



ZumLink™

Covers Model: Z9-C or Z9-T

Firmware 1.0.7.0

User & Reference Manual



Part Number: LUM0075AA

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

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

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

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

FreeWave Technologies, Inc.
5395 Pearl Parkway, Suite 100
Boulder, CO 80301
303.381.9200
Toll Free: 1.866.923.6168
Fax: 303.786.9948

Copyright © 2018 by FreeWave Technologies, Inc.
All rights reserved.

www.freewave.com

Table of Contents

Preface	6
4. Overview	8
4.1. Communication Method	8
5. Included & User-supplied Equipment	9
5.1. Included Equipment	9
5.2. User-supplied Equipment	9
6. Port Connections and Pinout Assignments	10
6.1. Z9-C or Z9-T Ports and Pinout Connections	11
6.2. Z9-C or Z9-T Pinout Assignments	12
7. Installation	14
7.1. Power Setup	15
7.2. Installation	15
8. Firmware Upgrade	16
8.1. Download the Upgrade File and ZumLink Z9-C and Z9-T Programmer Tool	17
8.2. Upgrade the Z9-C or Z9-T	22
9. CLI Configuration	30
10. Creating a Basic ZumLink Gateway and Endpoint Network	33
11. Approved Antennas	35
11.0.1. Omni-Directional Antennas	35
11.0.2. Directional Antennas	35
11.0.3. Alternative Antennas	36
12. config Parameters	37
12.1. factoryDefaults	38
12.2. reset	38
12.3. restore	38
12.4. save	39
13. diagPortConfig Parameters	40
13.1. cliBaudRate	41
13.2. databits	41
13.3. diagBaudRate	41
13.4. diagMode	42
13.5. parity	42
13.6. stopbits	43
14. fileHandler Parameters	44
15. localDiagnostics Parameters	45
15.1. signalLevel	46

15.2. clearStats	46
15.3. noiseLevel	46
15.4. RadioAckTx	47
15.5. RadioBadAckRx	47
15.6. RadioBadCRC	47
15.7. RadioBadSync	48
15.8. RadioContentionDrop	48
15.9. RadioLLRx	48
15.10. RadioLLTx	49
15.11. RadioNoAckTx	49
15.12. RadioReliableRx	49
15.13. RadioReliableTx	49
15.14. RadioRexmit	50
15.15. RadioRx	50
15.16. RadioSendingDrop	50
15.17. RadioTimedOut	50
15.18. RadioTooLong	50
15.19. RadioTooShort	50
15.20. RadioTx	51
16. radioSettings Parameters	52
16.1. beaconBurstCount	53
16.2. beaconInterval	54
16.3. frequencyKey	55
16.4. frequencyMasks	57
16.5. InaBypass	59
16.6. maxLinkDistanceinMiles	59
16.7. networkId	60
16.8. nodeId	60
16.9. radioFrequency	61
16.10. radioMode	62
16.11. radioHoppingMode	63
16.12. rfDataRate	65
16.13. txPower	67
17. radioStatus Parameters	68
17.1. curPD	69
17.2. curRssi	69
18. serialPortConfig Parameters	70
18.1. cliBaudRate	71

18.2. databits	71
18.3. flowControl	72
18.4. packetizedBaudRate	72
18.5. parity	72
18.6. passthruBaudRate	72
18.7. passthruLatencyMode	73
18.8. passthruLatencyTimer	74
18.9. stopbits	74
19. system Parameters	75
19.1. exit	76
19.2. filter	76
19.3. pages	76
19.4. serialMode	76
19.5. tags	77
20. systemInfo Parameters	78
20.1. deviceConfiguration	79
20.2. deviceFirmwareVersion	79
20.3. deviceModel	79
20.4. deviceName	80
20.5. deviceSerialNumber	80
20.6. FirmwareVersion	81
20.7. hopTableVersion	81
20.8. layoutHash	81
21. Release Notes	83
21.1. Version 1.0.7.0	83
21.2. Version 1.0.4.0 (Initial Release)	85
22. Mechanical Drawing - Z9-C / Z9-T	86
23. Hop Tables	87
23.1. Standard Hop Set - ZumLink 900MHz Channels	88
23.1.1. RF Data Rate: 115.2 kbps	88
23.1.2. RF Data Rate: 250 kbps	89
23.1.3. RF Data Rate: 500 kbps	89
23.1.4. RF Data Rate: 1 Mbps	90
23.1.5. RF Data Rate: 4 Mbps	90
Appendix A: Technical Specifications	91
Appendix B: LEDs	94
Normal Operation	94
Appendix C: FreeWave Legal Information	95

Preface

Contact FreeWave Technical Support

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

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

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

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: **xxxxxxxxxx**.



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-C or Z9-T.

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

The Z9-C or Z9-T 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

Included Equipment	
Qty	Description
1	Z9-C or Z9-T wireless device.

5.2. User-supplied Equipment

- **Z9-C Connection:** The Z9-C requires an RS232 serial interface that supports a maximum of 1 Mbps over the user data / configuration serial port and 115.2 kbps over the configuration / diagnostic serial port.
- **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.
- Computer

6. Port Connections and Pinout Assignments

Port Connections

- [Z9-C or Z9-T Ports and Pinout Connections \(on page 11\)](#)

Pinout Assignments

- [Z9-C or Z9-T Pinout Assignments \(on page 12\)](#)

6.1. Z9-C or Z9-T Ports and Pinout Connections

- The Z9-C or Z9-T shares the same 14-pin interface found on FreeWave's MM2 OEM board level radios easing migration but is not a drop-in replacement.
- The 14-pin dual row header, location, and pinout are the same as the MM2, MM2-MU, MM2-M13, and GXM series of radios with the exception of pin 2 and pin 6.
 - Pin 2 is used to place the Z9-C or Z9-T into configuration mode.
 - Pin 6 is used to reset the Z9-C or Z9-T radio.

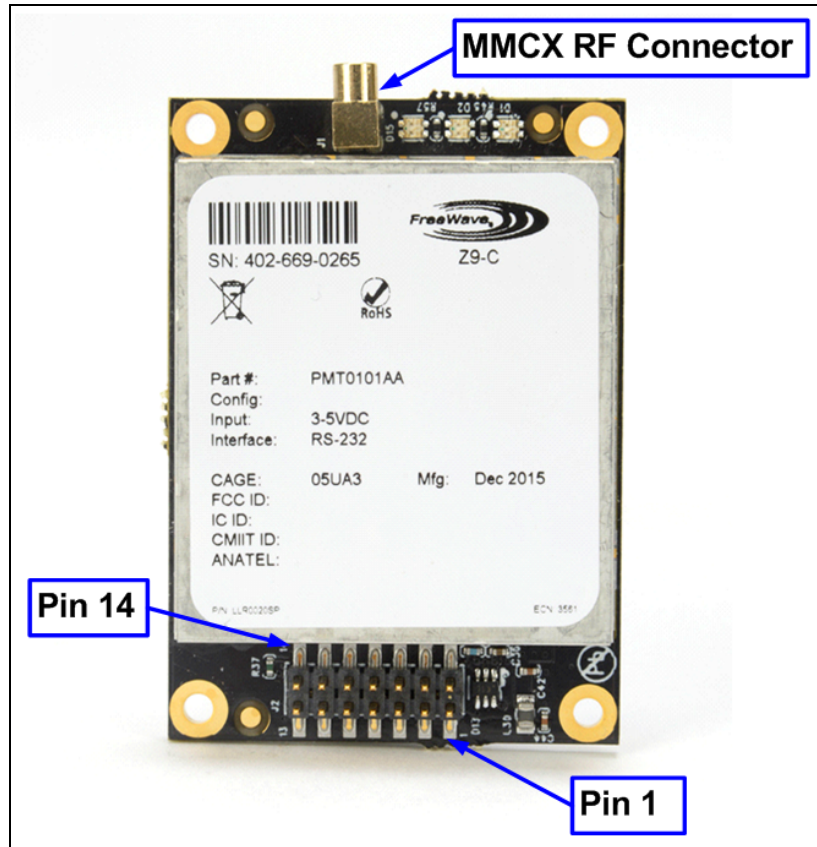


Figure 1: Z9-C or Z9-T MMCX RF Connector and Pinout with Pin 1 and Pin 14

6.2. Z9-C or Z9-T Pinout Assignments

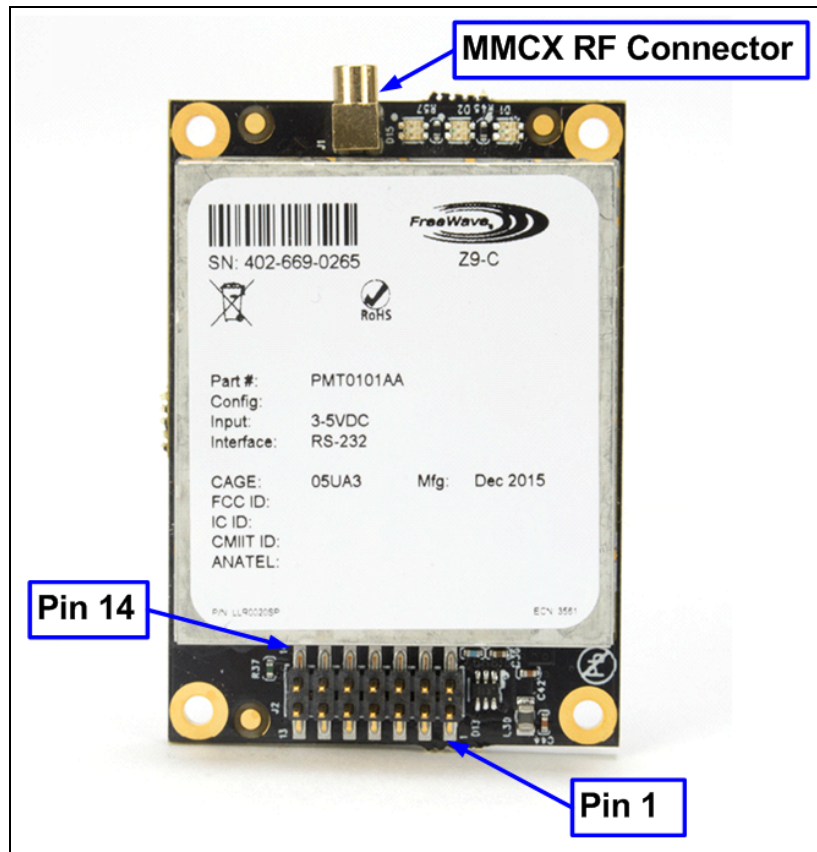


Figure 2: Z9-C or Z9-T Pinout Assignments

- The Z9-C or Z9-T includes a 14-pin header for power input, data input and output, diagnostics, and configuration.
- The 14-pin header:
 - is equivalent to the Samtec TMM-107-01-G-D-SM-A.
 - mates with Samtec CLT, SQT, SQW, ESQT, TLE, SMM, MMS, and TCSD style connectors.

