



Covers Model: Z9-C or Z9-T

Firmware v1.0.7.0

User-Reference Manual



Part Number: LUM0075AA

Revision: Aug-2019

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 use 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.

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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. Where applicable, this includes the addition of conformal coating.

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www.freewave.com

Table of Contents

Preface	7
4. Overview	9
4.1. Communication Method	9
5. Included & User-supplied Equipment	11
5.1. Included Equipment	11
5.2. User-supplied Equipment	11
6. Port Connections and Pinout Assignments	12
6.1. Z9-C or Z9-T Ports	13
6.2. Z9-C or Z9-T Pinout Assignments	14
7. Installation	16
8. Firmware Update	20
8.1. Z9-C or Z9-T	21
8.1.1. Optional: IQ Installation	21
8.2. Download the Z9-C or Z9-T Update Files	22
8.3. Install the Z9-C or Z9-T Update File	27
9. CLI Configuration	36
10. Approved Antennas	40
10.0.1. Yagi Directional Antennas	40
10.0.2. Omni-directional Antennas	40
10.0.3. Alternative Antennas	41
11. Config Parameters	42
11.1. Factory Defaults	43
11.2. Reset	43
11.3. Restore	43
11.4. Save	44
12. diagPortConfig Parameters	45
12.1. cliBaudRate	46
12.2. databits	46
12.3. diagBaudRate	46
12.4. diagMode	47
12.5. parity	47
12.6. stopbits	48
13. fileHandler Parameters	49
14. Local Diagnostics Parameters	50
14.1. Signal Level	51
14.2. clearStats	51
14.3. Noise Level	51

14.4. Radio Ack Tx	52
14.5. Radio Bad Ack Rx	52
14.6. Radio Bad CRC	52
14.7. Radio Bad Sync	53
14.8. Radio Contention Drop	53
14.9. Radio LL Rx	55
14.10. Radio LL Tx	55
14.11. Radio No Ack Tx	55
14.12. Radio Reliable Rx	56
14.13. Radio Reliable Tx	56
14.14. Radio Rexmit	56
14.15. Radio Rx	56
14.16. Radio Sending Drop	56
14.17. Radio Timed Out	56
14.18. Radio Too Long	57
14.19. Radio Too Short	57
14.20. Radio Tx	57
15. Radio Settings Parameters	58
15.1. Beacon Burst Count	59
15.2. Beacon Interval	59
15.3. Frequency Key	61
15.4. Frequency Masks	63
15.5. LNA Bypass	65
15.6. Max Link Distance in Miles	65
15.7. Network ID	66
15.8. Node ID	67
15.9. Radio Frequency	67
15.10. Radio Hopping Mode	69
15.11. Radio Mode	71
15.12. RF Data Rate	72
15.13. TX Power	74
16. Radio Status Parameters	76
16.1. curPD	77
16.2. curRssi	77
17. Serial Port Config Parameters	78
17.1. cliBaudRate	79
17.2. databits	79
17.3. flowControl	80
17.4. packetizedBaudRate	80

17.5. parity	80
17.6. passthruBaudRate	80
17.7. passthruLatencyMode	81
17.8. passthruLatencyTimer	82
17.9. stopbits	82
18. System Parameters	83
18.1. exit	84
18.2. filter	84
18.3. pages	84
18.4. serialMode	84
18.5. tags	85
19. systemInfo Parameters	86
19.1. Device Configuration	87
19.2. Device Firmware Version	87
19.3. Device Model	87
19.4. Device Name	88
19.5. deviceSerialNumber	88
19.6. FirmwareVersion	89
19.7. Hop Table Version	89
19.8. Layout Hash	89
20. Release Notes	91
20.1. Version 1.0.7.0	91
20.2. Version 1.0.4.0 (Initial Release)	94
21. Mechanical Drawing - Z9-C and Z9-T	95
22. Z9-C or Z9-T Hop Tables	96
22.1. Standard Hop Set - 900 MHz Channels	97
22.1.1. RF Data Rate: 115.2 kbps	97
22.1.2. RF Data Rate: 250 kbps	98
22.1.3. RF Data Rate: 500 kbps	98
22.1.4. RF Data Rate: 1 Mbps	98
22.1.5. RF Data Rate: 1.5 Mbps (Beta)	99
22.1.6. RF Data Rate: 4 Mbps	99
Appendix A: Technical Specifications	100
Data Transmission	101
General Information	101
Interfaces	102
Power Requirements	102
Receiver	102
Transmitter	103

Appendix B: LEDs	104
Normal Operation	104
Appendix C: FreeWave Legal Information	105

DRAFT

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 support@freewave.com.

Additional Information

Note: Use the support.freewave.com website to download the latest documentation for the Z9-C or Z9-T.
Registration is required to use this website.

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, the radio, data, or network.

Example: Provides example information of the related text.

FREEWAVE Recommends: Identifies FreeWave recommendation information.

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

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



Provides time saving or informative suggestions about using the product.



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

4. Overview

Thank you for purchasing the FreeWave ZumLink 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 900 MHz Series:

- Operates in the unlicensed 900 MHz 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

The Z9-C or Z9-T use Listen Before Talk (LBT) and Carrier Sense Multiple Access (CSMA). There are no assigned slots. The radios transmit when the channel is clear.

- The Gateway broadcasts packets to all Endpoints and Endpoint-Repeaters within range.
- Endpoint-Repeaters broadcast packets to all Endpoints and Endpoint-Repeaters within range.
- The Endpoints unicast packets back to the Gateway or downstream Endpoint-Repeaters.
- The Gateway acknowledges the Endpoint or Endpoint-Repeater packets.

FreeWave's traditional protocol has a Gateway Time Slot and an 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.

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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

Note: **See [Approved Antennas \(on page 40\)](#) for detailed information.
Approved antennas can be purchased directly from FreeWave.

6. Port Connections and Pinout Assignments

Port Connections

- [Z9-C or Z9-T Ports \(on page 13\)](#)

Pinout Assignments

- [Z9-C or Z9-T Pinout Assignments \(on page 14\)](#)

6.1. Z9-C or Z9-T Ports

- The Z9-C or Z9-T shares the same 14-pin interface found on FreeWave's MM2 OEM board level radios easing migration but it is not a drop-in replacement.
- The 14-pin dual row header, location, and pinouts 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.

Note: See [Z9-C or Z9-T Pinout Assignments \(on page 14\)](#) for additional information.

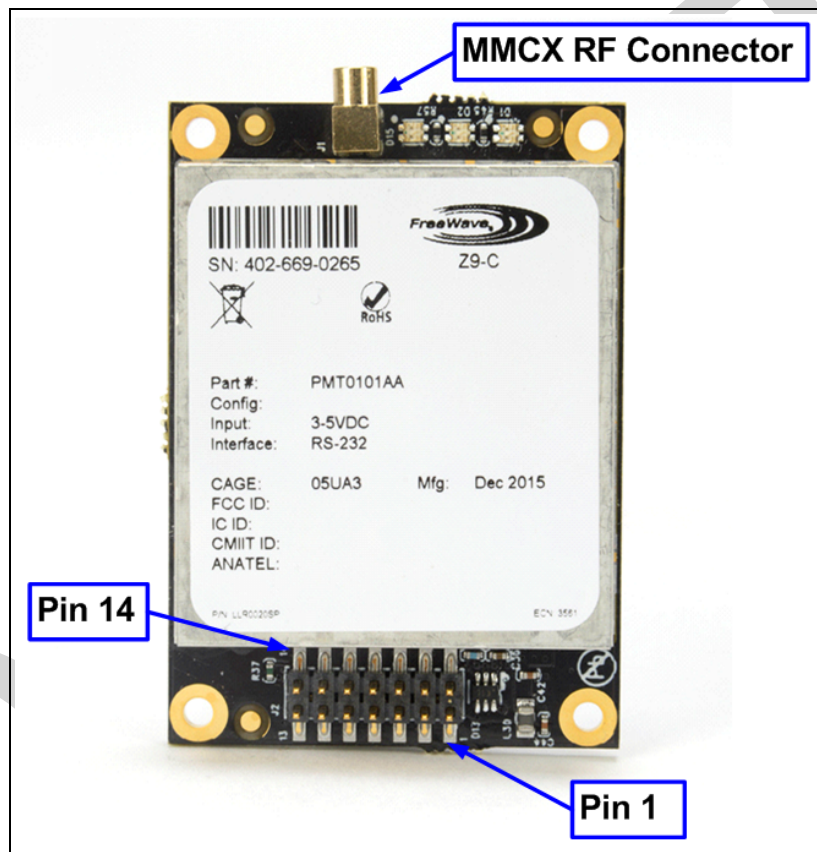


Figure 1: Z9-C or Z9-T MMCX RF Connector and Pinout with Pin 1 and Pin 14

6.2. Z9-C or Z9-T Pinout Assignments

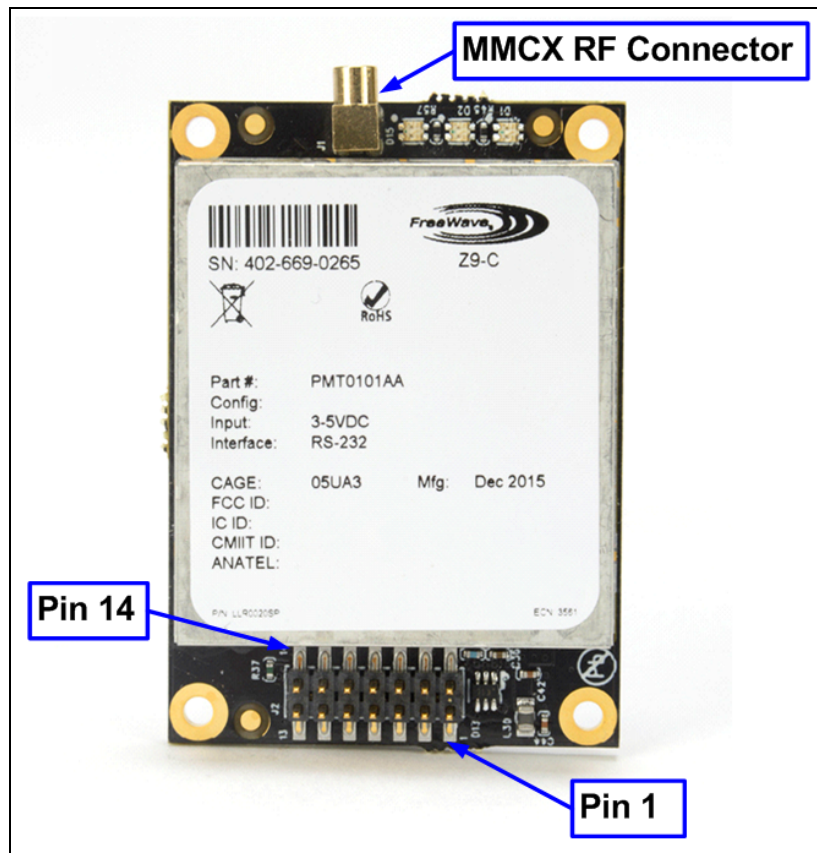


Figure 2: Z9-C or Z9-T Pinout Assignments

- 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 +5 VDC	+3 to +5 VDC	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

- The Z9-C or Z9-T is approved to operate with an input voltage range of +3 to +5 VDC that can supply at least 0.8 Amps at 6 VDC.
- See the [Technical Specifications \(on page 100\)](#) for additional information.

FREEWAVE Recommends: All input power supply wires should be at least **20 AWG** 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 at 12V).



Warning! Use electrostatic discharge (ESD) protectors to protect the Z9-C or Z9-T from electric shock and provide filtered conditioned power with over-voltage protection.

Note: The images in this procedure are for **Windows® 7** and/or **Windows® 10** and **Firefox®**.

Procedure

1. Install an FCC-approved antenna.
2. Connect the antenna feed line to the Z9-C or Z9-T.

Warning! Only FCC approved antennas may be used. See [Approved Antennas \(on page 40\)](#).



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 LEDs (on page 104) blink to show startup.

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

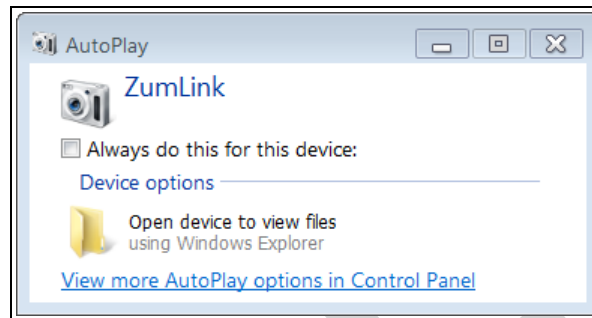


Figure 3: AutoPlay ZumLink window

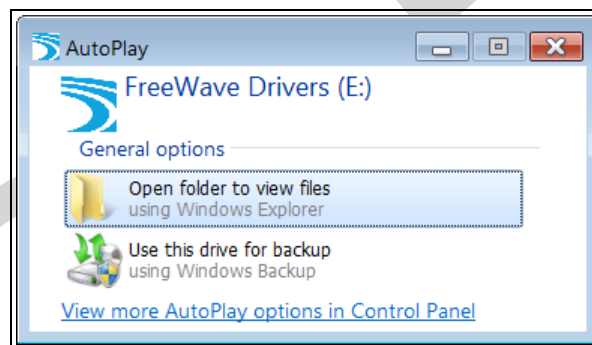


Figure 4: AutoPlay FreeWave Drivers window

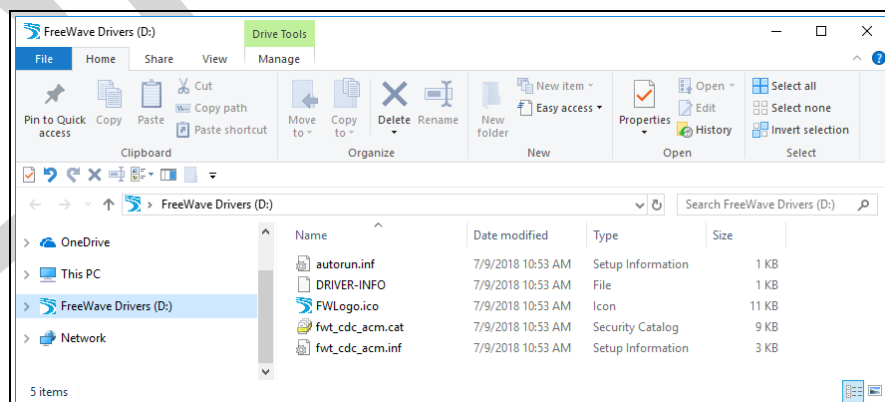


Figure 5: FreeWave Drivers window

Important! The drivers install automatically.

