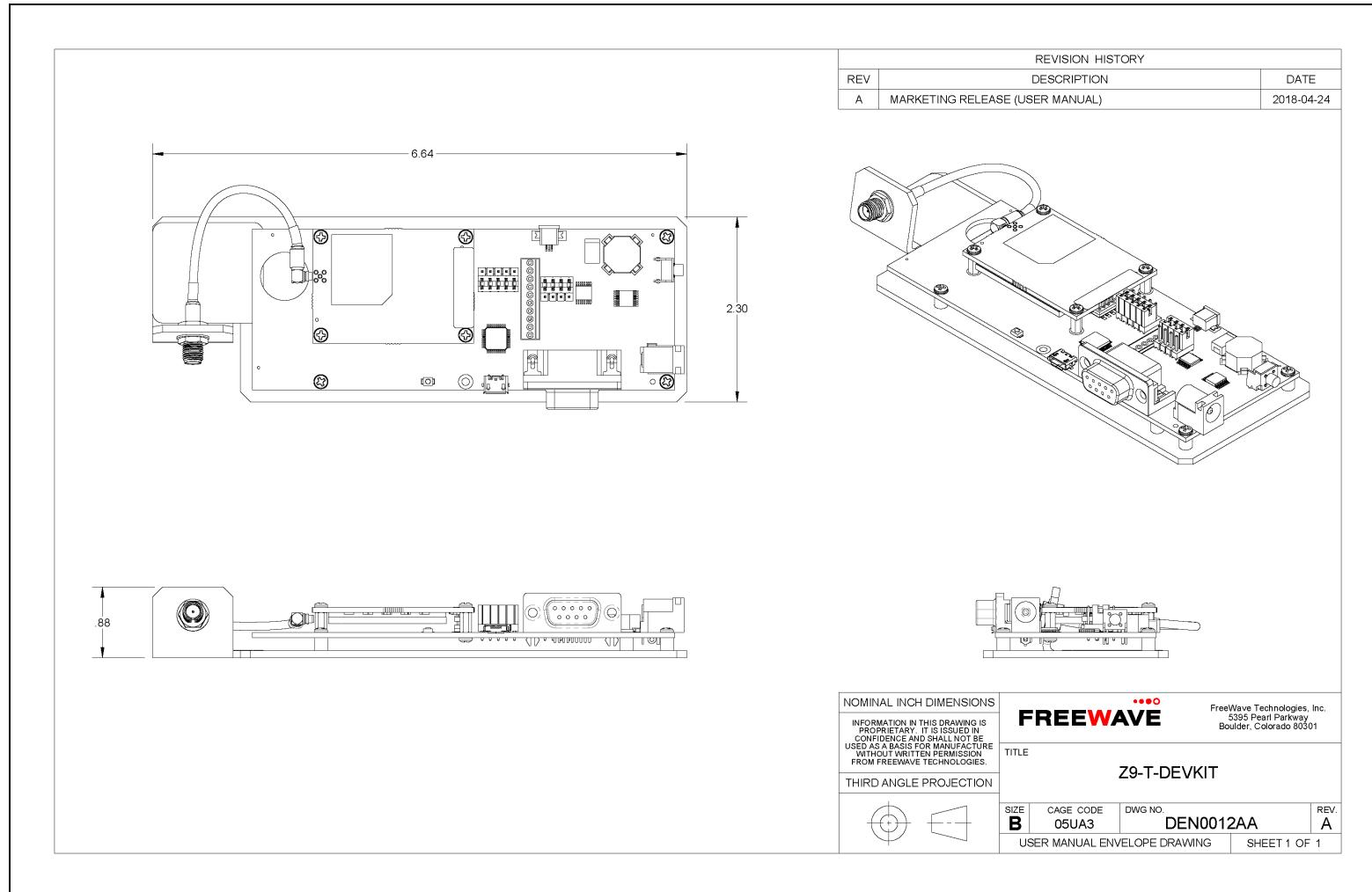
Known Limitations and Workarounds

- The **Request To Send** signal at the serial interface must be active whether handshaking is enable or not for the radio to pass data wirelessly.

22. Mechanical Drawing - Z9-C / Z9-T



23. Mechanical Drawing - Z9-T-DEVKIT



24. Hop Tables

- Standard Hop Set - ZumLink 900MHz Channels (on page 94)

24.1. Standard Hop Set - ZumLink 900MHz Channels

These are the standard channels supported when the [radioHoppingMode \(on page 68\)](#) is **Enabled**.

Note: When the **Radio Hopping Mode** is **Disabled**, the frequency can be set manually.