Z9-C or Z9-T Pinout Assignments					
Pin Number	Name / Signal Description	Radio Input / Output	Z9-C Signal Level	Z9-T Signal Level	Description
1	Power (B+)	Input	+3 to +5VDC (±10%)	+3 to +5VDC (±10%)	DC Input power
2	Interrupt	Input	TTL	TTL	Interrupt is used to place the Z9-C / Z9-T into configuration mode.
Serial Ports (Pins 3 to 10)					
3	DTR --- (I)	Input	RS232	TTL	Data terminal ready input
4	GND	N/A			Ground
5	TXD --- (O)	Output	RS232	TTL	Transmit data output
6	Reset	Input	TTL**	TTL**	Resets the radio module to power up condition.
7	RXD --- (I)	Input	RS232	TTL	Receive data input
8	CD --- (O)	Output	RS232	TTL	Carrier detect output
9	RTS --- (I)	Input	RS232	TTL	Request to send input
10	CTS --- (O)	Output	RS232	TTL	Clear to send output
Diagnostic Ports (Pins 11 to 13)					
11	Diag RX	Input	RS232	TTL	Diagnostic Received Data
12	Diag TX	Output	RS232	TTL	Diagnostic Transmitted Data
13	GND	N/A			Ground
14	NC	N/A			Do Not Connect

Notes

- **A low or ground places the Z9-C or Z9-T into reset.
- **A high or floating allows normal Z9-C or Z9-T operation.
- FreeWave defines TTL as 0 (zero) to 3.3VDC.
- If it's an active-**low** pin, that pin **MUST BE 'pulled' LOW** by connecting it to ground ($V_{IL} < 0.66V$).
- For an active high pin, connect it to the HIGH voltage ($V_{IH} > 2.64V$).

7. Installation

- [Power Setup \(on page 15\)](#)
- [Installation \(on page 15\)](#)

7.1. Power Setup

- The Z9-C or Z9-T 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 \(on page 91\)](#) 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. Installation

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

Warning! Only FCC approved antennas may be used. See [Approved Antennas \(on page 35\)](#).



The antenna must be professionally installed on a fixed, mounted, and permanent outdoor structure to satisfy RF exposure requirements.

Any antenna placed outdoors must be properly grounded.

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



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

3. Connect the Z9-C or Z9-T to a power supply.
The Z9-C or Z9-T is approved to operate with an input voltage range of +3 to +5VDC ($\pm 10\%$) that can supply at least 0.8 Amps.

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 \(on page 94\)](#) for more information.

4. Continue with:
 - [Firmware Upgrade \(on page 16\)](#)
 - [CLI Configuration \(on page 30\)](#)

8. Firmware Upgrade

Important! The **Download** procedure must be completed first.

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

- A. [Download the Upgrade File and ZumLink Z9-C and Z9-T Programmer Tool \(on page 17\)](#)
- B. [Upgrade the Z9-C or Z9-T \(on page 22\)](#)

8.1. Download the Upgrade File and ZumLink Z9-C and Z9-T Programmer Tool

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.

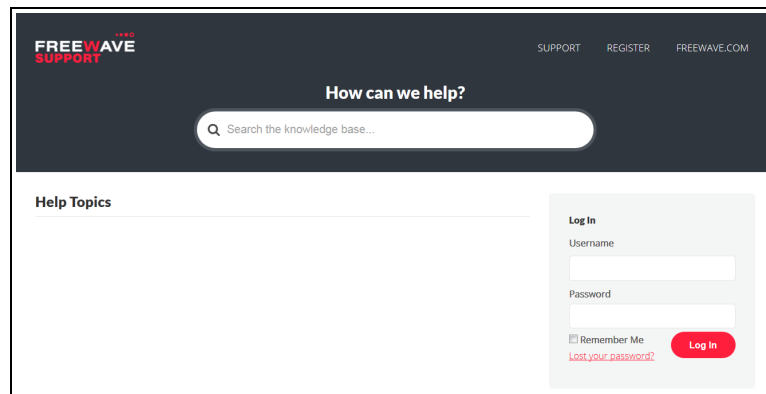
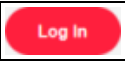


Figure 3: FreeWave Login window

2. Enter the **User Name** and **Password**.
3. Click .
A successful Login message briefly appears.

The **Help Topics** window opens.