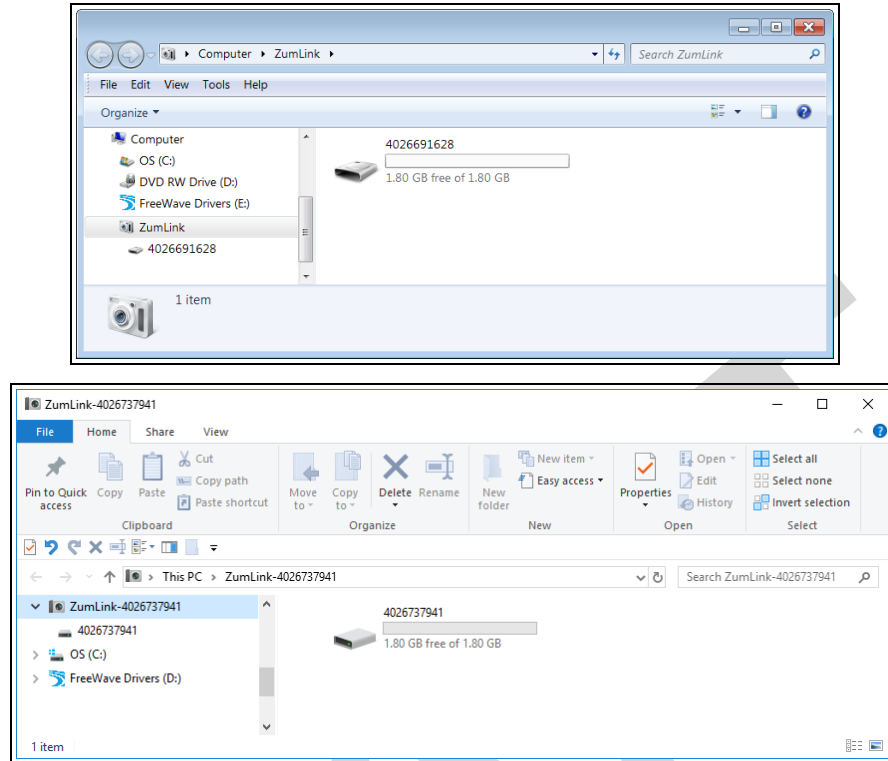


Figure 6: ZumLink window

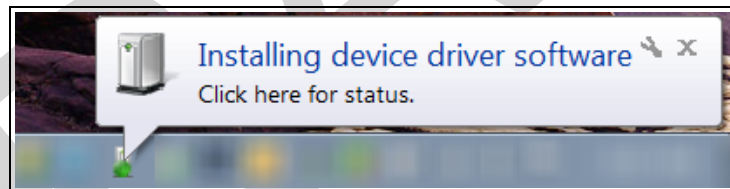


Figure 7: Installing Driver message

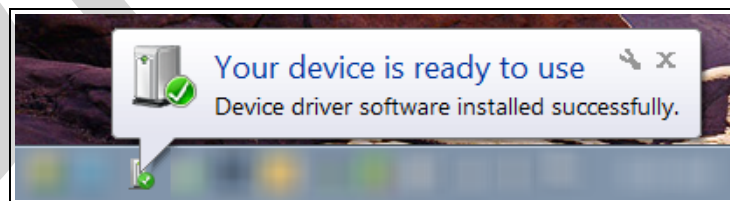


Figure 8: Driver ready to use message

Note: If the Z9-C or Z9-T driver does NOT automatically install, complete the [Install the Driver](#) procedure.

4. Close the **AutoPlay** windows.
5. Continue with:
 - [CLI Configuration \(on page 36\)](#)



Caution: Firmware v1.0.7.0 is **NOT a required** upgrade. **ONLY** upgrade the Z9-C or Z9-T firmware if the user values the new features and fixes within a firmware version.

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8. Firmware Update

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

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

- A. [Download the Z9-C or Z9-T Update Files \(on page 22\)](#)
- B. [Install the Z9-C or Z9-T Update File \(on page 27\)](#)



Caution: Firmware v1.0.7.0 is **NOT a required** upgrade. **ONLY** upgrade the Z9-C or Z9-T firmware if the user values the new features and fixes within a firmware version.

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

- A. [v1101-Download the Upgrade File](#)

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

- A. [v1112-Download the Update File](#)
- B. Review the [v1.1.0.1 - Upgrade Summary](#)[v1112-Update from All Previous Firmware Versions](#)[v1122-Update from All Previous Firmware Versions-UM](#) to identify the files used to update from a previous firmware version.
- C. Complete either the:
[v1112-Firmware Update - Drag and Drop](#) or
[v1112-Firmware Update - Web Interface](#)

Optional Installation

- D. [v1112-Download the IQ Application Environment](#)
- E. Complete either the:
[v1112-Drag and Drop - Installation of the](#)
[v1112-Web Interface - Installation of](#)

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

8.1. Z9-C or Z9-T

- A. [v1122-Download the Update Files](#)
- B. Review the [v1.1.0.1 - Upgrade Summaryv1112-Update from All Previous Firmware Versionsv1122-Update from All Previous Firmware Versions-UM](#) to identify the files used to update from a previous firmware version.
- C. Complete either the:
[v1122-Firmware Update - Drag and Drop-ZL](#) or
[v1122-Firmware Update - Web Interface-ZL](#)

8.1.1. Optional: IQ Installation

- D. [v1122-Download the IQ Application Environment](#)
- E. Complete either the:
[v1122-Drag and Drop - Installation of the - ZL](#)
[v1122-Web Interface - Installation of - ZL](#)
- A. [v1070-Download the Update Files](#)
- B. [v1070-Install the Update File-Z9-C/T](#)

8.2. Download the Z9-C or Z9-T Update Files

This procedure is used to download these files:

- The **Z9-C and Z9-T** firmware update file.
- The **ZumLink Z9-C / Z9-T Programmer Tool**.

Important! The **ZumLink Z9-C / Z9-T Programmer Tool** is **required** to install the **Z9-C or Z9-T** firmware update file.

Procedure

Note: The images in this procedure are for **Windows® 7** and/or **Windows® 10** and **Firefox®**.

1. Click support.freewave.com.
The **Login** window opens. [Figure 9](#)

Important! Registration is required to use this website.

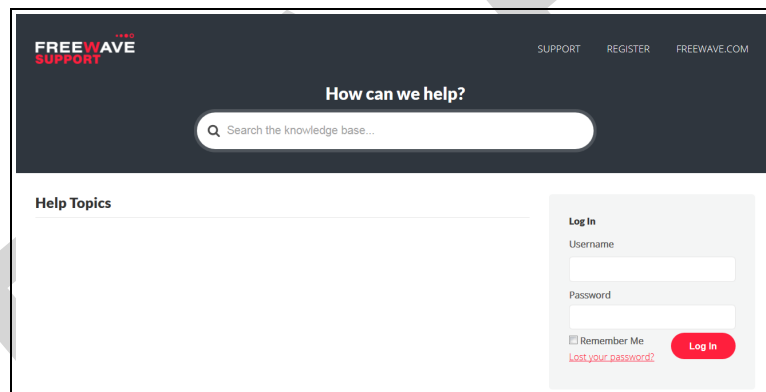
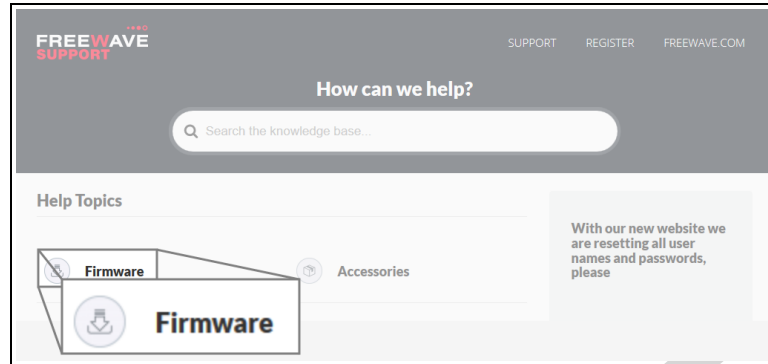
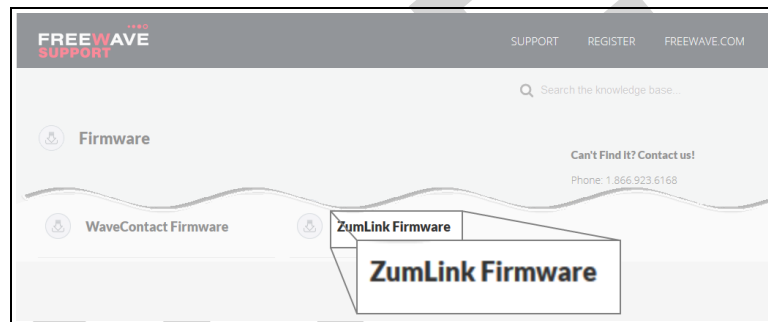


Figure 9: Login window

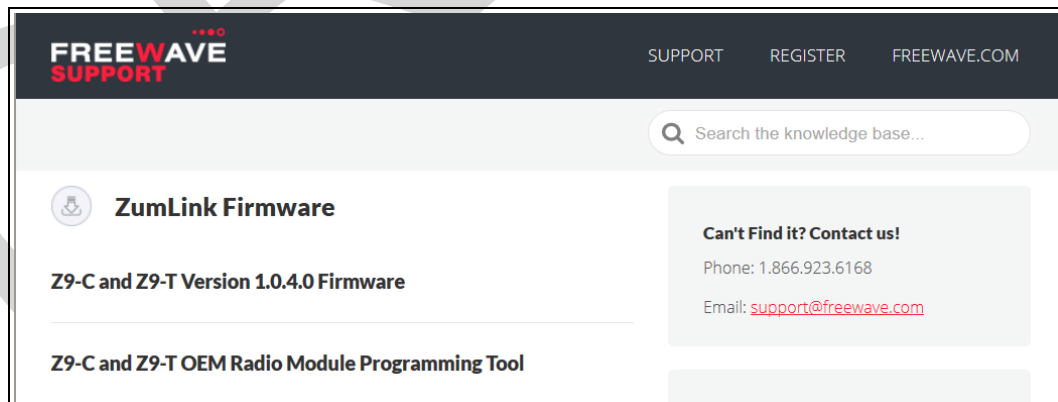
2. Enter the **User Name** and **Password**.
3. Click .
A successful Login message briefly appears.
The **Help Topics** window opens. [Figure 10](#)

**Figure 10: Help Topics window**

4. Click the **Firmware** link.
The **Firmware** window opens.
5. Click the link. [Figure 11](#)

**Figure 11: Firmware window**

The available firmware/software appears in the window. [Figure 12](#)

**Figure 12: Z9-C and Z9-T Firmware window**

6. Click the firmware/software link.

The **Firmware Update** window opens. [Figure 13](#) or [Figure 14](#)

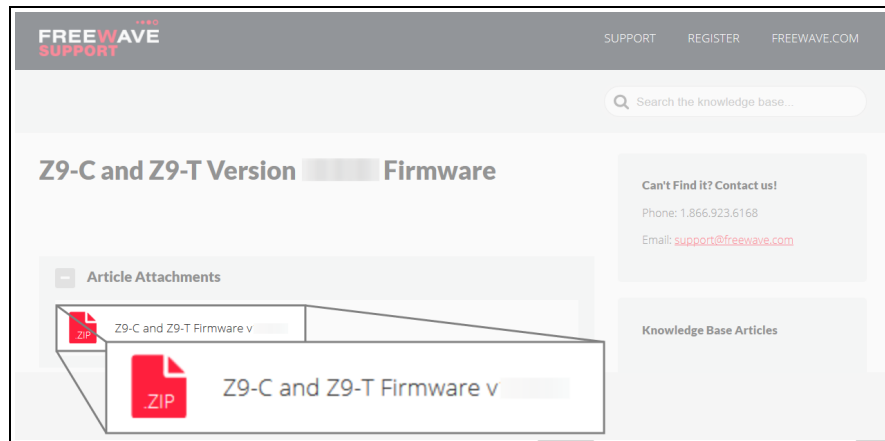


Figure 13: Z9-C and Z9-T Firmware Upgrade window with Selected Attachment

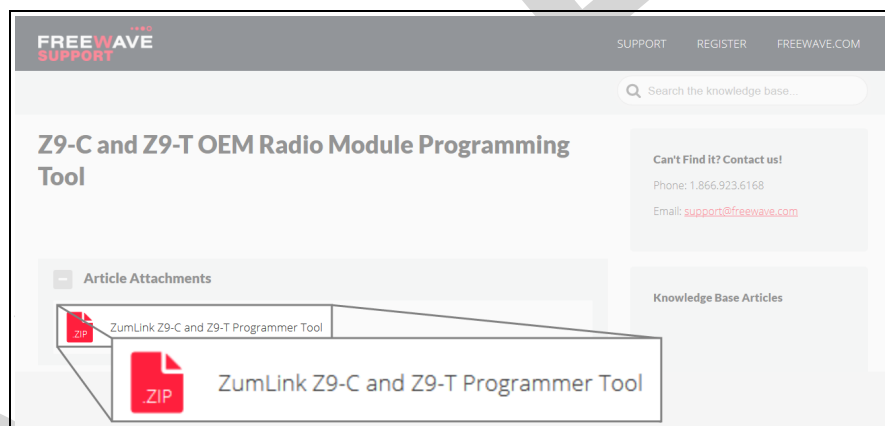
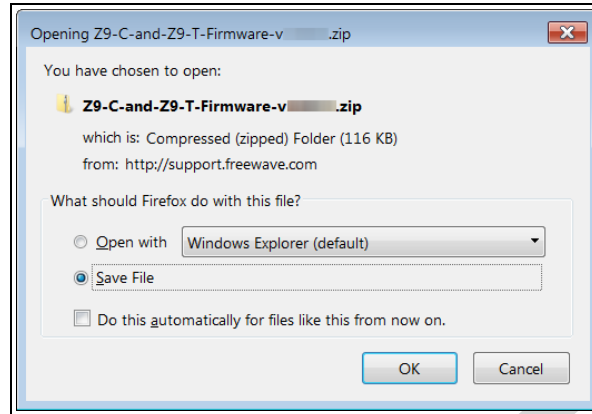
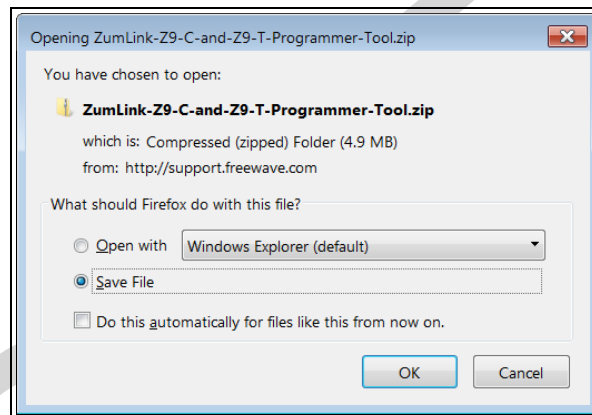