- RF Data Rate: 115.2 kbps (on page 94)
- RF Data Rate: 250 kbps (on page 95)
- RF Data Rate: 500 kbps (on page 95)
- RF Data Rate: 1 Mbps (on page 96)
- RF Data Rate: 4 Mbps (on page 96)

24.1.1. 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		
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		

24.1.2. 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	
MHz		MHz		MHz		MHz	
902.5344		907.0272		911.5200		916.0128	
902.8800		907.3728		911.8656		916.3584	
903.2256		907.7184		912.2112		916.7040	
903.5712		908.0640		912.5568		917.0496	
903.9168		908.4096		912.9024		917.3952	
904.2624		908.7552		913.2480		917.7408	
904.6080		909.1008		913.5936		918.0864	
904.9536		909.4464		913.9392		918.4320	
905.2992		909.7920		914.2848		918.7776	
905.6448		910.1376		914.6304		919.1232	
905.9904		910.4832		914.9760		919.4688	
906.3360		910.8288		915.3216		919.8144	
906.6816		911.1744		915.6672		920.1600	
						924.6528	

24.1.3. 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	
MHz		MHz		MHz		MHz	
902.7072		906.8544		911.0016		915.1488	
903.3984		907.5456		911.6928		915.8400	
904.0896		908.2368		912.3840		916.5312	
904.7808		908.9280		913.0752		917.2224	
905.4720		909.6192		913.7664		917.9136	
906.1632		910.3104		914.4576		918.6048	
						922.7520	
						926.8992	

24.1.4. 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

24.1.5. 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		Frequency
MHz		MHz
904.5504		
907.7760		
911.0016		
914.2272		
917.4528		
920.6784		
923.9040		

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	<ul style="list-style-type: none">• 10mW to 1W• User selectable
Range	97 km (60 miles), clear line of sight
Channel Spacing	<ul style="list-style-type: none">• 230.4 kHz• 345.6 kHz• 691.2 kHz• 1382.4 kHz• 3225.6 kHz
RF Data Rates	User selectable <ul style="list-style-type: none">• 115.2 kbps• 250 kbps• 500 kbps• 1 Mbps• 4 Mbps
Receiver	
IF Selectivity	> 40 dB
System Gain	136 dB

Technical Specifications			
Specification	Description		
Sensitivity	115.2 kbps	-105 dBm	
	250 kbps	-102 dBm	
	500 kbps	-99 dBm	
	1 Mbps	-95 dBm	
	4 Mbps	-83 dBm	
Data Transmission			
Type	<ul style="list-style-type: none"> Frequency Hopping Spread Spectrum 		
Modulation	<ul style="list-style-type: none"> 2 level GFSK 8-ary FSK 		
Link Throughput	Maximum of 2.2 Mbps		
Error Detection	<ul style="list-style-type: none"> 16-bit CRC, 16-bit ARQ Retransmit on error 		
Hopping Rates	User selectable <ul style="list-style-type: none"> 25ms 50ms 100ms 200ms 400ms 		
Hopping Channels	<ul style="list-style-type: none"> Maximum of 110 channels Dependent on the rfDataRate (on page 70) setting User selectable 		
Hopping Patterns	<ul style="list-style-type: none"> Maximum of 16 patterns Dependent on the rfDataRate (on page 70) setting User selectable 		
Protocol	Adaptive Spectrum Learning		
User Interface Rate	<ul style="list-style-type: none"> TTL - 3 Mbps RS232 - 1 Mbps 		
Power Requirements			
Operating Voltage	+3 to +5VDC ($\pm 10\%$)		
Current Consumption	Voltage	Transmit	Receive
	+3 VDC	843 mA	30 mA
	+5 VDC	680 mA	30 mA

Technical Specifications	
Specification	Description
Interfaces	
Data Connector	<ul style="list-style-type: none">• 14-pin dual row header for power, data, and diagnostics• 2mm pin spacing• Either two RS232 or two TTL serial interfaces
Diagnostics Interface	Serial, RS232 or TTL
RF Connector	MMCX

Appendix B: LEDs

These are the LEDs for the Z9-T-DEVKIT.

Note: See [Z9-T-DEVKIT Ports and Pinout Connections \(on page 13\)](#) for additional information.

Normal Operation

LEDs - Normal Operation			
LED	Position	Color	Description
D1	Right	Blinking Green 	Blinking green when RF data transmitting.
D1	Right	Blinking Red 	Blinking red when the RF channel is busy.
D2	Middle	Solid Green 	Solid green when the RF is in receive mode.
D2	Middle	Blinking Green 	Blinking green when the RF is receiving data.
D15	Left (RF side)	Solid Green 	Solid green when the power is On.
D15	Left (RF side)	Blinking Red 	Blinking red when the RF Packet is received and sent out the serial port.

Appendix C: 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.

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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 Z9-T-DEVKIT 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-T Número IFETEL: RCPFRZ917-1310-A2.

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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GNU License Notification

Some of the software in the firmware is licensed under the GNU General Public License and other Open Source and Free Software licenses. Contact FreeWave to obtain the corresponding source on CD.

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-T-DEVKIT is +3 to +5VDC ($\pm 10\%$).

Z9-T



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

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.



FREEWAVE