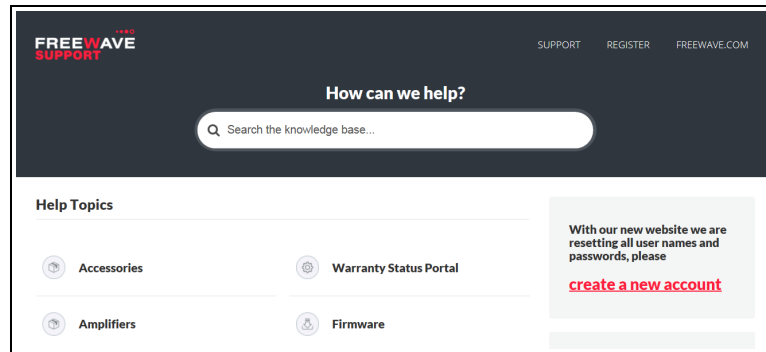


Figure 4: Help Topics window

4. Click the **Firmware** link.
The **Firmware** window opens.

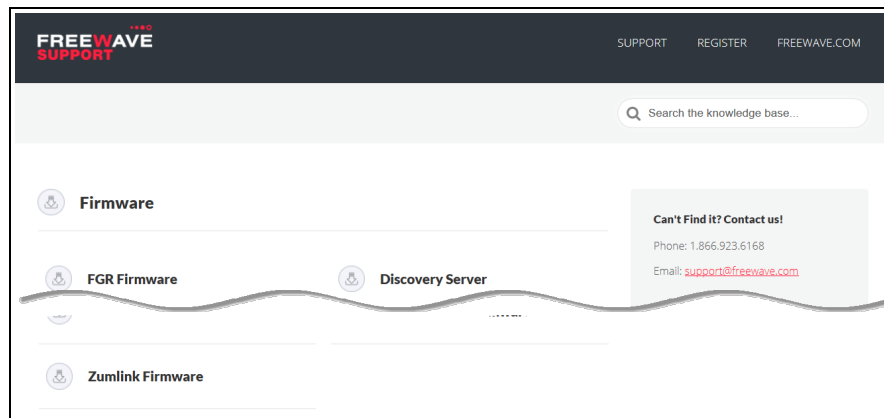


Figure 5: Firmware window

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

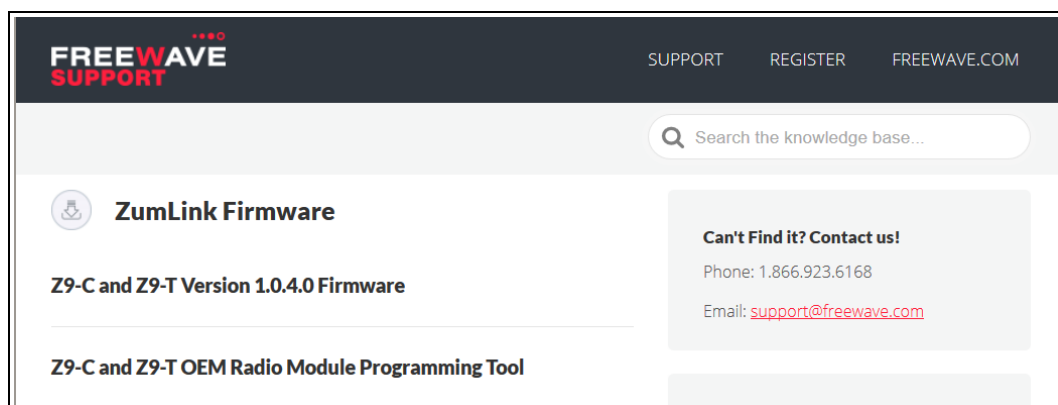


Figure 6: ZumLink Firmware window

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

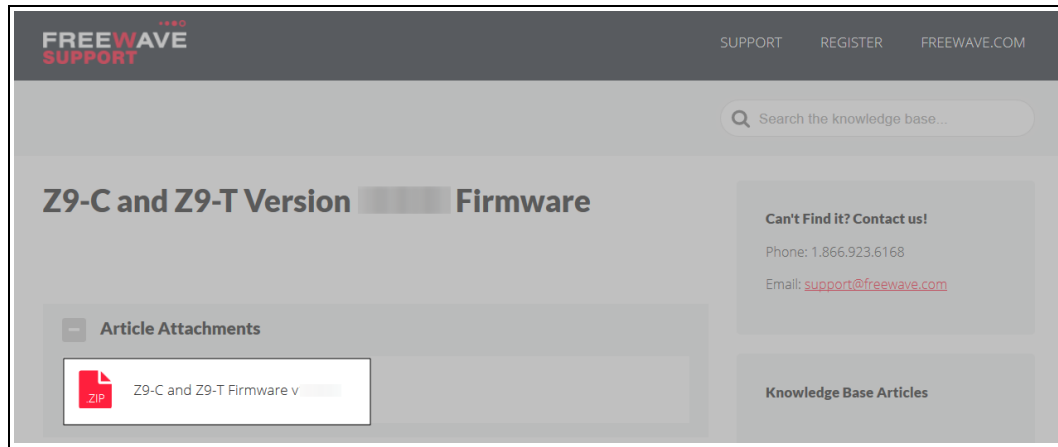


Figure 7: Z9-C / Z9-T Firmware Upgrade window with selected attachment

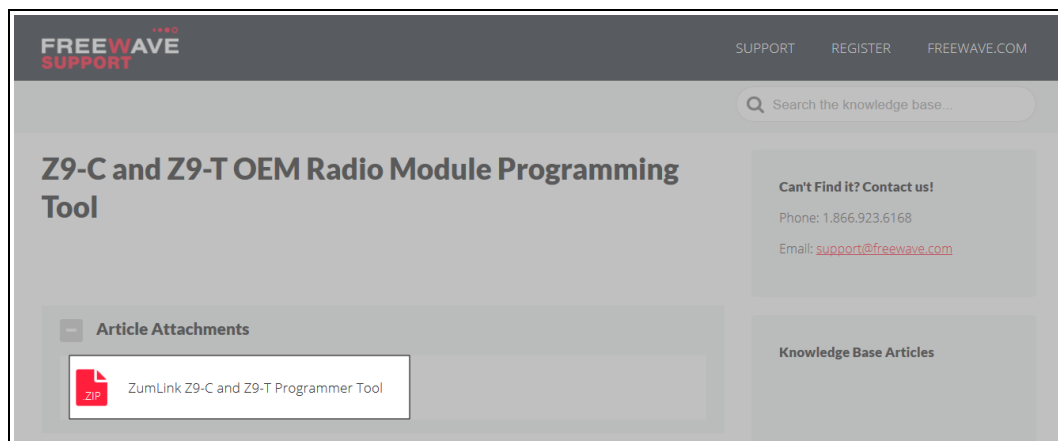
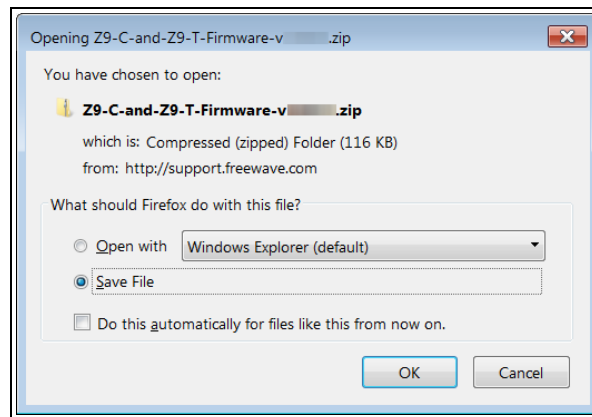
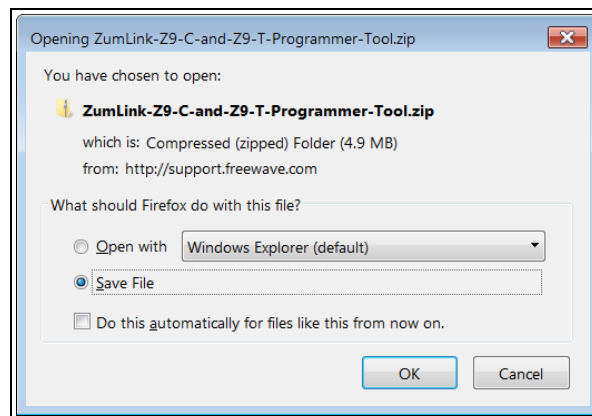


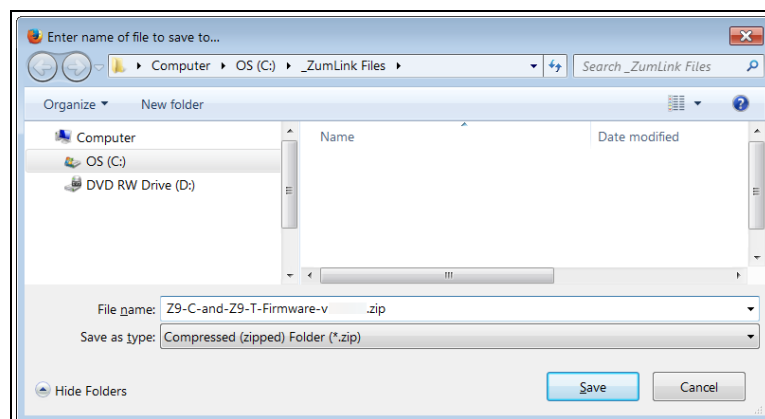
Figure 8: ZumLink Z9-C and Z9-T Programmer Tool Firmware Upgrade window with selected attachment

The **Opening** dialog box opens.

**Figure 9: Z9-C / Z9-T Opening dialog box****Figure 10: 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 11: Z9-C / Z9-T Enter name of file to save to dialog box**

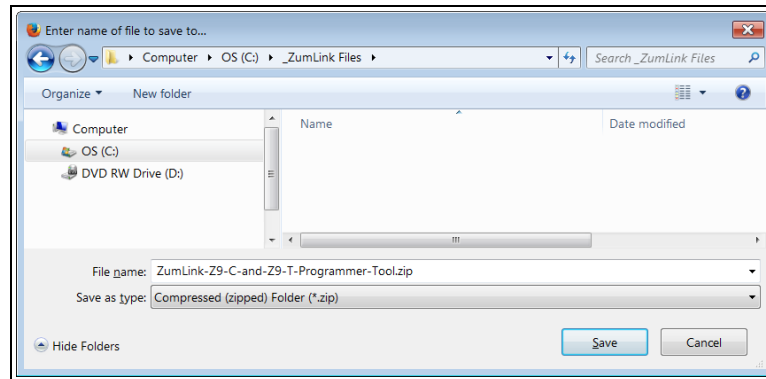


Figure 12: ZumLink Z9-C and Z9-T Programmer Tool Enter name of file to save to dialog box

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 \(on page 22\)](#) 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-C / Z9-T 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-C or Z9-T CLI. Other terminal emulators (e.g., HyperTerminal, PuTTY) may be used.

Procedure

1. Verify the [Download the Upgrade File and ZumLink Z9-C and Z9-T Programmer Tool \(on page 17\)](#) procedure is complete.
2. Connect to the Serial Interface of the ZumLink device.
On the Z9-C or Z9-T ([Figure 13](#)):
 - 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.