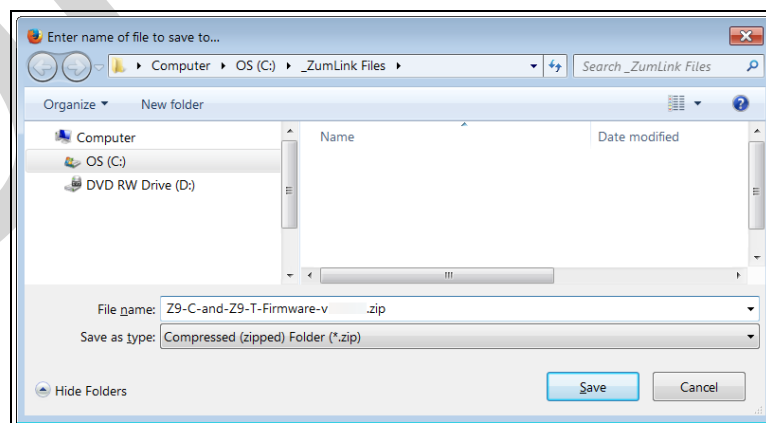
Figure 14: Z9-C and Z9-T Programmer Tool Firmware Upgrade window with Selected Attachment

The **Opening** dialog box opens. [Figure 15](#) or [Figure 16](#)

**Figure 15: Z9-C and Z9-T Opening dialog box****Figure 16: ZumLink Z9-C and Z9-T Programmer Tool Opening dialog box**

7. Click **OK**.

The **Enter name of file to save to** dialog box opens. [Figure 17](#) or [Figure 18](#)

**Figure 17: Z9-C and Z9-T Enter name of file to save to dialog box**

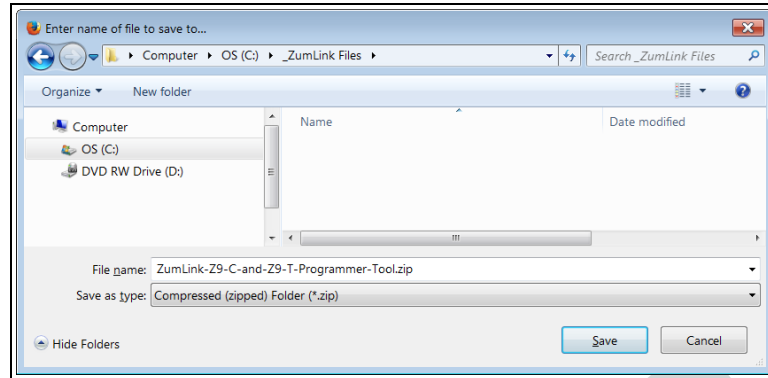


Figure 18: ZumLink Z9-C and Z9-T Programmer Tool Enter name of file to save to dialog box

8. 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.
9. Open a Windows® Explorer window and find the location where the **.zip** file was saved.
10. Double-click the **.zip** file.
11. Extract the files from the **.zip** file into the parent location.

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

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

12. Continue with the [v1070-Update the -Z9-C/T](#) procedure.

8.3. Install the Z9-C or Z9-T Update File

This procedure describes using **ZumLink Z9-C / Z9-T Programmer Tool** to update the **Z9-C or Z9-T** firmware.

Notes

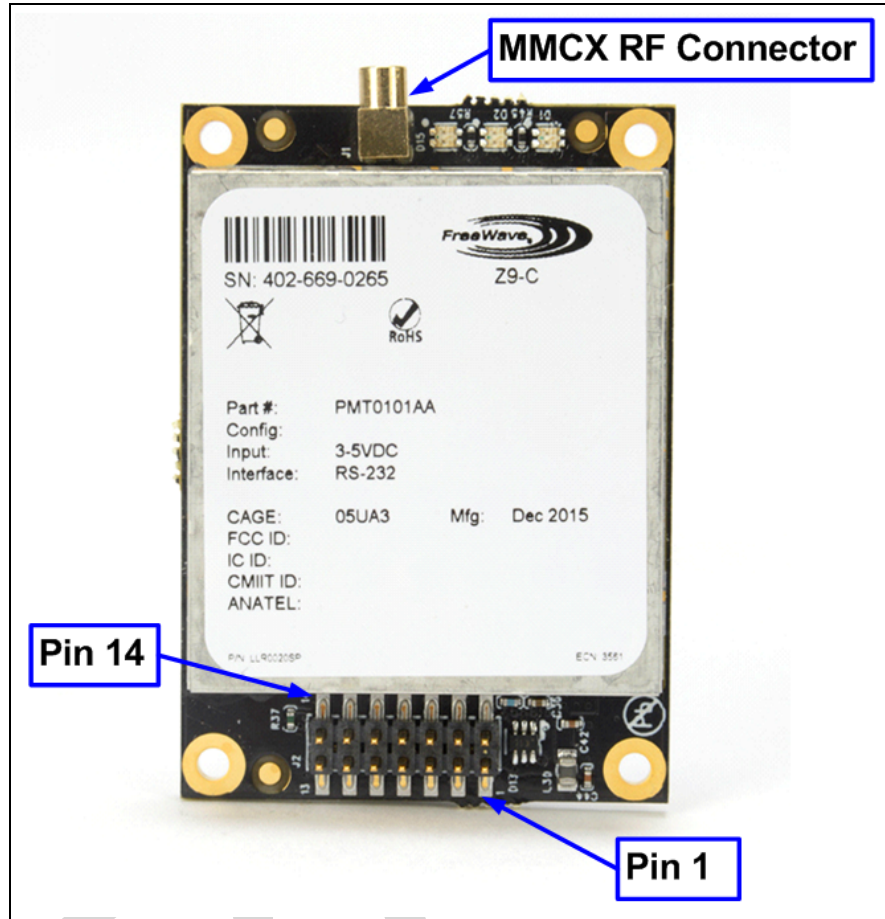
- This procedure is for a **Z9-C / Z9-T** module interfaced to a computer. If interfaced to a device other than a computer, some of these procedure steps may not be used.
- This procedure provides a **Tera Term** terminal connection to the FreeWave CLI. Other terminal emulators (e.g., **HyperTerminal**, **PuTTY**) may be used.

Procedure

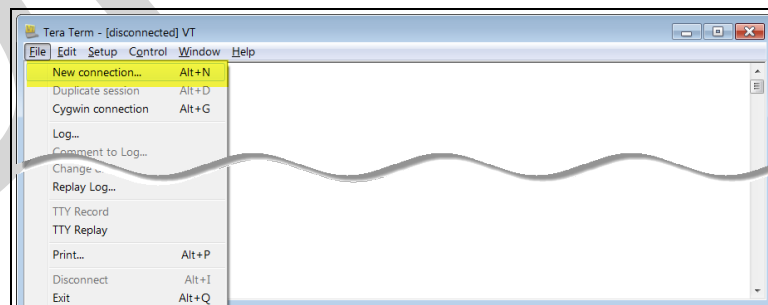
Note: The images in this procedure are for **Windows® 7** and/or **Windows® 10** and **Firefox®**.

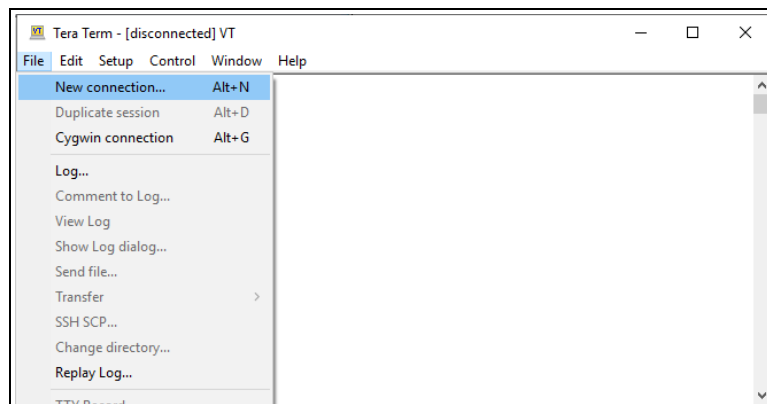
1. Verify the [v1070-Download the Update Files](#) procedure is completed.
2. Connect to the Serial Interface of the **ZumLink** device.
On the **Z9-C or Z9-T** [Figure 19](#):
 - The **Z9-C** model has an RS232 interface and can be connected directly to an RS232 device.
 - FreeWave offers a cable (FreeWave 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.

Important!: If connecting to a device or circuit that is RS232, a circuit is required to adapt between the two interfaces.

**Figure 19: Z9-C or Z9-T Connections**

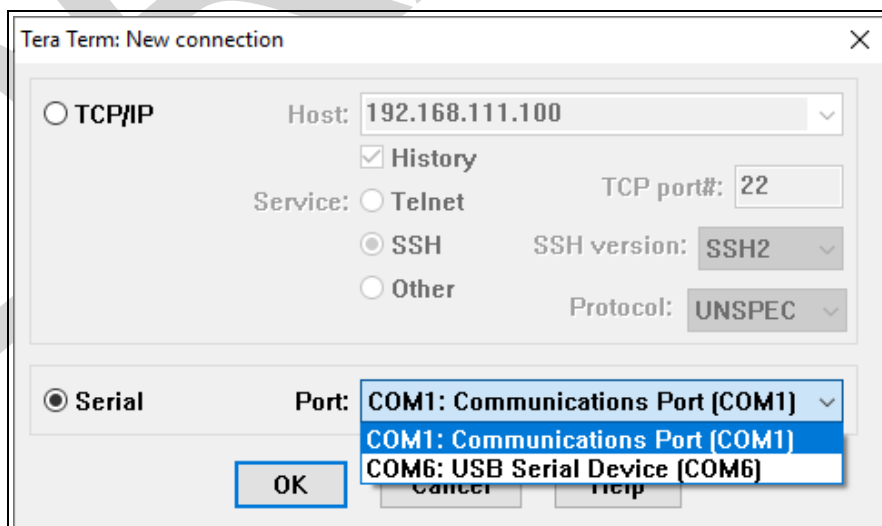
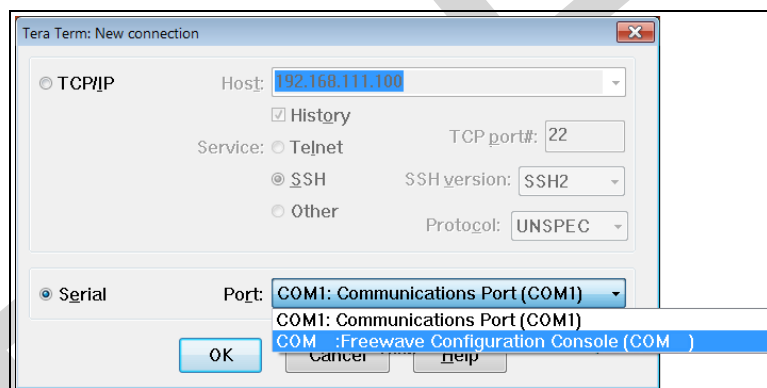
3. On the computer connected to the Z9-C or Z9-T, open a terminal program (e.g., **Tera Term** <http://ttssh2.osdn.jp/>).
4. In **Tera Term**, click the **File** menu and select **New Connection**. **Figure 20**



**Figure 20: File menu > New Connection**

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

5. Click the **Port** list box arrow and select the COM port the Z9-C or Z9-T is connected to. [Figure 21](#)

**Figure 21: Select the Zum productCOM 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 22](#)

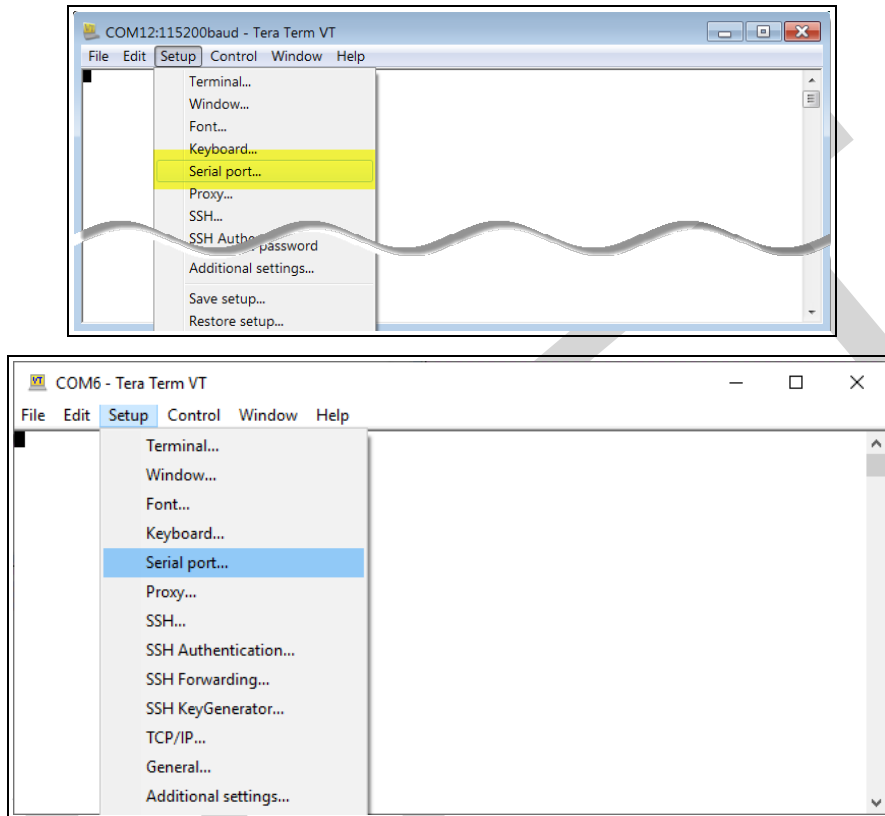


Figure 22: Setup menu > Serial Port

The **Tera Term: Serial Port Setup** dialog box opens. [Figure 23](#)

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

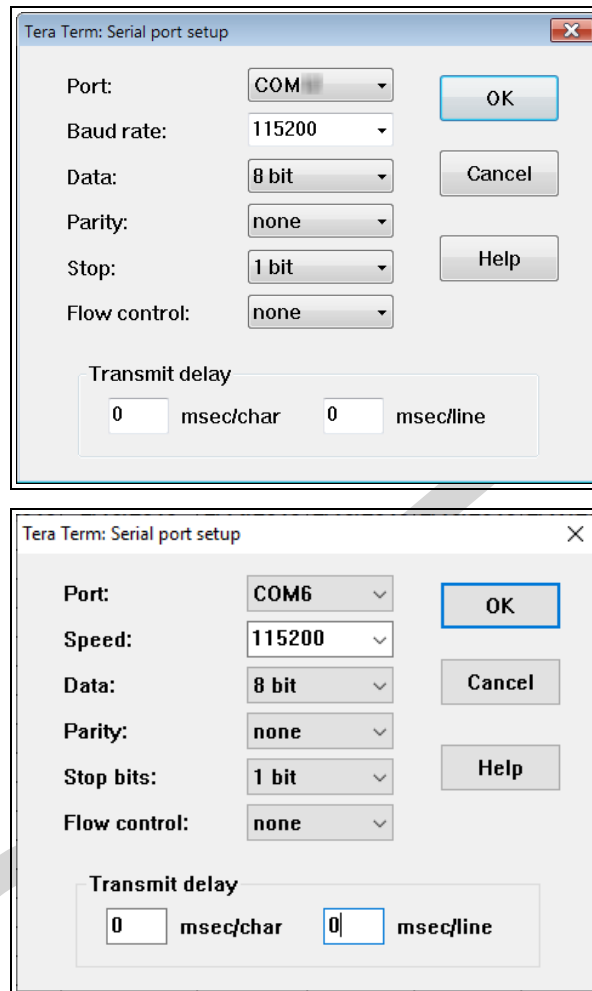


Figure 23: Tera Term: Serial Port Setup dialog box with Default Settings

8. Using [Figure 23](#) as the example, verify the COM port settings are:

Speed (Baud Rate): 115200

Data (Databits): 8 bit

Parity: none

Stop bits: 1 bit

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 11.

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 24**

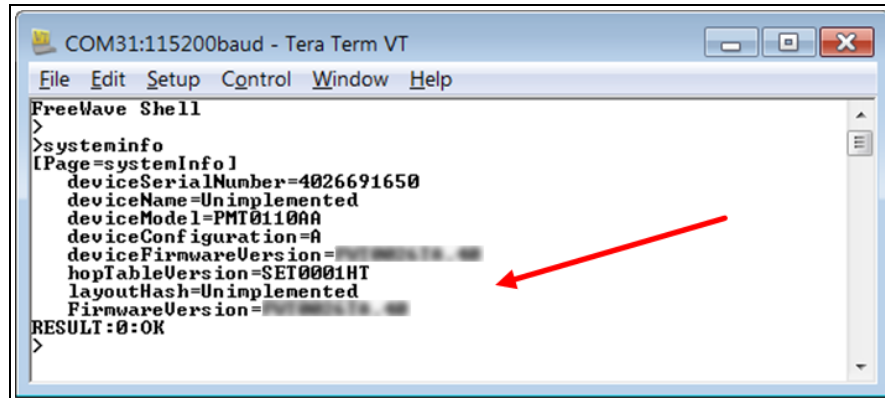


Figure 24: Existing Firmware Version Installed on the Z9-C / Z9-T

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 / Z9-T Programmer Tool .exe** file and double-click the **.exe** file.

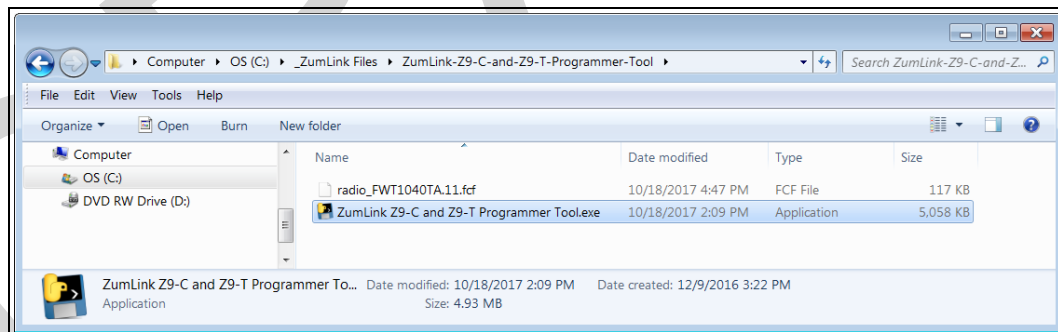
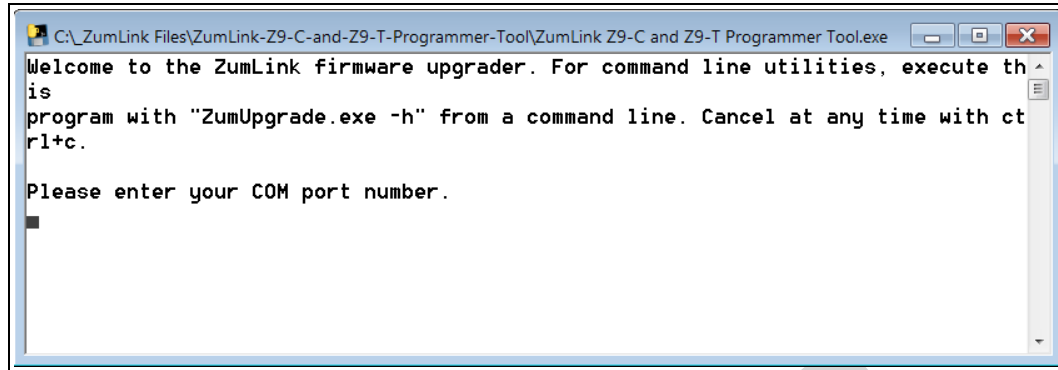
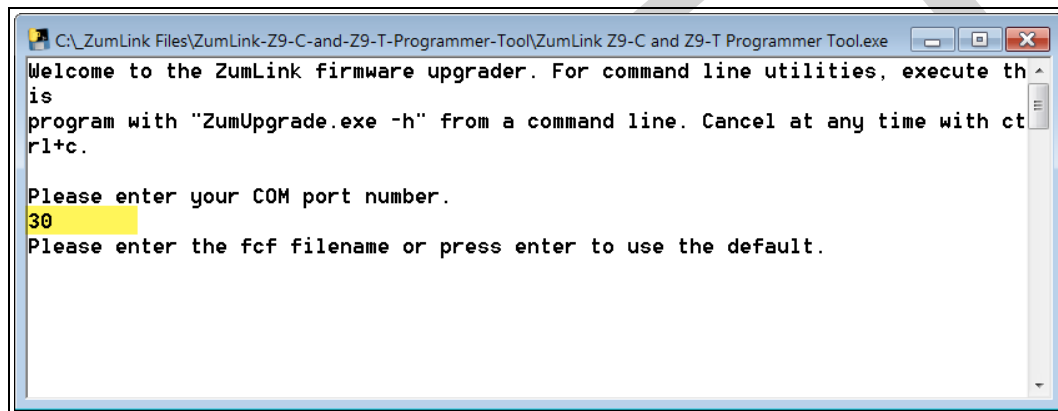


Figure 25: Double-click the .exe File

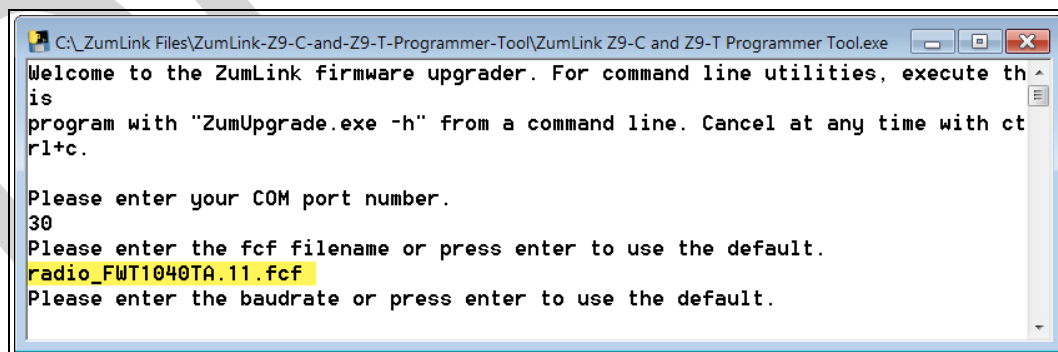
The **ZumLink Z9-C / Z9-T Programmer Tool** opens.

**Figure 26: Opened ZumLink Z9-C / Z9-T Programmer Tool**

21. Enter the COM port for the **Z9-C** or **Z9-T** and press <Enter>. [Figure 27](#)

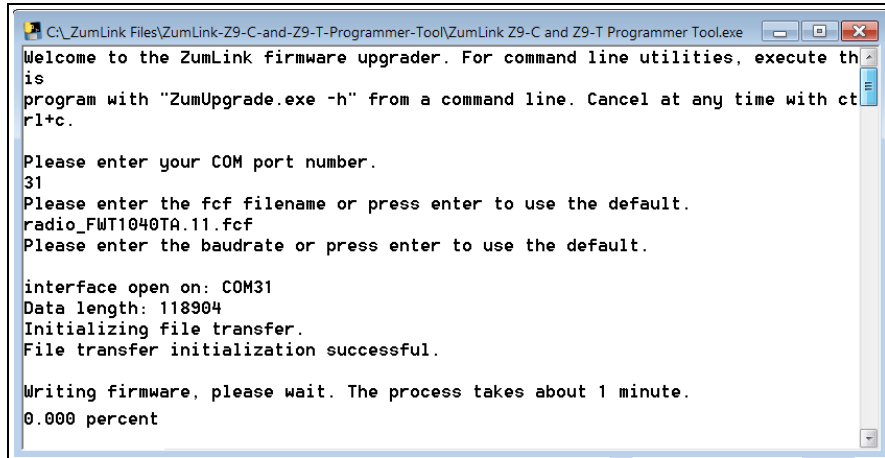
**Figure 27: Entered COM Port**

22. Enter the name of the **.fcf** file in the designated download folder and press <Enter>. [Figure 28](#)

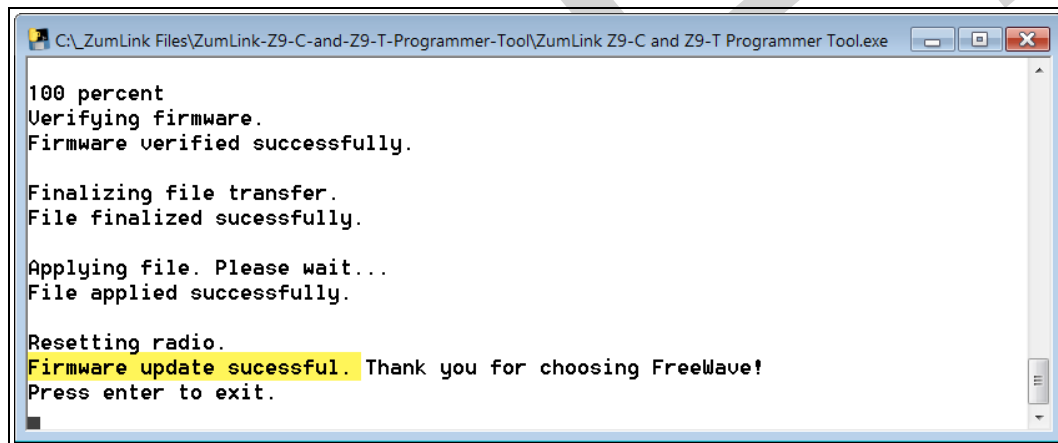
**Figure 28: Entered .fcf File Name**

23. Enter **230400** for the **baudrate** and press <Enter>. [Figure 29](#)

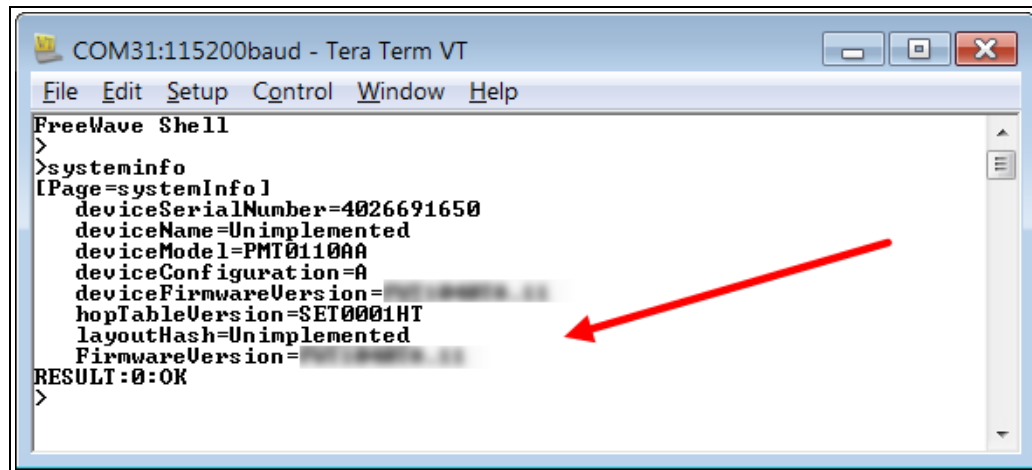
Note: **230400** is the entered **serialPortConfig.cliBaudRate** in Step 13.