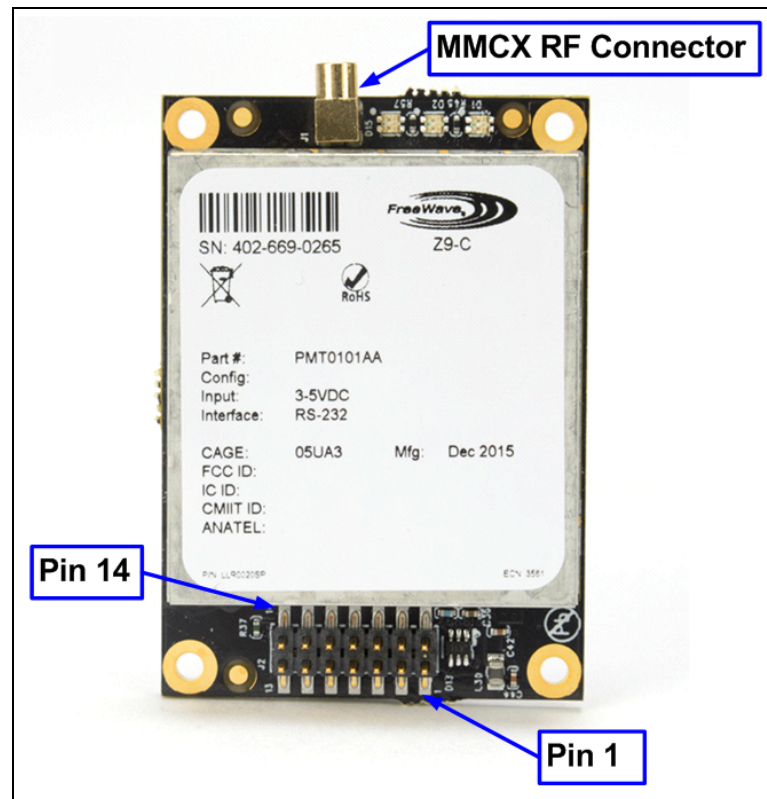


Figure 13: Z9-C or Z9-T Connections

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

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

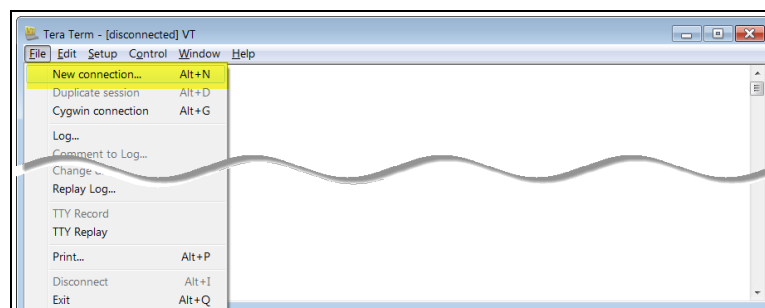


Figure 14: File menu > New Connection

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

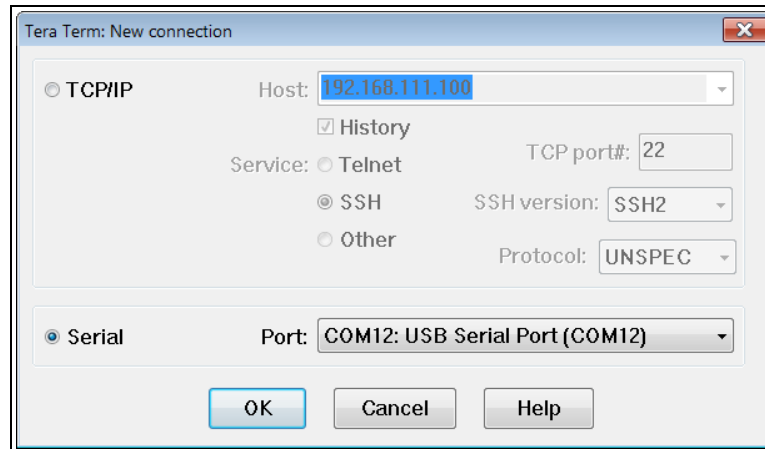


Figure 15: Select the ZumLink COM port

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**.

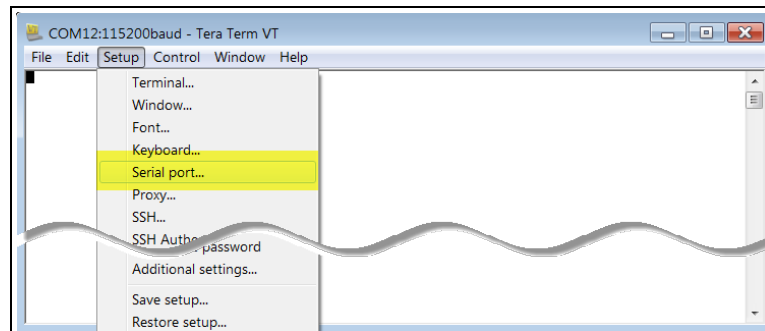


Figure 16: Serial menu > Setup Port

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

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

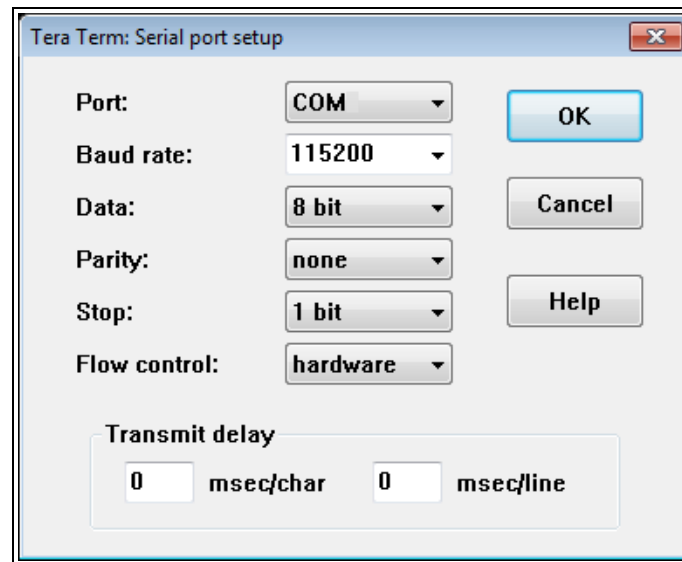


Figure 17: Tera Term: Serial Port Setup dialog box with default settings

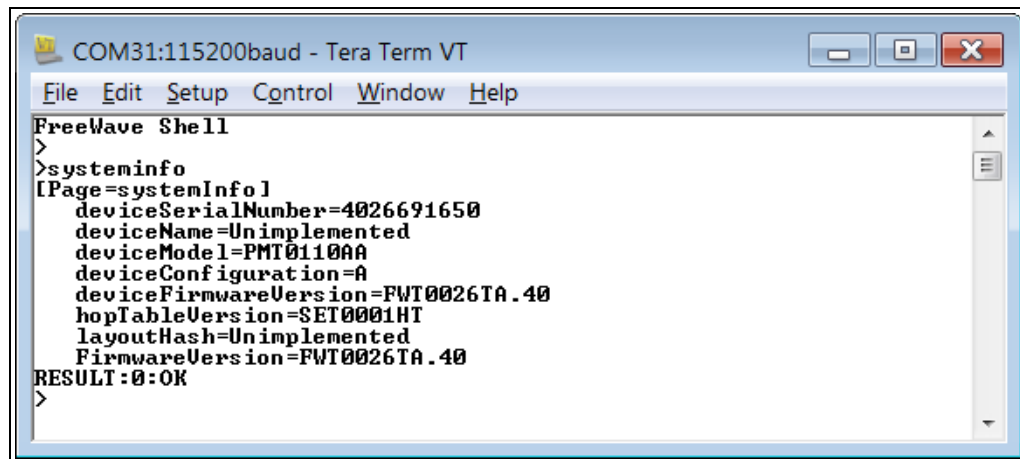
8. **Important:** Verify, and change if required, the Tera Term serial port settings (except the **Port** setting) of the connected Z9-C or Z9-T so the settings are the same as the defaults shown in [Figure 17](#).

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. On the Z9-C or Z9-T device, momentarily ground the interrupt line (pin 2 on the 14-pin header).
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 18](#)).



```

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

```

Figure 18: 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. Ground Pin 2 to put the Z9-C or Z9-T into CLI mode.
18. Open the Microsoft® Windows® **Device Manager**.
19. Locate and identify the COM port for the Z9-C or Z9-T.
20. Locate the designated folder for the ZumLink Z9-C and Z9-T Programmer Tool `.exe` file and double-click the `.exe` file.

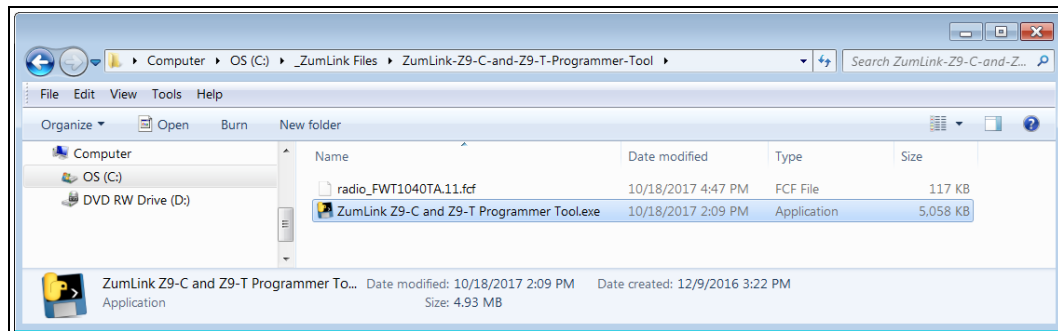


Figure 19: Double-click the `.exe` File

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

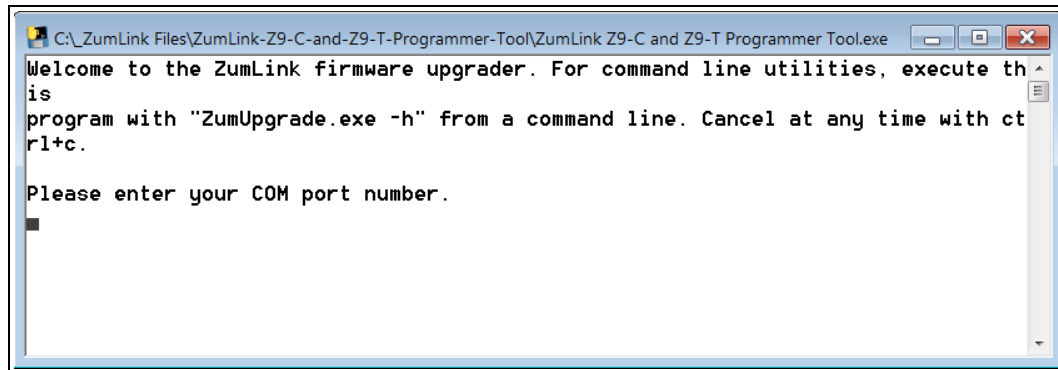


Figure 20: Opened ZumLink Z9-C and Z9-T Programmer Tool

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

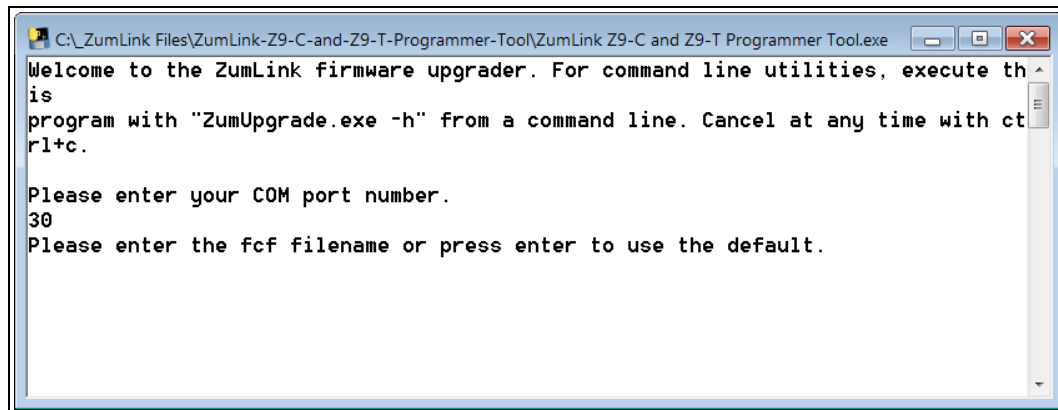


Figure 21: Opened ZumLink Z9-C and Z9-T Programmer Tool

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

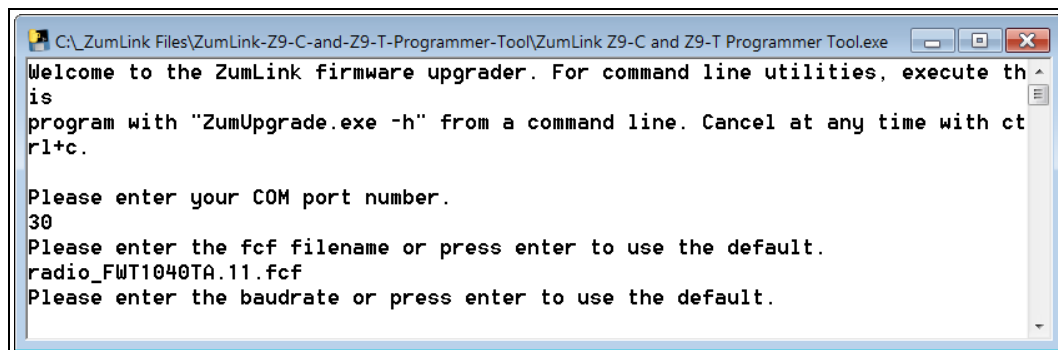
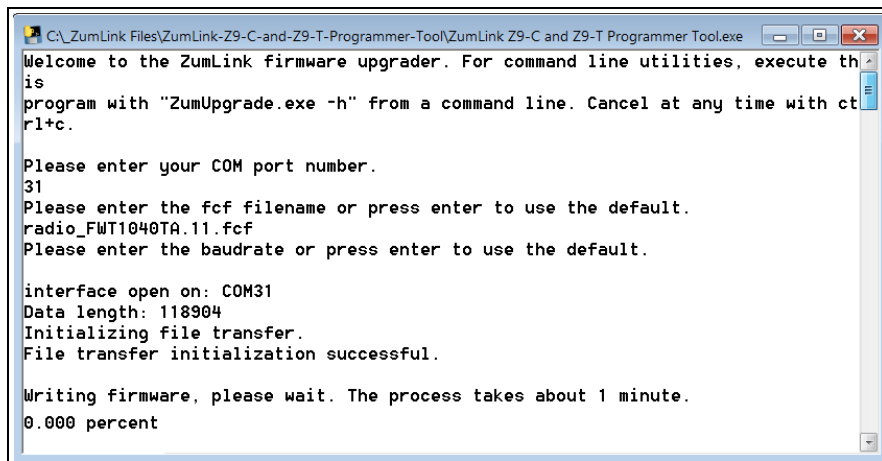


Figure 22: Opened ZumLink Z9-C and Z9-T Programmer Tool

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.

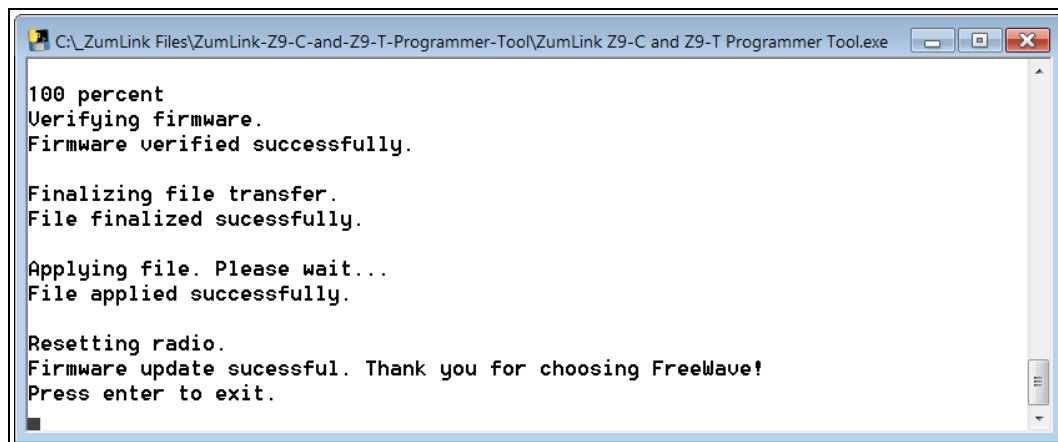
Please enter your COM port number.
31
Please enter the fcf filename or press enter to use the default.
radio_FWT1040TA.11.fcf
Please enter the baudrate or press enter to use the default.

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 23: Initialed Upgrade Process

A successful upgrade message appears when the upgrade process is complete. (Figure 24)



```
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.

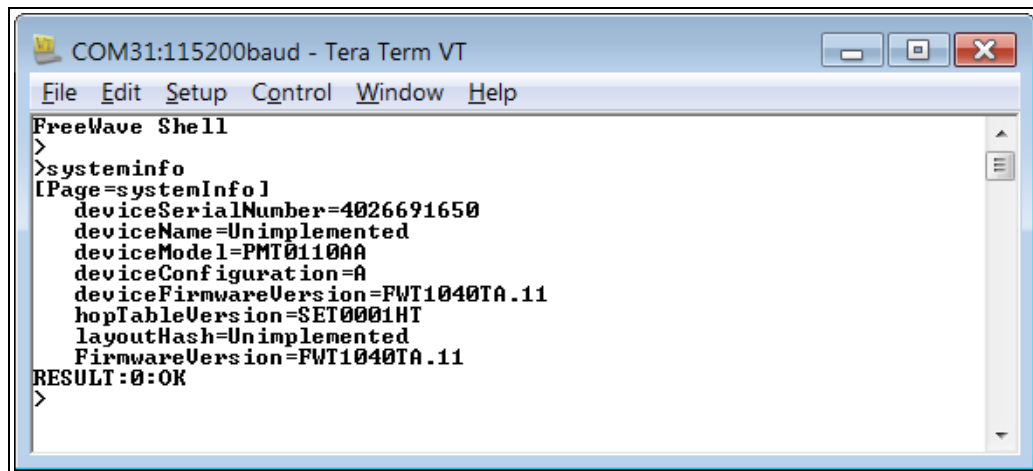
Finalizing file transfer.
File finalized successfully.

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

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

Figure 24: Successful Upgrade Process

- Optional: Open Tera Term to view the upgraded firmware version on the [systeminfo](#) page (Figure 25):