**Figure 29: Initialed Upgrade Process**

A successful upgrade message appears when the upgrade process is complete. [Figure 30](#)

**Figure 30: Successful Upgrade Process**

24. Optional: Open **Tera Term** to view the upgraded firmware version on the [systeminfo](#) page [Figure 31](#):



```
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=1.0.0
hopTableVersion=SET0001HT
layoutHash=Unimplemented
FirmwareVersion=1.0.0
RESULT:0:OK
>
```

Figure 31: systeminfo page Showing Upgraded Firmware Version

25. Use the [CLI Configuration \(on page 36\)](#) 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 **Windows® 10** and **Firefox®**. This procedure provides a **Tera Term** terminal connection to the FreeWave 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**.

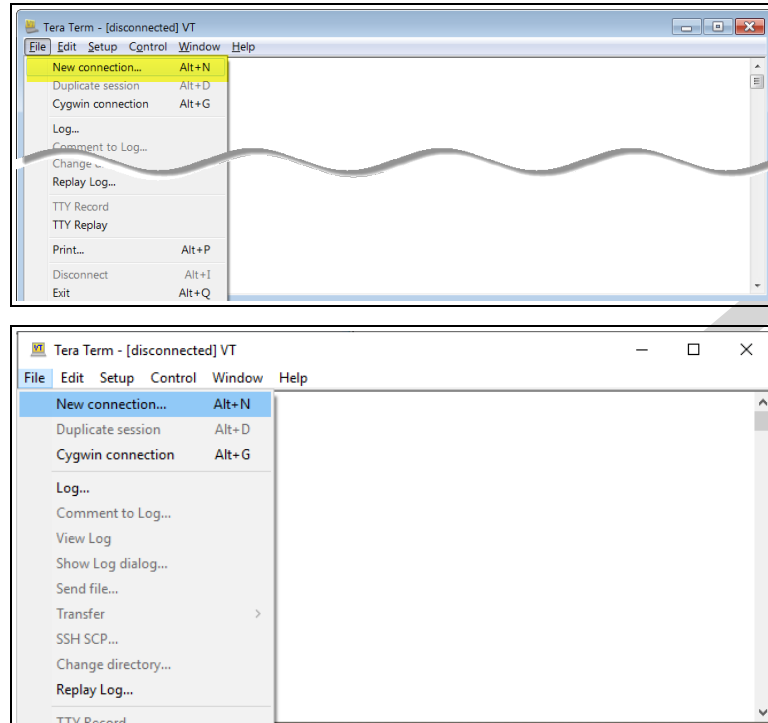


Figure 32: File menu > New Connection

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.

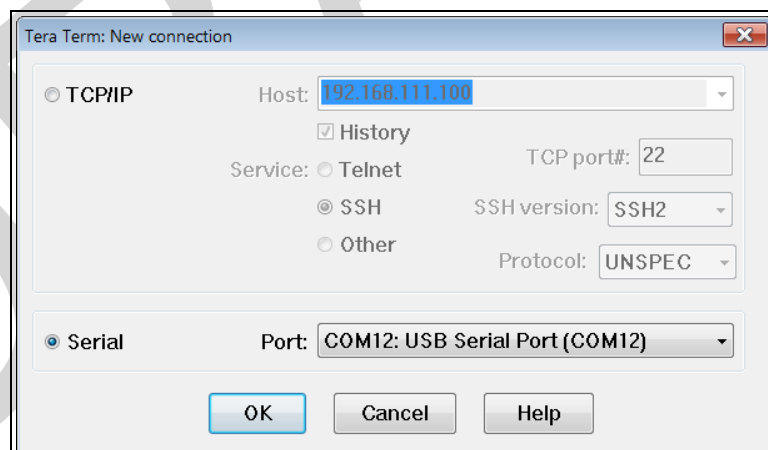
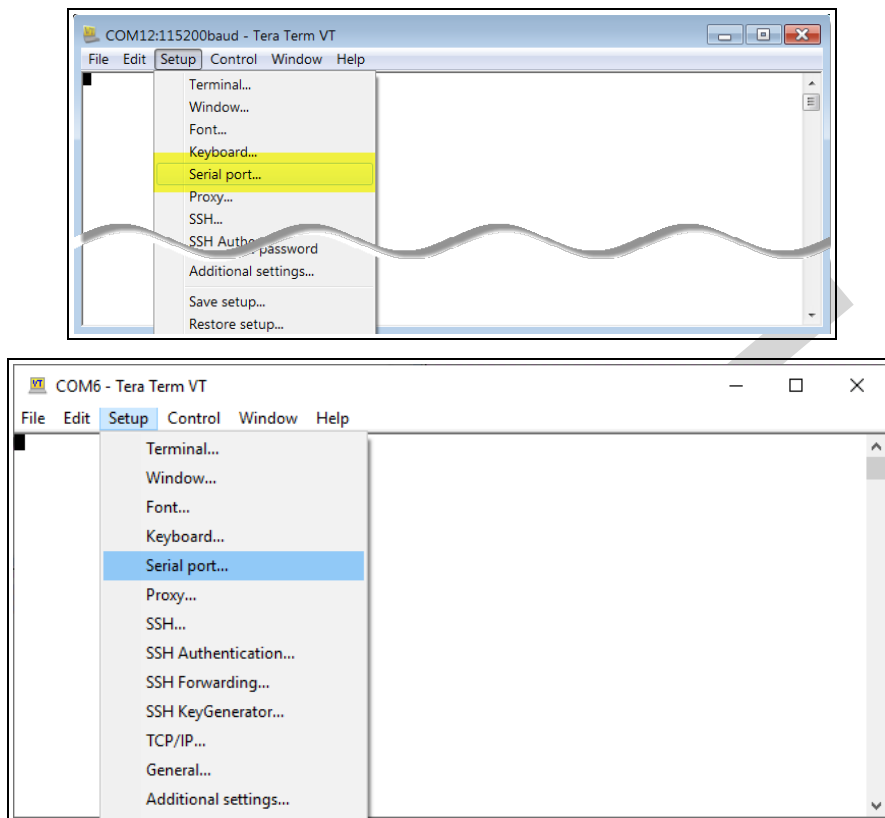
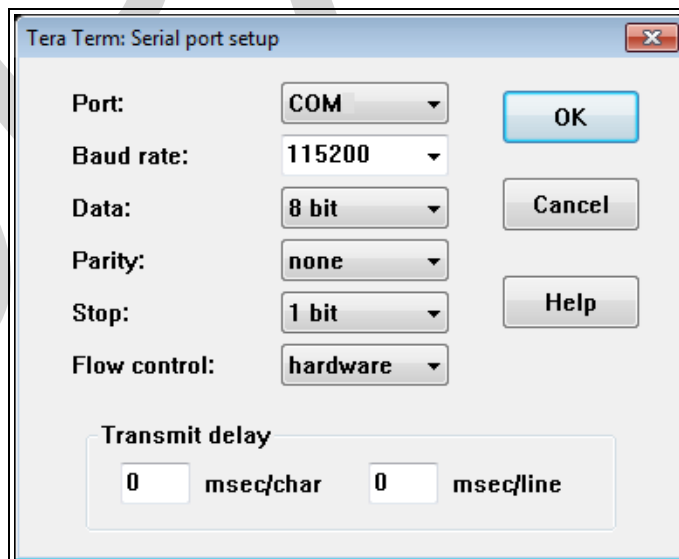


Figure 33: Select the **ZumLink COM port**

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 34: Serial menu > Setup Port**

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

**Figure 35: 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 35](#).

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.

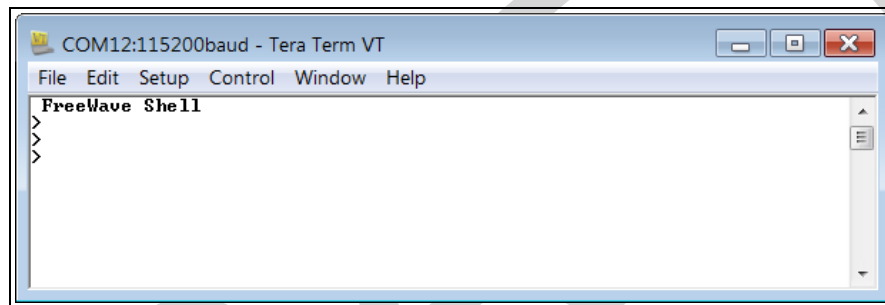


Figure 36: FreeWave Shell in Tera Term

11. Continue with Creating a Basic Gateway and Endpoint Network.

10. Approved Antennas

10.0.1. Yagi Directional Antennas

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

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

10.0.2. Omni-directional Antennas

The 900 MHz 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.

900 MHz 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
0.85	3.0	Mobile Mark	PSKN3-925S	EAN0900SR
-2.15	0.0	Mobile Mark	PSTG0-915SE	EAN0900SQ

10.0.3. 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.

11. Config Parameters

Note: See the [Config window](#).

[Factory Defaults \(on page 43\)](#)

[Reset \(on page 43\)](#)

[Restore \(on page 43\)](#)

[Save \(on page 44\)](#)



The parameter syntax is: page.parameter=value.
Parameters with unique names can be specified as parameter=value.

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).

11.1. Factory Defaults

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

11.2. 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 .

11.3. Restore

Restore	
Setting	Description
CLI / Web Page	[Page=config]
CLI Command	<code>config.restore=now</code> <code>config.restore</code> <code>restore</code>
Default Setting	N/A
Options	N/A
Description	The config.restore command reloads a previously saved setting configuration of the Z9-C or Z9-T. Note: Restore happens automatically when the Z9-C or Z9-T starts.

11.4. Save

Save	
Setting	Description
CLI / Web Page	[Page=config]
CLI Command	• <code>config.save=now</code> • <code>config.save</code> • <code>save</code>
Default Setting	N/A
Options	N/A
Description	The <code>config.save</code> command saves changes made to the Z9-C or Z9-T configuration.

12. diagPortConfig Parameters

[cliBaudRate \(on page 46\)](#)

[databits \(on page 46\)](#)

[diagBaudRate \(on page 46\)](#)

[diagMode \(on page 47\)](#)

[parity \(on page 47\)](#)

[stopbits \(on page 48\)](#)



The parameter syntax is: `page.parameter=value`.
Parameters with unique names can be specified as `parameter=value`.

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. cliBaudRate

cliBaudRate	
Setting	Description
CLI / Web Page	[Page=diagPortConfig]
CLI Command	- diagPortConfig.cliBaudRate=9600 - diagPortConfig.cliBaudRate=19200 - diagPortConfig.cliBaudRate=115200
Default Setting	115200
Options	9600 19200 115200
Description	The diagPortConfig.cliBaudRate parameter designates the baud rate of the diagnostic port.

12.2. databits

databits	
Setting	Description
CLI / Web Page	[Page=diagPortConfig]
CLI Command	- diagPortConfig.databits=7 - diagPortConfig.databits=8
Default Setting	8
Options	7 8
Description	The diagPortConfig.databits parameter designates the byte length for the diagnostic port.

12.3. diagBaudRate

diagBaudRate	
Setting	Description
CLI / Web Page	[Page=diagPortConfig]
CLI Command	- diagPortConfig.cliBaudRate=9600 - diagPortConfig.cliBaudRate=19200 - diagPortConfig.cliBaudRate=115200
Default Setting	115200

diagBaudRate	
Setting	Description
Options	• 9600 • 19200 • 115200
Description	The diagPortConfig.diagBaudRate parameter designates the baud rate for the diagnostics port.

12.4. diagMode

diagMode	
Setting	Description
CLI / Web Page	[Page=diagPortConfig]
CLI Command	• <code>diagPortConfig.diagMode=CLI</code> • <code>diagPortConfig.diagMode=Diag</code>
Default Setting	Diag
Options	• CLI • Diag
Description	The diagPortConfig.diagMode parameter designates whether the diagnostic port is supporting the command line interface (CLI) or diagnostics.

12.5. parity

parity	
Setting	Description
CLI / Web Page	[Page=diagPortConfig]
CLI Command	• <code>diagPortConfig.parity=None</code> • <code>diagPortConfig.parity=Even</code> • <code>diagPortConfig.parity=Odd</code>
Default Setting	None
Options	• None • Even • Odd
Description	The diagPortConfig.parity parameter designates the parity for the diagnostic port.

12.6. stopbits

stopbits	
Setting	Description
CLI / Web Page	[Page=diagPortConfig]
CLI Command	- diagPortConfig.stopbits=1 - diagPortConfig.stopbits=2
Default Setting	1
Options	1 2
Description	The diagPortConfig.stopbits parameter designates the number of stop bits for the diagnostic port.

13. fileHandler Parameters

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

14. Local Diagnostics Parameters

[Signal Level \(on page 51\)](#)
[clearStats \(on page 51\)](#)
[Noise Level \(on page 51\)](#)
[Radio Ack Tx \(on page 52\)](#)
[Radio Bad Ack Rx \(on page 52\)](#)
[Radio Bad CRC \(on page 52\)](#)
[Radio Bad Sync \(on page 53\)](#)
[Radio Contention Drop \(on page 53\)](#)
[Radio LL Rx \(on page 55\)](#)

[Radio LL Tx \(on page 55\)](#)
[Radio No Ack Tx \(on page 55\)](#)
[Radio Reliable Rx \(on page 56\)](#)
[Radio Reliable Tx \(on page 56\)](#)
[Radio Rexmit \(on page 56\)](#)
[Radio Rx \(on page 56\)](#)
[Radio Sending Drop \(on page 56\)](#)
[Radio Timed Out \(on page 56\)](#)
[Radio Too Long \(on page 57\)](#)
[Radio Too Short \(on page 57\)](#)
[Radio Tx \(on page 57\)](#)

14.1. Signal Level

Important!: Most of the **localDiagnostics** parameters are read-only.
The information reported is dependent upon the connected Z9-C or Z9-T.

signalLevel	
Setting	Description
CLI / Web Page	[Page=localDiagnostics]
CLI Command	- localDiagnostics.signalLevel - signalLevel
Default Setting	0 (zero)
Options	N/A
Description	The localDiagnostics.signalLevel command reports the signal level of the Z9-C or Z9-T, in dBm, of the last received packet. Note: This setting shows -128.00 if no packet has been received since the stats were cleared.

14.2. clearStats

Important!: Most of the **localDiagnostics** parameters are read-only.
The information reported is dependent upon the connected Z9-C or Z9-T.

clearStats	
Setting	Description
CLI / Web Page	[Page=localDiagnostics]
CLI Command	- localDiagnostics.clearStats - clearStats
Default Setting	N/A
Options	N/A
Description	The localDiagnostics.clearStats setting clears diagnostic information.

14.3. Noise Level

Important!: Most of the **localDiagnostics** parameters are read-only.
The information reported is dependent upon the connected Z9-C or Z9-T.

Noise Level	
Setting	Description
CLI / Web Page	[Page=localDiagnostics]
CLI Command	<code>localDiagnostics.noiseLevel</code> <code>noiseLevel</code>
Default Setting	0.000000
Options	N/A
Description	The <code>localDiagnostics.noiseLevel</code> command reports the amount of link noise measured in dB before the last packet was transmitted.

14.4. Radio Ack Tx

Important!: FreeWave internal use only.

14.5. Radio Bad Ack Rx

Important!: Most of the `localDiagnostics` parameters are read-only. The information reported is dependent upon the connected Z9-C or Z9-T.

Radio Bad Ack Rx	
Setting	Description
CLI / Web Page	[Page=localDiagnostics]
CLI Command	<code>localDiagnostics.RadioBadAckRx</code> <code>RadioBadAckRx</code>
Default Setting	N/A
Options	N/A
Description	The <code>localDiagnostics.RadioBadAckRx</code> command reports the number of received ACKs missed in unicast transmissions.

14.6. Radio Bad CRC

Important!: Most of the `localDiagnostics` parameters are read-only. The information reported is dependent upon the connected Z9-C or Z9-T.

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

14.7. Radio Bad Sync

Important!: Most of the `localDiagnostics` parameters are read-only.
The information reported is dependent upon the connected Z9-C or Z9-T.

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

14.8. Radio Contention Drop

Important!: Most of the `localDiagnostics` parameters are read-only.
The information reported is dependent upon the connected Z9-C or Z9-T.

Radio Contention Drop	
Setting	Description
CLI / Web Page	[Page=localDiagnostics]

Radio Contention Drop	
Setting	Description
CLI Command	- 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.

14.9. Radio LL Rx

Important!: Most of the **localDiagnostics** parameters are read-only.
The information reported is dependent upon the connected Z9-C or Z9-T.

Radio LL Rx	
Setting	Description
CLI / Web Page	[Page=localDiagnostics]
CLI Command	- 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.

14.10. Radio LL Tx

Important!: Most of the **localDiagnostics** parameters are read-only.
The information reported is dependent upon the connected Z9-C or Z9-T.

Radio LL Tx	
Setting	Description
CLI / Web Page	[Page=localDiagnostics]
CLI Command	- localDiagnostics.RadioLLTx - RadioLLTx
Default Setting	N/A
Options	N/A
Description	The localDiagnostics.RadioLLTx command reports the number of packets transmitted over the air.

14.11. Radio No Ack Tx

Important!: FreeWave internal use only.

14.12. Radio Reliable Rx

Important!: FreeWave internal use only.

14.13. Radio Reliable Tx

Important!: FreeWave internal use only.

14.14. Radio Rexmit

Important!: FreeWave internal use only.

14.15. Radio Rx

Important!: Most of the [localDiagnostics](#) parameters are read-only.
The information reported is dependent upon the connected Z9-C or Z9-T.

Radio Rx

Setting	Description
CLI / Web Page	[Page=localDiagnostics]
CLI Command	<code>localDiagnostics.RadioRx</code> <code>RadioRx</code>
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 Endpoint.

14.16. Radio Sending Drop

Important!: FreeWave internal use only.

14.17. Radio Timed Out

Important!: FreeWave internal use only.

14.18. Radio Too Long

Important!: FreeWave internal use only.

14.19. Radio Too Short

Important!: FreeWave internal use only.

14.20. Radio Tx

Important!: Most of the **localDiagnostics** parameters are read-only.
The information reported is dependent upon the connected Z9-C or Z9-T.

Radio Tx	
Setting	Description
CLI / Web Page	[Page=localDiagnostics]
CLI Command	- 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.

15. Radio Settings Parameters

Note: See the [Radio Settings window](#).

[Beacon Burst Count \(on page 59\)](#)
[Beacon Interval \(on page 59\)](#)
[Frequency Key \(on page 61\)](#)
[Frequency Masks \(on page 63\)](#)
[LNA Bypass \(on page 65\)](#)
[Max Link Distance in Miles \(on page 65\)](#)
[Network ID \(on page 66\)](#)
[Node ID \(on page 67\)](#)

[Radio Frequency \(on page 67\)](#)
[Radio Hopping Mode \(on page 69\)](#)
[Radio Hopping Mode \(on page 69\)](#)
[Radio Mode \(on page 71\)](#)
[RF Data Rate \(on page 72\)](#)
[TX Power \(on page 74\)](#)



The parameter syntax is: `page.parameter=value`.
Parameters with unique names can be specified as `parameter=value`.

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).

15.1. Beacon Burst Count

Beacon Burst Count	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<code>radioSettings.beaconBurstCount=n</code> <code>beaconBurstCount=n</code> Note: Where <code>n</code> is any number between 1 and 7.
Default Setting	3
Options	Any number between 1 and 7.
Description	The <code>radioSettings.beaconBurstCount</code> setting designates the number of consecutive beacons to send per <code>Beacon Interval</code> time. Notes - The <code>radioSettings.beaconBurstCount</code> is set only on the Gateway device. - The Endpoint radios obtain this value from a Gateway with the same <code>networkId</code> via the beacon frame. - This setting is only used when <code>radioSettings.radioHoppingMode=Hopping_On</code>. Increasing the number of beacons may improve RF link reliability in noisy environments. Decreasing the number of beacons may improve throughput in environments where interference is minimal. FREEWAVE Recommends: Set the <code>Beacon Burst Count</code> (on page 59) to 2 or more. This increases the number of beacons sent in a beacon interval.

15.2. Beacon Interval

Beacon Interval	
Setting	Description
CLI / Web Page	[Page=radioSettings]

Beacon Interval	
Setting	Description
CLI Command	<code>radioSettings.beaconInterval=TWENTY_FIVE_MS</code> <code>beaconInterval=TWENTY_FIVE_MS</code> <code>radioSettings.beaconInterval=FIFTY_MS</code> <code>beaconInterval=FIFTY_MS</code> <code>radioSettings.beaconInterval=ONE_HUNDRED_MS</code> <code>beaconInterval=ONE_HUNDRED_MS</code> <code>radioSettings.beaconInterval=TWO_HUNDRED_MS</code> <code>beaconInterval=TWO_HUNDRED_MS</code> <code>radioSettings.beaconInterval=FOUR_HUNDRED_MS</code> <code>beaconInterval=FOUR_HUNDRED_MS</code>
Default Setting	ONE_HUNDRED_MS
Options	- TWENTY_FIVE_MS - FIFTY_MS - ONE_HUNDRED_MS - TWO_HUNDRED_MS - FOUR_HUNDRED_MS
Description	The radioSettings.beaconInterval controls how often a Gateway radio sends out a beacon packet and changes to the next radio frequency in the hopping pattern. Notes - The radioSettings.beaconInterval is set only 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.  A longer Beacon Interval may improve throughput in environments where interference is minimal.

15.3. Frequency Key

Frequency Key																			
Setting	Description																		
CLI / Web Page	[Page=radioSettings]																		
CLI Command	- radioSettings.frequencyKey=Key0 - frequencyKey=Key0 - radioSettings.frequencyKey=Key1 to Key16 - frequencyKey=Key1 to Key16																		
Default Setting	Key0 (zero)																		
Options	- Key0 (zero) - Key1 to Key16 Valid frequencyKey Values <table> <tr> <th colspan="2">Data Rate of 115.2K</th></tr> <tr> <th>Frequency Key Values</th><th>Description</th></tr> <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> </table> <table> <tr> <th colspan="2">All Other Data Rates</th></tr> <tr> <th>Frequency Key Values</th><th>Description</th></tr> <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> </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.																		

Frequency Key	
Setting	Description
Description	The radioSettings.frequencyKey setting designates the Key number used as an index to select a hopping table. Notes • Use a unique Frequency Key setting to use different hop patterns for each ZumLink network. • This setting is only used when radioSettings.radioHoppingMode=Hopping_On. • The number of available frequency keys is based on the number of hopping sequences in the hop table. • An invalid frequency key setting is determined by being outside of the specified range. • If an invalid frequency key setting is found, the radioSettings.frequencyKey is NOT changed. • A frequency key setting is also invalid if the frequency key setting is larger than the number of hopping tables configured for a specific RF Data Rate (on page 72). • In this instance, the radioSettings.frequencyKey is set to Key0 (zero). Important!: The Endpoint radios obtain this value from a Gateway with the same Network ID (on page 66) via the beacon frame. After communications are established, any change of this value are picked up by the Endpoints.  When using different hop patterns on each network, interference caused by neighboring ZumLink networks can be minimized.

15.4. Frequency Masks

Frequency Masks	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<code>radioSettings.frequencyMasks=nnnn</code> <code>frequencyMasks=nnnn</code> Note: Where <code>nnnn</code> is the specified format of the frequency range to mask shown in: A. Single Channel Format, B. Range of Channels Format, or C. Combination of Channels Format. Important! Hop table frequency masking masks the channels that fall within the range plus or minus one-half ($\frac{1}{2}$) the channel bandwidth.
Default Setting	Blank
Options	 Caution: ONLY A comma MUST separate the values - NOT a comma with a space. Use this information in examples A to C: <code>xxx</code> is a value between 902-927 MHz. <code>yyyy</code> is a value between .0000-.9999 MHz. A. Single Channel Format - A single entry masks the specified frequency plus the bandwidth on each side of the center frequency as a function of the rfDataRate. <code>frequencyMasks=xxx.yyyy,xxx.yyyy,xxx.yyyy</code> B. Range of Channels Format Important! If a radio channel intersects with the mask limits, it will be masked and not used. <code>frequencyMasks=xxx.yyyy-xxx.yyyy,xxx.yyyy-xxx.yyyy</code> C. Combination of Channels Format <code>frequencyMasks=xxx.yyyy-xxx.yyyy,xxx.yyyy</code>

Frequency Masks

Setting	Description
Description	The radioSettings.frequencyMasks setting designates specific frequencies or a set of frequencies in the hopping pattern to remove from usage.  Caution: radioSettings.frequencyMasks entries MUST BE less than 128 bytes. Notes - This setting is only used when radioSettings.radioHoppingMode=Hopping_On. - All radios in the network MUST use the same value for this parameter. - 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. .9, .09, .009 are valid entries as well as .9000, .0900, .0090. - The radioSettings.frequencyMasks parameter needs to be re-entered when moving between RF Data Rate (on page 72).  Type frequencyMasks= and press <Enter> to clear all Frequency Mask entries. Important!: Special rules must be applied for the 115.2 and 250 kbps data rates to enforce regulatory rules. Notes for 115.2 and 250 kbps Rates for Regulatory Compliance For 115.2 kbps: - If the number of hopping channels contained in the hop table is > 50, TX Power (on page 74) can be set to values up to and including 30 dBm. radioSettings.txPower is NOT automatically changed. - If the number of hopping channels contained in the hop table is < 50, all masking is removed and all of the channels contained in the hop table are re-enabled. radioSettings.txPower is NOT automatically changed. For 250 kbps: - If the number of hopping channels contained in the hop table is > 50, TX Power (on page 74) can be set to values up to and including 30 dBm. radioSettings.txPower is NOT automatically changed. - If the number of hopping channels contained in the hop table is >= 25, but < 50, radioSettings.txPower can be set to values up to and including 24 dBm. radioSettings.txPower is automatically reduced to 24 dBm.

Frequency Masks	
Setting	Description
	- If the number of hopping channels contained in the hop table is < 25, all masking is removed and all of the channels contained in the hop table are re-enabled. radioSettings.txPower is NOT automatically changed.

15.5. LNA Bypass

LNA Bypass	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	Enable LNA: <code>radioSettings.lnaBypass=0</code> <code>lnaBypass=0</code> Bypass LNA: <code>radioSettings.lnaBypass=1</code> <code>lnaBypass=1</code>
Default Setting	0 (zero)
Options	0 1
Description	When set to 1, the radioSettings.lnaBypass parameter bypasses the Low Noise Amplifier (LNA) and reduces the radio module receive signal by 10dB.  It can be useful to bypass the LNA if there is a presence of strong signals in band and packet reception is not good.

15.6. Max Link Distance in Miles

Max Link Distance in Miles	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<code>radioSettings.maxLinkDistanceinMiles=nnn</code> <code>maxLinkDistanceinMiles=nnn</code> Note: Where <code>nnn</code> is the maximum one-way distance (in miles) between any nodes in the network.