```
COM31:115200baud - Tera Term VT
File Edit Setup Control Window Help
FreeWave Shell
>
>systeminfo
[Page=systemInfo]
deviceSerialNumber=4026691650
deviceName=Unimplemented
deviceModel=PMT0110AA
deviceConfiguration=A
deviceFirmwareVersion=FWT1040TA.11
hopTableVersion=SET0001HT
layoutHash=Unimplemented
FirmwareVersion=FWT1040TA.11
RESULT:0:OK
>
```

Figure 25: systeminfo page Showing Upgraded Firmware Version

25. Use the [CLI Configuration \(on page 30\)](#) 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-C or Z9-T 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-C or Z9-T, open a terminal program (e.g., Tera Term).
3. In Tera Term, click the **File** menu and select **New Connection**.

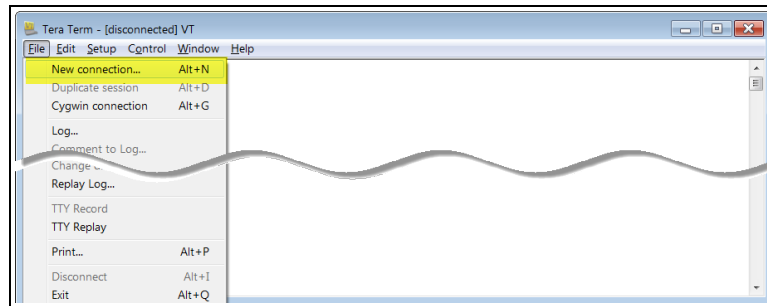


Figure 26: File menu > New Connection

The Tera Term New Connection dialog box opens.

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

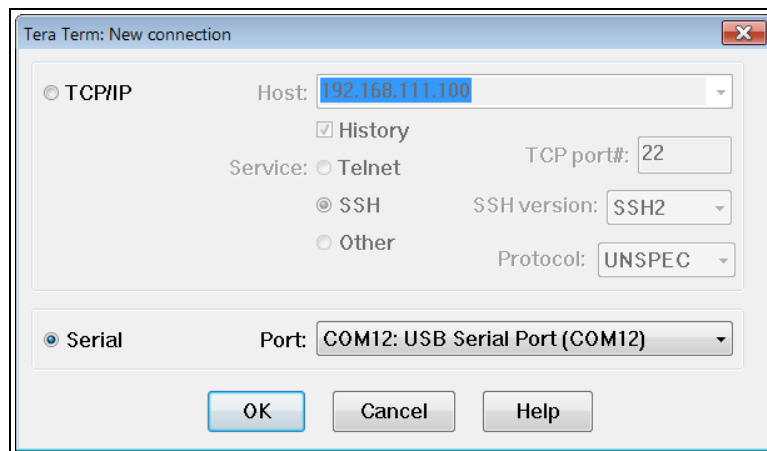


Figure 27: Select the ZumLink COM port

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**.

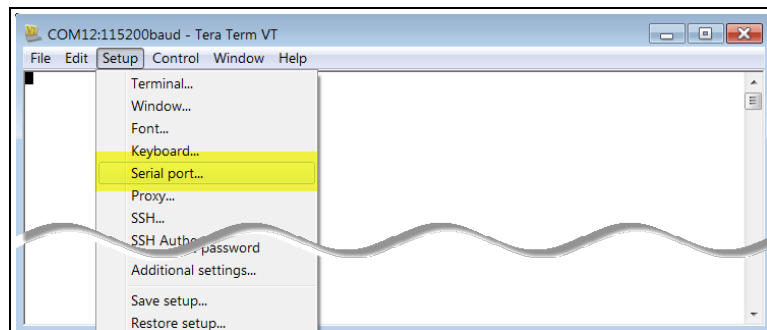


Figure 28: Serial menu > Setup Port

The Tera Term: Serial Port Setup dialog box opens.

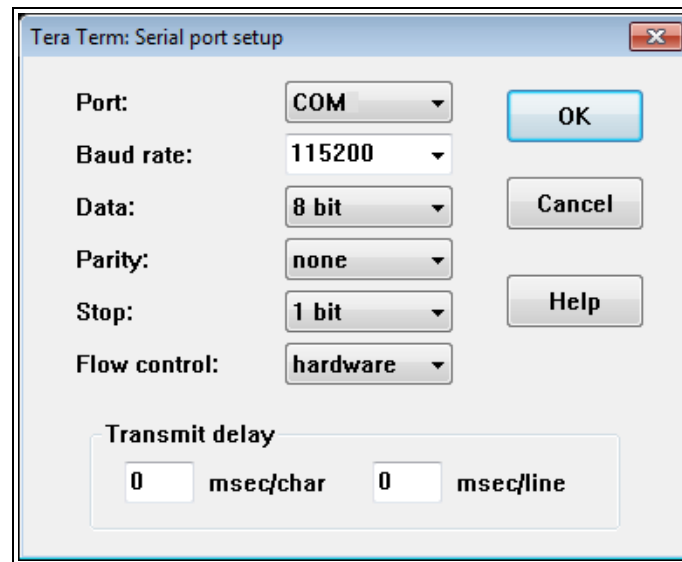


Figure 29: Tera Term: Serial Port Setup dialog box with Default Z9-C or Z9-T Settings

7. **Important:** Verify, and change if required, the Tera Term serial port settings (except the **Port** setting) of the connected Z9-C or Z9-T so the settings are the same as the defaults shown in [Figure 29](#).

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. On the Z9-C or Z9-T device, momentarily ground the interrupt line (pin 2 on the 14-pin header).
10. In Tera Term, press <Enter>. The **FreeWave Shell** returns.

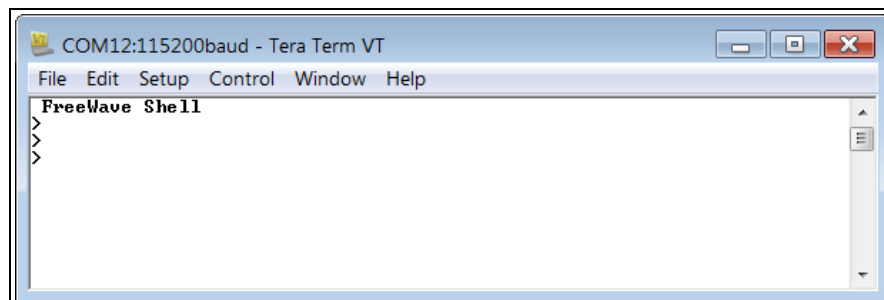


Figure 30: FreeWave Shell in Tera Term

11. Continue with [Creating a Basic ZumLink Gateway and Endpoint Network \(on page 33\)](#).

10. Creating a Basic ZumLink Gateway and Endpoint Network

Note: The basic network described in this procedure is created by accessing the [CLI Configuration \(on page 30\)](#).

1. Connect and apply power to the ZumLink devices in the network.
2. Optional: Upgrade the devices using the procedure [Upgrade the Z9-C or Z9-T \(on page 22\)](#).
3. Complete the [CLI Configuration \(on page 30\)](#) procedure.
4. Select one radio and, at the > prompt, type `radioSettings.radioMode=Gateway` and press <Enter>.
5. At the > prompt, type a setting between `10 and 30` for the `radioSettings.txPower` and press <Enter>.

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



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

Note: See [radioSettings Parameters \(on page 52\)](#) for detailed information.

6. For the other radio in the network, at the > prompt, type `radioSettings.radioMode=Endpoint` and press <Enter>.
7. 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.

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

Note: See [LEDs \(on page 94\)](#) for additional information.

- Verify the `serialMode` (on page 76) parameter is set to `system.serialMode=Passthru_Data`.

Important! The `serialMode` setting MUST be set to `Passthru_Data` for the Z9-C or Z9-T to connect.

- Type `exit` and press <Enter> to exit the FreeWave Shell.

11. Approved Antennas

11.0.1. Omni-Directional Antennas

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

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

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

11.0.2. Directional Antennas

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

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

11.0.3. Alternative Antennas

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

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



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

12. config Parameters

- [factoryDefaults](#) (on page 38)
- [reset](#) (on page 38)
- [restore](#) (on page 38)
- [save](#) (on page 39)



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 41).

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 0 (zero).

12.1. factoryDefaults

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

12.2. reset

reset	
Setting	Description
CLI / Web Page	[Page=config]
CLI Command	<code>config.reset=now</code>
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"> • <code>config.restore=now</code> • <code>config.restore</code> • <code>restore</code>
Default Setting	N/A
Options	N/A
Description	<p>The config.restore command reloads a previously saved setting configuration of the Z9-C or Z9-T.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Note: Restore happens automatically when the Z9-C or Z9-T starts.</p> </div>

12.4. save

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

13. diagPortConfig Parameters

- cliBaudRate (on page 41)
- databits (on page 41)
- diagBaudRate (on page 41)
- diagMode (on page 42)
- parity (on page 42)
- stopbits (on page 43)



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 41).

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 0 (zero).

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"> • <code>diagPortConfig.diagMode=CLI</code> • <code>diagPortConfig.diagMode=Diag</code>
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"> • <code>diagPortConfig.parity=None</code> • <code>diagPortConfig.parity=Even</code> • <code>diagPortConfig.parity=Odd</code>
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">• <code>diagPortConfig.stopbits=1</code>• <code>diagPortConfig.stopbits=2</code>
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 46)
- [clearStats](#) (on page 46)
- [noiseLevel](#) (on page 46)
- [RadioAckTx](#) (on page 47)
- [RadioBadAckRx](#) (on page 47)
- [RadioBadCRC](#) (on page 47)
- [RadioBadSync](#) (on page 48)
- [RadioContentionDrop](#) (on page 48)
- [RadioLLRx](#) (on page 48)
- [RadioLLTx](#) (on page 49)
- [RadioNoAckTx](#) (on page 49)
- [RadioReliableRx](#) (on page 49)
- [RadioReliableTx](#) (on page 49)
- [RadioRexmit](#) (on page 50)
- [RadioRx](#) (on page 50)
- [RadioSendingDrop](#) (on page 50)
- [RadioTimedOut](#) (on page 50)
- [RadioTooLong](#) (on page 50)
- [RadioTooShort](#) (on page 50)
- [RadioTx](#) (on page 51)

15.1. signalLevel

Important! The **localDiagnostics** are read-only and are dependent upon the connected Z9-C or Z9-T 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> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Note: This setting shows -128.00 if no packet has been received since the stats were cleared.</p> </div>

15.2. clearStats

Important! The **localDiagnostics** are read-only and are dependent upon the connected Z9-C or Z9-T 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-C or Z9-T 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-C or Z9-T 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-C or Z9-T 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-C or Z9-T 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-C or Z9-T 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-C or Z9-T 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-C or Z9-T 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-C or Z9-T 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 53)
- beaconInterval (on page 54)
- frequencyKey (on page 55)
- frequencyMasks (on page 57)
- InaBypass (on page 59)
- maxLinkDistanceinMiles (on page 59)
- networkId (on page 60)
- nodeId (on page 60)
- radioFrequency (on page 61)
- radioHoppingMode (on page 63)
- radioMode (on page 62)
- rfDataRate (on page 65)
- txPower (on page 67)



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 41).


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 0 (zero).

16.1. beaconBurstCount


beaconBurstCount	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<ul style="list-style-type: none"> radioSettings.beaconBurstCount=n beaconBurstCount=n <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Note: Where n is any number between 1 and 7.</p> </div>
Default Setting	1
Options	Any number between 1 and 7.
Description	<p>The radioSettings.beaconBurstCount setting designates the number of consecutive beacons to send per beaconInterval Beacon Interval time.</p> <p>Notes</p> <ul style="list-style-type: none"> The radioSettings.beaconBurstCount is set on the Gateway device. The Endpoint radios obtain this value from a Gateway with the same networkId via the beacon frame. This setting is only used when radioSettings.radioHoppingMode=Hopping_On. 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;"> <p>FREEWAVE Recommends: Set the beaconBurstCount (on page 53) to 2 or more. This increases the number of beacons sent in a beacon interval.</p> </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 gray; padding: 5px; margin-top: 10px;">  <p>A longer Beacon Interval may improve throughput in environments where interference is minimal.</p> </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																			
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.																		


frequencyKey	
Setting	Description
Description	<p>The <code>radioSettings.frequencyKey</code> 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 <code>radiosettings.radioHoppingMode=Hopping_On</code>. <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. <ul style="list-style-type: none"> If an invalid frequency key setting is found, the <code>radioSettings.frequencyKey</code> is NOT changed. The frequency key setting being larger than the number of hopping tables configured for a specific <code>rfDataRate</code>. <ul style="list-style-type: none"> In this instance, the <code>radioSettings.frequencyKey</code> 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 <code>networkId</code> 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: 5px; margin-top: 10px;"> <p> Tip When using different hop patterns on each network, interference caused by neighboring ZumLink networks can be minimized.</p> </div>

16.4. frequencyMasks

frequencyMasks	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<p><code>radioSettings.frequencyMasks=nnnn</code></p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>Note: Where <code>nnnn</code> is the specified format of the frequency range to mask shown in:</p> <p>A. Single Channel Format, B. Range of Channels Format, or C. Combination of Channels Format.</p> </div> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <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> </div>
Default Setting	Blank
Options	<div style="border: 1px solid orange; padding: 5px; margin-bottom: 10px;"> <p> Caution: ONLY A comma MUST separate the values - NOT a comma with a space.</p> </div> <p>Use this information in examples A to C:</p> <ul style="list-style-type: none"> • <code>xxx</code> is a value between 902-927 MHz. • <code>yyyy</code> 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. • <code>frequencyMasks=xxx.yyyy, xxx.yyyy, xxx.yyyy</code> <p>B. Range of Channels Format</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>Important! If a radio channel intersects with the mask limits, it will be masked and not used.</p> </div> <ul style="list-style-type: none"> • <code>frequencyMasks=xxx.yyyy-xxx.yyyy, xxx.yyyy-xxx.yyyy</code> <p>C. Combination of Channels Format</p> <ul style="list-style-type: none"> • <code>frequencyMasks=xxx.yyyy-xxx.yyyy, xxx.yyyy</code>

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 orange; padding: 5px; margin: 10px 0;"> <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 gray; padding: 5px; margin-top: 10px;"> <p> Type frequencyMasks= and press <Enter> to clear all Frequency Mask entries.</p> </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"> • <code>radioSettings.lnaBypass=0</code> • <code>lnaBypass=0</code> • Bypass LNA: <ul style="list-style-type: none"> • <code>radioSettings.lnaBypass=1</code> • <code>lnaBypass=1</code>
Default Setting	0 (zero)
Options	<ul style="list-style-type: none"> • 0 • 1
Description	<p>The radioSettings.lnaBypass setting enables the Low Noise Amplifier (LNA) used to boost the radio module receive signal by 10dB.</p> <div style="border: 1px solid gray; padding: 5px; margin-top: 10px;">  <p>It can be useful to bypass the LNA if there is a presence of strong signals in band and packet reception is not good.</p> </div>

16.6. maxLinkDistanceinMiles

maxLinkDistanceinMiles	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<ul style="list-style-type: none"> • <code>radioSettings.maxLinkDistanceinMiles=nnn</code> • <code>maxLinkDistanceinMiles=nnn</code> <div style="border: 1px solid gray; padding: 5px; margin-top: 10px;"> <p>Note: Where <code>nnn</code> is the maximum one-way distance (in miles) between any nodes in the network.</p> </div>
Default Setting	20 miles
Options	<ul style="list-style-type: none"> • The minimum value is 0 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 gray; padding: 5px; margin-top: 10px;"> <p>FREEWAVE Recommends: All nodes in the network that communicate with each other should use the same distance value.</p> </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 <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Note: Where nnnn is the network identifier which subdivides traffic on radio units.</p> </div>
Default Setting	43981
Options	<ul style="list-style-type: none"> The minimum value is 0 (zero). 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. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <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> </div>


16.8. nodeId

nodeId	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<ul style="list-style-type: none"> radioSettings.nodeId=nnnn nodeId=nnnn <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Note: Where nnnn is a user-designated nodeId instead of the auto-generated nodeId.</p> </div>
Default Setting	Predetermined by the Z9-C or Z9-T, this is an auto-generated, unique number from 2 through 65533.
Options	N/A

nodeld	
Setting	Description
Description	<p>The <code>radioSettings.nodeld</code> setting designates the unique ID of the device.</p> <p>Notes</p> <ul style="list-style-type: none"> Each radio with the same <code>networkId</code> must have a UNIQUE <code>nodeld</code>. <ul style="list-style-type: none"> Otherwise 2 or more nodes will unicast an acknowledgement which may collide. The Gateway device ALWAYS has a <code>nodeld</code> 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"> <code>radioSettings.radioFrequency=nnn.nnnn</code> <code>radioFrequency=nnn.nnnn</code> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Note: Where <code>nnn.nnnn</code> is the operating center frequency.</p> </div>														
Default Setting	915.0000 for the Standard Hop Set - ZumLink 900MHz Channels (on page 88)														
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
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														

radioFrequency	
Setting	Description
Description	<p>The <code>radioSettings.radioFrequency</code> 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 <code>radioSettings.radioHoppingMode=Hopping_Off</code>. The range of this setting is dependent on the <code>rfDataRate</code> (on page 65) setting. The frequency interval is 100 Hz. The minimum value increases and the maximum value decreases as the <code>radioSettings.rfDataRate</code> increases. <ul style="list-style-type: none"> The increase in channel bandwidth affects these ranges. If the <code>radioSettings.radioFrequency</code> setting is set too close to the band edge for the current <code>radioSettings.rfDataRate</code>, the radio module rejects the setting. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Important! A few seconds are needed to apply the change; allow some time prior to reading back this value.</p> </div> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p> Tip Read back this value after setting it to determine if it was accepted by the radio module.</p> </div>

16.10. radioMode

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

radioMode	
Setting	Description
Description	<p>The <code>radioSettings.radioMode</code> 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 <code>nodeId</code> of value 1. It cannot be changed. • The Endpoint or Endpoint-Repeater <code>nodeId</code> values are 2 through 65535. • 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>.


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"> • <code>radioSettings.radioHoppingMode=Hopping_On</code> • Disable: <ul style="list-style-type: none"> • <code>radioSettings.radioHoppingMode=Hopping_Off</code>
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>. <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <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.

16.12. rfDataRate

rfDataRate	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<ul style="list-style-type: none"> • <code>radioSettings.rfDataRate=RATE_4M</code> • <code>radioSettings.rfDataRate=RATE_1M</code> • <code>radioSettings.rfDataRate=RATE_1.5M_BETA_FEATURE</code> • <code>radioSettings.rfDataRate=RATE_500K</code> • <code>radioSettings.rfDataRate=RATE_250K</code> • <code>radioSettings.rfDataRate=RATE_115.2K</code>
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 61) 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; margin: 10px 0;"> <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; margin: 10px 0;"> <p> Caution: The <code>RATE_1.5M_BETA_FEATURE</code> data rate is a Beta feature NOT recommended for production deployment.</p> </div>

16.13. txPower

txPower	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<ul style="list-style-type: none"> <code>radioSettings.txPower=nn</code> <code>txPower=nn</code> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>Note: Where <code>nn</code> is the RF output transmit power.</p> </div> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>Important! Entering a decimal value changes the txpower to 0 (zero).</p> </div> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>FREEWAVE Recommends: Use whole numbers only.</p> </div>
Default Setting	<ul style="list-style-type: none"> 30
Options	<ul style="list-style-type: none"> The maximum value is 30.
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 57) for additional details. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;">  <p>Entering txpower=0 or radioSettings.txpower=0 changes the output power to the minimum or 10 dB.</p> </div>

17. radioStatus Parameters

- [curPD](#) (on page 69)
- [curRssi](#) (on page 69)



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 41).

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 0 (zero).

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.curRssi curRssi
Default Setting	N/A
Options	N/A
Description	<p>The radioStatus.curRssi command reports the value of the current RSSI ONLY when there is data being transferred.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Note: This is a Read-only parameter.</p> </div>

18. serialPortConfig Parameters

- cliBaudRate (on page 71)
- databits (on page 71)
- flowControl (on page 72)
- packetizedBaudRate (on page 72)
- parity (on page 72)
- passthruBaudRate (on page 72)
- passthruLatencyMode (on page 73)
- passthruLatencyTimer (on page 74)
- stopbits (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 41).

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 0 (zero).

18.1. cliBaudRate

cliBaudRate	
Setting	Description
CLI / Web Page	[Page=serialPortConfig]
CLI Command	<pre>serialPortConfig.cliBaudRate=nnn</pre> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Note: Where <code>nnn</code> is the baud rate of the command line interface port.</p> </div>
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"> Type <code>serialPortConfig.cliBaudRate=</code> using any of the valid options. <div style="border: 1px solid gray; background-color: #f0f0f0; padding: 5px; margin: 10px 0;"> <p>Example: <code>serialPortConfig.cliBaudRate=3000000</code></p> </div> <ol style="list-style-type: none"> Press <Enter>. Type <code>save</code> and press <Enter> to save the selection. Type <code>reset=now</code> 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"> • <code>serialPortConfig.databits=7</code> • <code>serialPortConfig.databits=8</code>
Default Setting	8
Options	<ul style="list-style-type: none"> • 7 • 8
Description	<p>The serialPortConfig.databits setting designates the number of data bits per byte for the serial port.</p>

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	<pre>serialPortConfig.passthruBaudRate=n</pre> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Note: Where <i>n</i> is the data rate of the serial port.</p> </div>
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> <div style="border: 1px solid black; padding: 10px; margin-top: 10px;"> <p>FREEWAVE Recommends: For ALLradioSettings.rfDataRates, use: serialPortConfig.passthruBaudRate=3Mbps.</p> <p>If 3Mbps CANNOT be used, set the serialPortConfig.passthruBaudRate= to be GREATER THAN the radioSettings.rfDataRate.</p> </div>

18.7. passthruLatencyMode