Max Link Distance in Miles	
Setting	Description
Default Setting	20 miles
Options	- The minimum value is 0 miles. - The maximum value is 120 miles.
Description	The radioSettings.maxLinkDistanceinMiles parameter designates the maximum one-way distance (in miles) used to set the maximum expected propagation delay between any Endpoints in the network. Notes - If the parameter is set too small, then packets are retransmitted unnecessarily and could significantly reduce throughput. - If the parameter is set larger than the maximum propagation delay, it will take longer than needed to retransmit lost packets. FREEWAVE Recommends: Set a slightly larger number than needed. All Endpoints in the network that communicate with each other should use the same distance value.

15.7. Network ID

Network ID	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<code>radioSettings.networkId=nnnn</code> <code>networkId=nnnn</code> Note: Where <code>nnnn</code> is the network identifier which subdivides traffic on radio units.
Default Setting	43981
Options	- The minimum value is 0 (zero). - The maximum value is 65535.
Description	The radioSettings.networkId parameter designates the network identifier which subdivides traffic on radio units. Notes Radio units can only communicate with other units that have the same radioSettings.networkId setting. Important! If radios are on the same frequency, they still receive data from radios of a different networkId, but the data is dropped.

15.8. Node ID

Node ID	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	- radioSettings.nodeId=nnnn - nodeId=nnnn Note: Where <code>nnnn</code> is a user-designated nodeId instead of the auto-generated nodeId.
Default Setting	Predetermined by the Z9-C or Z9-T, this is an auto-generated, unique number from 2 through 65533.
Options	N/A
Description	The radioSettings.nodeId parameter designates the unique ID of the device. Notes - Each radio with the same networkId must have a UNIQUE nodeId. - Otherwise, two or more nodes will unicast an acknowledgment that may collide. - The Gateway device ALWAYS has a nodeId of value 1. It cannot be changed.

15.9. Radio Frequency

Radio Frequency	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	- radioSettings.radioFrequency=nnn.nnnn - radioFrequency=nnn.nnnn Note: Where <code>nnn.nnnn</code> is the operating center frequency.
Default Setting	915.0000 for the Standard Hop Set - 900 MHz Channels (on page 97)

Radio Frequency		
Setting	Description	
Options	Valid Ranges	
	Data Rate	MHz Range
	4 Mbps	904.5504 - 925.7472
	1.5 Mbps (Beta)	903.2562 - 925.8354
	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
Description	The radioSettings.radioFrequency parameter designates the operating center frequency in MHz. Notes - All radios in the network MUST use the same value for this parameter. - This setting is only used when radioSettings.radioHoppingMode=Hopping_Off. - The range of this parameter is dependent on the RF Data Rate (on page 72) setting. - The frequency interval is 100 Hz. - The minimum value increases and the maximum value decreases as the radioSettings.rfDataRate increases. - The increase in channel bandwidth affects these ranges. - If the radioSettings.radioFrequency parameter is set too close to the band edge for the current radioSettings.rfDataRate, the radio module rejects the setting. - A minimum of 3 hopping channels are supported when radioSettings.rfDataRate = RATE_4M, RATE_1M, and RATE_500K. FREEWAVE Recommends: Use a single radioSettings.radioFrequency if radioSettings.radioHoppingMode=Hopping_Off. Important! A few seconds are needed to apply the change; allow some time prior to reading back this value.  Read back this value after setting it to determine if it was accepted by the Z9-C or Z9-T.	

15.10. Radio Hopping Mode

Radio Hopping Mode	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	• Enable: • <code>radiosettings.radioHoppingMode=Hopping_On</code> • <code>radioHoppingMode=Hopping_On</code> • Disable: • <code>radiosettings.radioHoppingMode=Hopping_Off</code> • <code>radioHoppingMode=Hopping_Off</code>
Default Setting	Hopping_On
Options	• Hopping_Off • Hopping_On

Radio Hopping Mode	
Setting	Description
Description	The radioSettings.radioHoppingMode parameter enables frequency hopping. Notes - All radios in the network MUST use the same value for this parameter. - For rfDataRate values of 115.2 and 250 kbps, the radioSettings.radioHoppingMode is forced On and CANNOT be set to radioSettings.radioHoppingMode=Hopping_Off. - For rfDataRate 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 radioSettings.radioHoppingMode=Hopping_On. - A Gateway is NOT required when the radioSettings.radioHoppingMode=Hopping_Off. Important!: Special rules must be applied for the 115.2 and 250 kbps data rates to enforce regulatory rules. Notes for 115.2 and 250 kbps Rates for Regulatory Compliance For 115.2 kbps: - If the number of hopping channels contained in the hop table is > 50, TX Power (on page 74) can be set to values up to and including 30 dBm. radioSettings.txPower is NOT automatically changed. - If the number of hopping channels contained in the hop table is < 50, all masking is removed and all of the channels contained in the hop table are re-enabled. radioSettings.txPower is NOT automatically changed. For 250 kbps: - If the number of hopping channels contained in the hop table is > 50, TX Power (on page 74) can be set to values up to and including 30 dBm. radioSettings.txPower is NOT automatically changed. - If the number of hopping channels contained in the hop table is >= 25, but < 50, radioSettings.txPower can be set to values up to and including 24 dBm. radioSettings.txPower is automatically reduced to 24 dBm. - If the number of hopping channels contained in the hop table is < 25, all masking is removed and all of the channels contained in the hop table are re-enabled. radioSettings.txPower is NOT automatically changed.

15.11. Radio Mode

Radio Mode	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	- radioSettings.radioMode=Gateway - radioMode=Gateway - radioSettings.radioMode=Endpoint - radioMode=Endpoint
Default Setting	Endpoint
Options	- Endpoint - Gateway
Description	The radioSettings.radioMode parameter designates the device type. Notes - Each network can have only ONE Gateway device. - The remaining devices MUST BE configured as Endpoints . - The Gateway device ALWAYS has a nodeId of value 1. It cannot be changed. - The Endpoint or Endpoint-Repeater nodeId values are 2 through 65535. - A Gateway is required when the radioSettings.radioHoppingMode=Hopping_On. - A Gateway is NOT required when the radioSettings.radioHoppingMode=Hopping_Off.

15.12. RF Data Rate

RF Data Rate	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	- radioSettings.rfDataRate=RATE_4M - rfDataRate=RATE_4M - radioSettings.rfDataRate=RATE_1M - rfDataRate=RATE_1M - radioSettings.rfDataRate=RATE_1.5M_BETA_FEATURE - rfDataRate=RATE_1.5M_BETA_FEATURE - radioSettings.rfDataRate=RATE_500K - rfDataRate=RATE_500K - radioSettings.rfDataRate=RATE_250K - rfDataRate=RATE_250K - radioSettings.rfDataRate=RATE_115.2K - rfDataRate=RATE_115.2K
Default Setting	RATE_500K
Options	- RATE_4M (4 Mbps mode) - RATE_1M (1 Mbps mode) - RATE_1.5M_BETA_FEATURE - RATE_500K (500 kbps mode) - RATE_250K (250 kbps mode) - RATE_115.2K (115.2 kbps mode)

RF Data Rate	
Setting	Description
Description	The <code>radioSettings.rfDataRate</code> parameter designates the RF link data rate in bits per second. Notes - All radios in the network MUST use the same value for this parameter. - 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 Radio Frequency (on page 67) 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> remains at its current setting. Important!: Special rules must be applied for the 115.2 and 250 kbps data rates to enforce regulatory rules. Notes for 115.2 and 250 kbps Rates for Regulatory Compliance For 115.2 kbps: - If the number of hopping channels contained in the hop table is > 50, TX Power (on page 74) can be set to values up to and including 30 dBm. <code>radioSettings.txPower</code> is NOT automatically changed. - If the number of hopping channels contained in the hop table is < 50, all masking is removed and all of the channels contained in the hop table are re-enabled. <code>radioSettings.txPower</code> is NOT automatically changed. For 250 kbps: - If the number of hopping channels contained in the hop table is > 50, TX Power (on page 74) can be set to values up to and including 30 dBm. <code>radioSettings.txPower</code> is NOT automatically changed. - If the number of hopping channels contained in the hop table is >= 25, but < 50, <code>radioSettings.txPower</code> can be set to values up to and including 24 dBm. <code>radioSettings.txPower</code> is automatically reduced to 24 dBm. - If the number of hopping channels contained in the hop table is < 25, all masking is removed and all of the channels contained in the hop table are re-enabled.

RF Data Rate	
Setting	Description
	<code>radioSettings.txPower</code> is NOT automatically changed. FREEWAVE Recommends: Use a single <code>radioSettings.radioFrequency</code> if <code>radiosettings.radioHoppingMode=Hopping_Off</code>.  Caution: The <code>RATE_1.5M_BETA_FEATURE</code> data rate is a Beta feature NOT recommended for production deployment.

15.13. TX Power

TX Power	
Setting	Description
CLI / Web Page	[Page=radioSettings]
CLI Command	<code>radioSettings.txPower=nn</code> <code>txPower=nn</code> Note: Where <code>nn</code> is the RF output transmit power. Important!: Entering a decimal value changes the <code>txpower</code> to 0 (zero). FREEWAVE Recommends: Use whole numbers only.
Default Setting	30
Options	The maximum value is 30.
Description	The <code>radioSettings.txPower</code> setting designates the dB RF output transmit power for the Z9-C or Z9-T. Notes - 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 <code>radioSettings.txPower</code> can be limited if the <code>radiosettings.radioHoppingMode=Hopping_On</code>. - See Frequency Masks (on page 63) for additional details.  Tip Entering <code>txpower=0</code> or <code>radiosettings.txpower=0</code> changes the output power to the minimum or 10 dB.

DRAFT

16. Radio Status Parameters

[curPD \(on page 77\)](#)

[curRssi \(on page 77\)](#)



The parameter syntax is: `page.parameter=value`.
Parameters with unique names can be specified as `parameter=value`.

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. curPD

Important!: FreeWave internal use only.

16.2. curRssi

curRssi	
Setting	Description
CLI / Web Page	[Page=radioStatus]
CLI Command	- radioStatus.curRssi - curRssi
Default Setting	N/A
Options	N/A
Description	The radioStatus.curRssi command reports the value of the current RSSI ONLY when there is data being transferred. Note: This is a Read-only parameter.

17. Serial Port Config Parameters

cliBaudRate (on page 79)

databits (on page 79)

flowControl (on page 80)

packetizedBaudRate (on page 80)

parity (on page 80)

passthruBaudRate (on page 80)

passthruLatencyMode (on page 81)

passthruLatencyTimer (on page 82)

stopbits (on page 82)



The parameter syntax is: page.parameter=value.
Parameters with unique names can be specified as parameter=value.

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. cliBaudRate

cliBaudRate	
Setting	Description
CLI / Web Page	[Page=serialPortConfig]
CLI Command	<pre>serialPortConfig.cliBaudRate=nnn</pre> Note: Where <code>nnn</code> is the baud rate of the command line interface port.
Default Setting	115200
Options	• 9600 • 19200 • 115200 • 230400 • 460800 • 921600 • 3000000
Description	The <code>serialPortConfig.cliBaudRate</code> parameter designates the baud rate of the command line interface port. Procedure 1. Type <code>serialPortConfig.cliBaudRate=nnnn</code> using any of the valid options. Example: Where <code>nnnn</code> is one of the Options. 2. Press <Enter>. 3. Type <code>save</code> and press <Enter> to save the selection. 4. Type <code>reset=now</code> to apply the setting to the serial hardware.

17.2. databits

databits	
Setting	Description
CLI / Web Page	[Page=serialPortConfig]
CLI Command	• <code>serialPortConfig.databits=7</code> • <code>serialPortConfig.databits=8</code>
Default Setting	8
Options	• 7 • 8
Description	The <code>serialPortConfig.databits</code> parameter designates the number of data bits per byte for the serial port.

17.3. flowControl

flowControl	
Setting	Description
CLI / Web Page	[Page=serialPortConfig]
CLI Command	- serialPortConfig.flowControl=Off - serialPortConfig.flowControl=Hardware
Default Setting	Hardware
Options	- Off - Hardware
Description	The serialPortConfig.flowControl parameter designates the RTS/CTS flow control of the serial port (not DTR/DSR).

17.4. packetizedBaudRate

Important!: FreeWave internal use only.

17.5. parity

parity	
Setting	Description
CLI / Web Page	[Page=serialPortConfig]
CLI Command	- serialPortConfig.parity=None - serialPortConfig.parity=Even - serialPortConfig.parity=Odd
Default Setting	None
Options	- None - Even - Odd
Description	The serialPortConfig.parity parameter designates the parity of the serial port.

17.6. passthruBaudRate

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

passthruBaudRate	
Setting	Description
CLI Command	<code>serialPortConfig.passthruBaudRate=n</code> Note: Where <i>n</i> is the data rate of the serial port.
Default Setting	115200
Options	9600 19200 115200 230400 460800 921600 3000000
Description	The <code>serialPortConfig.passthruBaudRate</code> parameter designates the data rate of the serial port when operating in pass through mode. FREEWAVE Recommends: For ALL <code>radioSettings.rfDataRates</code>, use: <code>serialPortConfig.passthruBaudRate=3Mbps</code>. If 3Mbps CANNOT be used, set the <code>serialPortConfig.passthruBaudRate=</code> to be GREATER THAN the <code>radioSettings.rfDataRate</code>.

17.7. passthruLatencyMode

passthruLatencyMode	
Setting	Description
CLI / Web Page	[Page=serialPortConfig]
CLI Command	<code>serialPortConfig.passthruLatencyMode=Auto</code> - Calculated based on the RF Data Rate (on page 72) setting. <code>serialPortConfig.passthruLatencyMode=Manual</code> - Uses the value set in the <code>serialPortConfig.passthruLatencyTimer=</code> timer.
Default Setting	Auto
Options	- Auto - Manual
Description	The <code>serialPortConfig.passthruLatencyMode</code> parameter designates whether the Latency Timer is automatically or manually set.