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

18.8. passthruLatencyTimer

passthruLatencyTimer	
Setting	Description
CLI / Web Page	[Page=serialPortConfig]
CLI Command	<pre>serialPortConfig.passthruLatencyTimer=n</pre> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Note: Where <i>n</i> is the amount of millisecond time between transmits.</p> </div>
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"> <code>serialPortConfig.stopbits=1</code> <code>serialPortConfig.stopbits=2</code>
Default Setting	1
Options	<ul style="list-style-type: none"> 1 2
Description	<p>The serialPortConfig.stopbits setting designates the number of stop bits of the serial port.</p>

19. system Parameters

- [exit](#) (on page 76)
- [filter](#) (on page 76)
- [pages](#) (on page 76)
- [serialMode](#) (on page 76)
- [tags](#) (on page 77)



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 41).

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 0 (zero).

19.1. exit

Important! The [Page=system] parameters are only available in the CLI window.
See the [CLI Configuration \(on page 30\)](#) procedure for CLI access.

exit	
Setting	Description
CLI / Web Page	[Page=system]
CLI Command	<code>system.exit=now</code>
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"> <code>system.pages</code> <code>pages</code>
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 \(on page 30\)](#) 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> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Important! The serialMode setting MUST be set to Passthru_Data for the Z9-C or Z9-T to connect.</p> </div>

19.5. tags

Important! FreeWave internal use only.

20. systemInfo Parameters

- [deviceConfiguration](#) (on page 79)
- [deviceFirmwareVersion](#) (on page 79)
- [deviceModel](#) (on page 79)
- [deviceName](#) (on page 80)
- [deviceSerialNumber](#) (on page 80)
- [FirmwareVersion](#) (on page 81)
- [hopTableVersion](#) (on page 81)
- [layoutHash](#) (on page 81)



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 41).

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 0 (zero).

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-C or Z9-T.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Note: This is a Read-only parameter.</p> </div>

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-C or Z9-T.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Note: This is a Read-only parameter.</p> </div>

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	The systemInfo.deviceModel command reports the device model. Note: This is a Read-only parameter.

20.4. deviceName

deviceName	
Setting	Description
CLI / Web Page	[Page=systemInfo]
CLI Command	<ul style="list-style-type: none"> systemInfo.deviceName=nnnn deviceName Note: Where nnnn is the user-defined name for the Z9-C or Z9-T.
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"> systemInfo.deviceSerialNumber deviceSerialNumber
Default Setting	N/A
Options	N/A
Description	The systemInfo.deviceSerialNumber command reports the device serial number. Note: This is a Read-only parameter.

20.6. FirmwareVersion

FirmwareVersion	
Setting	Description
CLI / Web Page	[Page=systemInfo]
CLI Command	<ul style="list-style-type: none"> • <code>systemInfo.FirmwareVersion</code> • <code>FirmwareVersion</code>
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;"> <p>Note: This is a Read-only parameter.</p> </div>

20.7. hopTableVersion

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

20.8. layoutHash

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

layoutHash	
Setting	Description
Description	<p>The systemInfo.layoutHash command reports the Unique Layout Identifier.</p> <div style="border: 1px solid black; padding: 5px;"><p>Note: This is a Read-only parameter.</p></div>

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-C or Z9-T 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 65)).
 - **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 71).
- 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 \(on page 22\)](#).
- 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 \(on page 15\)](#).
- If the rfDataRate (on page 65) is set above **RATE_115.2K** and the user attempts to set the frequencyKey (on page 55) 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 72)** 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 \(on page 57\)](#)
 - 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 \(on page 59\)](#)
 - 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 \(on page 67\)](#)
 - 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

TEMPERATURE-CRITICAL SURFACE
EXPOSED COPPER CONTACT AREA TO BE MAINTAINED BETWEEN -40 AND 85°C WHENEVER POWER IS APPLIED

COMPONENTS Z9-C ONLY

4X ϕ .093 \pm .005

1.42

.59

2.00

1.80

1.22

.081

MMCX FEMALE JACK

MAJOR LEAGUE ELECTRONICS TSH8CM-207-D-126-04-G-V
SANTTEC TMM-107-01-G-SM-AP
(2x7 PIN, 2mm DC POWER & SIGNAL)

PIN 1

.35

REVISION HISTORY

REV	ECN	DESCRIPTION	DATE	APPROVED
A	4295	INITIAL RELEASE	2017-05-31	JACK STRANDQUIST

INTERFACE DRAWING

DIMENSIONS IN INCHES PER ASME Y14.5 - 2009		APPROVALS		 FreeWave Technologies, Inc. 5395 Pearl Parkway Boulder, Colorado 80301
TOLERANCES: \pm .02 INCH	THIRD ANGLE PROJECTION	DRAWN: JACK STRANDQUIST	CHECKED:	
		APPROVED: TIM MESTER		
INFORMATION IN THIS DRAWING IS PROPRIETARY. IT IS ISSUED IN CONFIDENCE AND SHALL NOT BE USED AS A BASIS FOR MANUFACTURE WITHOUT WRITTEN PERMISSION FROM FREEWAVE TECHNOLOGIES.		TITLE: ZUMLINK 900 MHz Radio MODELS Z9-C AND Z9-T		SCALE: 2:1
SIZE: B	CAGE CODE: 05UA3	DWG NO.: DIN0003ZL	REV: A	SHEET 1 OF 1

23. Hop Tables

- [Standard Hop Set - ZumLink 900MHz Channels \(on page 88\)](#)

23.1. Standard Hop Set - ZumLink 900MHz Channels

These are the standard channels supported when the [radioHoppingMode](#) (on page 63) is **Enabled**.

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

- RF Data Rate: 115.2 kbps (on page 88)
- RF Data Rate: 250 kbps (on page 89)
- RF Data Rate: 500 kbps (on page 89)
- RF Data Rate: 1 Mbps (on page 90)
- RF Data Rate: 4 Mbps (on page 90)

23.1.1. 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				
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		

23.1.2. 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		920.5056		924.9984
902.8800		907.3728		911.8656		916.3584		920.8512		925.3440
903.2256		907.7184		912.2112		916.7040		921.1968		925.6896
903.5712		908.0640		912.5568		917.0496		921.5424		926.0352
903.9168		908.4096		912.9024		917.3952		921.8880		926.3808
904.2624		908.7552		913.2480		917.7408		922.2336		926.7264
904.6080		909.1008		913.5936		918.0864		922.5792		927.0720
904.9536		909.4464		913.9392		918.4320		922.9248		927.4176
905.2992		909.7920		914.2848		918.7776		923.2704		
905.6448		910.1376		914.6304		919.1232		923.6160		
905.9904		910.4832		914.9760		919.4688		923.9616		
906.3360		910.8288		915.3216		919.8144		924.3072		
906.6816		911.1744		915.6672		920.1600		924.6528		

23.1.3. 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		919.2960		923.4432
903.3984		907.5456		911.6928		915.8400		919.9872		924.1344
904.0896		908.2368		912.3840		916.5312		920.6784		924.8256
904.7808		908.9280		913.0752		917.2224		921.3696		925.5168
905.4720		909.6192		913.7664		917.9136		922.0608		926.2080
906.1632		910.3104		914.4576		918.6048		922.7520		926.8992

23.1.4. 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

23.1.5. RF Data Rate: 4 Mbps**Channel Size (MHz): 3.2256****Number of Channels: 7**

Standard Hop Set - ZumLink 900MHz Channels
RF Data Rate: 4 Mbps
Frequency
MHz
904.5504
907.7760
911.0016
914.2272
917.4528
920.6784
923.9040

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 65) setting User selectable 			
Hopping Patterns	<ul style="list-style-type: none"> Maximum of 16 patterns Dependent on the rfDataRate (on page 65) 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	Idle
	+3 VDC	843 mA	30 mA	13 mA
	+5 VDC	680 mA	30 mA	13 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
General Information	
Operating Temperature	-40°C to +85°C -40°F to +185°F
Humidity	0 to 95% non-condensing
Dimensions	<ul style="list-style-type: none"> • 50.8 L x 35.56 W x 9.65 H (mm) • 2.0 L x 1.4 W x 0.38 H (in)
Weight	<ul style="list-style-type: none"> • 15g • 0.03 lb
Reliability	91,328 hour MTBF

Appendix B: LEDs

These are the LEDs for the Z9-C or Z9-T.

Note: See [Z9-C or Z9-T Ports and Pinout Connections \(on page 11\)](#) 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.

Restricted Rights

Any product names mentioned in this manual may be trademarks or registered trademarks of their respective companies and are hereby acknowledged.

This manual is only for use by purchasers and other authorized users of FreeWave products.

No part of this manual may be reproduced or transmitted in any form or by any means, electronic or mechanical, or for any purpose without the express written permission of FreeWave Technologies, Inc. FreeWave reserves the right to make changes to this manual without notice. FreeWave assumes no responsibility or liability for the use of this manual or the infringement of any copyright or other proprietary right.

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: KNYPM0101AB.

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: KNYPM0101AB.**"

FCC Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 52 cm between the radiator and your body.

FCC Notification of Power Warning

The ZumLink Z9-C or Z9-T 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-C Número IFETEL: RCPFRZ917-1310-A1.

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.

BSD Contiki License Notification

Copyright (c) 2010, Swedish Institute of Computer Science.

All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
3. Neither the name of the Institute nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE INSTITUTE AND CONTRIBUTORS ``AS IS'' AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE INSTITUTE OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL,

EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

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-C or Z9-T is +3 to +5VDC ($\pm 10\%$).



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
- It is hereby declared that the Z9-C or Z9-T described in this document is in compliance with RoHS Directive 2011/65/EU of the European Parliament and Council on restriction of the use of certain hazardous substances in electrical and electronic appliances.

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