17.8. passthruLatencyTimer

passthruLatencyTimer	
Setting	Description
CLI / Web Page	[Page=serialPortConfig]
CLI Command	<pre>serialPortConfig.passthruLatencyTimer=n</pre> Note: Where <i>n</i> is the amount of millisecond time between transmits.
Default Setting	16
Options	- The minimum value is 1. - The maximum value is 255.
Description	The serialPortConfig.passthruLatencyTimer parameter designates the amount of millisecond time between transmits. Notes - 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.

17.9. stopbits

stopbits	
Setting	Description
CLI / Web Page	[Page=serialPortConfig]
CLI Command	<code>serialPortConfig.stopbits=1</code> <code>serialPortConfig.stopbits=2</code>
Default Setting	1
Options	1 2
Description	The serialPortConfig.stopbits parameter designates the number of stop bits of the serial port.

18. System Parameters

[exit \(on page 84\)](#)
[filter \(on page 84\)](#)
[pages \(on page 84\)](#)
[serialMode \(on page 84\)](#)
[tags \(on page 85\)](#)



The parameter syntax is: `page.parameter=value`.
Parameters with unique names can be specified as `parameter=value`.

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. exit

Important! The [Page=system] parameters are only available in the CLI window.
See the [CLI Configuration \(on page 36\)](#) 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.

18.2. filter

Important! FreeWave internal use only.

18.3. pages

pages	
Setting	Description
CLI / Web Page	[Page=system]
CLI Command	<code>system.pages</code> <code>pages</code>
Default Setting	N/A
Options	N/A
Description	The system.pages command lists all of the pages of settings and commands in the Z9-C or Z9-T.

18.4. serialMode

serialMode	
Setting	Description
CLI / Web Page	[Page=system]

serialMode	
Setting	Description
CLI Command	• <code>system.serialMode=Passthru_Data</code> • The serial port is used for data or configuration but not at the same time. • <code>system.serialMode=CLI</code> • <code>system.serialMode=Packetized</code>
Default Setting	Passthru_Data
Options	• CLI • Passthru_Data • Packetized
Description	The <code>system.serialMode</code> parameter designates the serial port mode. Important!: The <code>serialMode</code> setting MUST be set to <code>Passthru_Data</code> for the Z9-C or Z9-T to connect.

18.5. tags

Important!: FreeWave internal use only.

19. systemInfo Parameters

Device Configuration (on page 87)

Device Firmware Version (on page 87)

Device Model (on page 87)

Device Name (on page 88)

deviceSerialNumber (on page 88)

FirmwareVersion (on page 89)

Hop Table Version (on page 89)

Layout Hash (on page 89)



The parameter syntax is: page.parameter=value.
Parameters with unique names can be specified as parameter=value.

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. Device Configuration

Device Configuration	
Setting	Description
CLI / Web Page	[Page=systemInfo]
CLI Command	- systemInfo.deviceConfiguration - deviceConfiguration
Default Setting	N/A
Options	N/A
Description	The systemInfo.deviceConfiguration command reports the device configuration of the Z9-C or Z9-T. Note: This is a Read-only parameter.

19.2. Device Firmware Version

Device Firmware Version	
Setting	Description
CLI / Web Page	[Page=systemInfo]
CLI Command	- systemInfo.deviceFirmwareVersion - deviceFirmwareVersion
Default Setting	N/A
Options	N/A
Description	The systemInfo.deviceFirmwareVersion command reports the device firmware version of the Z9-C or Z9-T. Note: This is a Read-only parameter.

19.3. Device Model

Device Model	
Setting	Description
CLI / Web Page	[Page=systemInfo]
CLI Command	- systemInfo.deviceModel - deviceModel
Default Setting	N/A
Options	N/A

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

19.4. Device Name

Device Name	
Setting	Description
CLI / Web Page	[Page=systemInfo]
CLI Command	<code>systemInfo.deviceName=nnnn</code> <code>deviceName=nnnn</code> Note: Where <code>nnnn</code> is the user-defined name for the Z9-C or Z9-T.
Default Setting	N/A
Options	N/A
Description	The systemInfo.deviceName parameter designates the user-defined name for the Z9-C or Z9-T.

19.5. deviceSerialNumber

deviceSerialNumber	
Setting	Description
CLI / Web Page	[Page=systemInfo]
CLI Command	<code>systemInfo.deviceSerialNumber</code> <code>deviceSerialNumber</code>
Default Setting	N/A
Options	N/A
Description	The systemInfo.deviceSerialNumber command reports the device serial number. Note: This is a Read-only parameter.

19.6. FirmwareVersion

FirmwareVersion	
Setting	Description
CLI / Web Page	[Page=systemInfo]
CLI Command	• <code>systemInfo.FirmwareVersion</code> • <code>FirmwareVersion</code>
Default Setting	N/A
Options	N/A
Description	The systemInfo.FirmwareVersion command reports the firmware version. Note: This is a Read-only parameter.

19.7. Hop Table Version

Hop Table Version	
Setting	Description
CLI / Web Page	[Page=systemInfo]
CLI Command	• <code>systemInfo.hopTableVersion</code> • <code>hopTableVersion</code>
Default Setting	N/A
Options	N/A
Description	The systemInfo.hopTableVersion command reports the radio Hop Table Version of the Z9-C or Z9-T. Note: This is a Read-only parameter.

19.8. Layout Hash

Layout Hash	
Setting	Description
CLI / Web Page	[Page=systemInfo]
CLI Command	• <code>systemInfo.layoutHash</code> • <code>layoutHash</code>
Default Setting	N/A
Options	N/A

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

20. Release Notes

These sections describe the additions, changes, and known limitations in each software version for the ZumLink Z9-C or Z9-T. The most recent version is listed first.



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

20.1. Version 1.0.7.0

Release Date: June 2018

Warning! DO NOT remove power from the Z9-C or Z9-T during the firmware update process!



If power is removed prematurely during the upgrade process, reinstall the **.fcf**.

DO NOT start another update or configuration change while an update is in progress.

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** (See [RF Data Rate \(on page 72\)](#)).
 - 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 \(on page 79\)](#).
- On rare occasions, the firmware upgrade reports **Success** but the firmware did not change.
 - **Workaround:** Re-install the firmware upgrade file.
 - See [Install the Z9-C or Z9-T Update File \(on page 27\)](#).
- 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.
- If the [RF Data Rate \(on page 72\)](#) is set above **RATE_115.2K** and the user attempts to set the [Frequency Key \(on page 61\)](#) 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 \(on page 80\)](#) 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.
- If the Z9-C or Z9-T is rebooted before the [TerminalServerTimeout](#) value on the local Z9-C or Z9-T, the remote Z9-C or Z9-T does NOT pass data until the terminal server timeout period has elapsed.
 - The smaller the timeout, the faster the system will reconnect on a power cycle.

FREEWAVE Recommends: Set the [Com1 or 2.TerminalServerTimeout=](#) to be larger than the polling rate of the system.

- The [Signal Level \(on page 51\)](#) parameter reports a maximum of -42 dBm when the [RF Data Rate=RATE_1M](#).

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

- [Frequency Masks \(on page 63\)](#)
 - 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.
- [Max Link Distance in Miles \(on page 65\)](#)
 - 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).
- [TX Power \(on page 74\)](#)
 - 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
- diagPortConfig.databits
- diagPortConfig.diagBaudRate
- diagPortConfig.parity
- diagPortConfig.stopbits
- radioSettings.beaconInterval
- radioSettings.lnaBypass
- radioSettings.maxLinkDistanceInMiles
- radioSettings.radioHoppingMode
- radioSettings.rfDataRate
- serialPortConfig.cliBaudRate
- serialPortConfig.databits
- serialPortConfig.flowControl
- serialPortConfig.packetizedBaudRate
- serialPortConfig.parity
- serialPortConfig.passthruBaudRate
- serialPortConfig.passthruLatencyMode
- serialPortConfig.stopbits

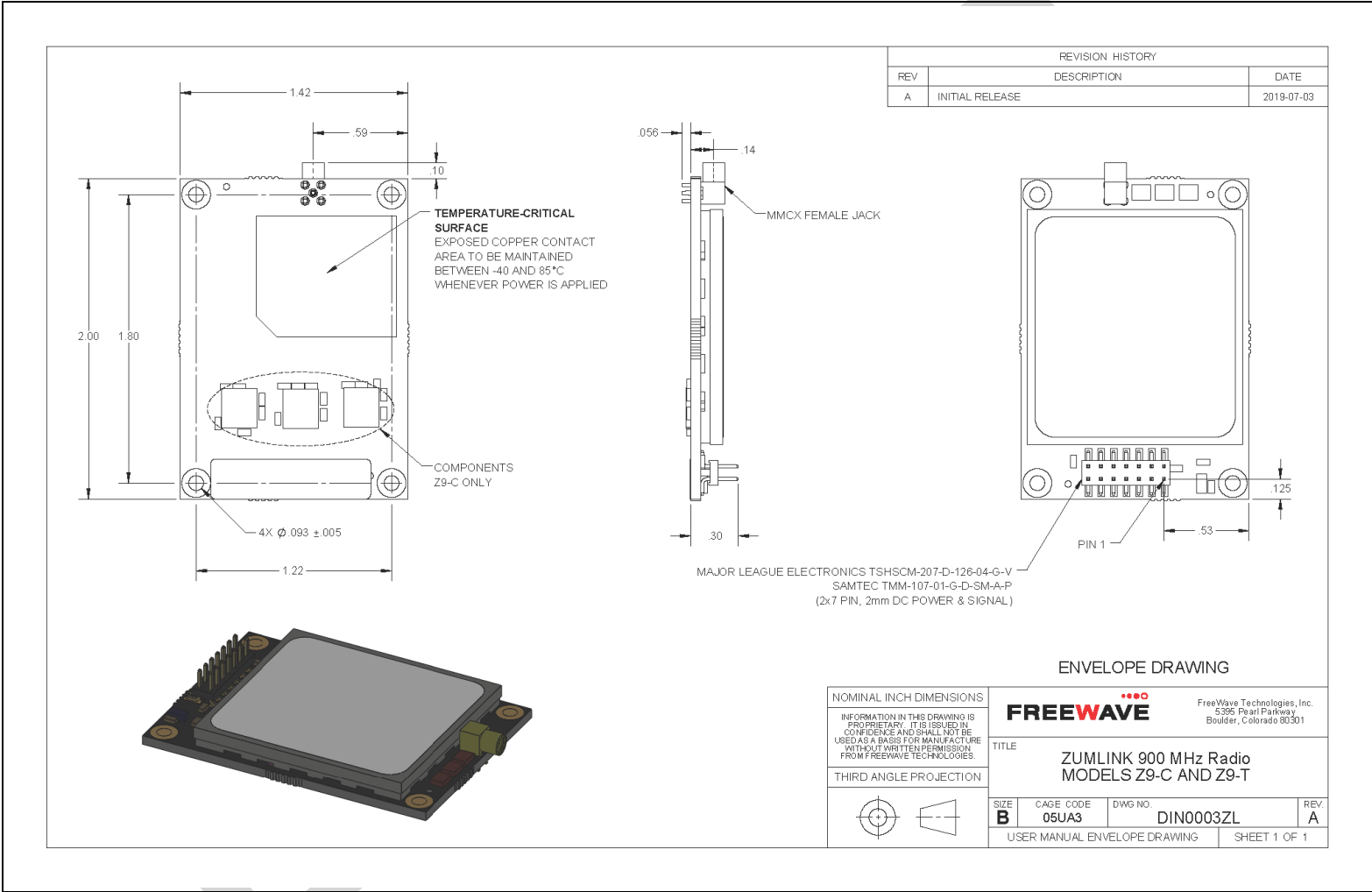
20.2. Version 1.0.4.0 (Initial Release)

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.
- The [Signal Level \(on page 51\)](#) parameter reports a maximum of -42 dBm when the **RF Data Rate=RATE_1M**.

21. Mechanical Drawing - Z9-C and Z9-T



22. Z9-C or Z9-T Hop Tables

- [Standard Hop Set - 900 MHz Channels \(on page 97\)](#)

22.1. Standard Hop Set - 900 MHz Channels

These are the standard channels supported when the [Radio Hopping Mode \(on page 69\)](#) is **Enabled**.

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

- [RF Data Rate: 115.2 kbps \(on page 97\)](#)
- [RF Data Rate: 250 kbps \(on page 98\)](#)
- [RF Data Rate: 500 kbps \(on page 98\)](#)
- [RF Data Rate: 1 Mbps \(on page 98\)](#)
- [RF Data Rate: 1.5 Mbps \(Beta\) \(on page 99\)](#)
- [RF Data Rate: 4 Mbps \(on page 99\)](#)

22.1.1. RF Data Rate: 115.2 kbps

Channel Size (MHz): 0.2304

Number of Channels: 110

Standard Hop Set - ZumLink 900 MHz Channels									
RF Data Rate: 115.2 kbps									
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	

22.1.2. RF Data Rate: 250 kbps**Channel Size (MHz): 0.3456****Number of Channels: 73**

Standard Hop Set - ZumLink 900 MHz Channels									
RF Data Rate: 250 kbps									
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	

22.1.3. RF Data Rate: 500 kbps**Channel Size (MHz): 0.6912****Number of Channels: 36**

Standard Hop Set - ZumLink 900 MHz Channels									
RF Data Rate: 500 kbps									
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

22.1.4. RF Data Rate: 1 Mbps**Channel Size (MHz): 1.3824****Number of Channels: 18**

Standard Hop Set - ZumLink 900 MHz Channels	
RF Data Rate: 1 Mbps	
903.0528	915.4944
904.4352	916.8768

Standard Hop Set - ZumLink 900 MHz Channels	
RF Data Rate: 1 Mbps	
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

22.1.5. RF Data Rate: 1.5 Mbps (Beta)**Channel Size (MHz): 1.3824****Number of Channels: 17**

Standard Hop Set - ZumLink 900 MHz Channels	
RF Data Rate: 1.5 Mbps (Beta)	
903.2562	916.1586
904.8690	917.7714
906.4818	919.3842
908.0946	920.9970
909.7074	922.6098
911.3202	924.2226
912.9330	925.8354
914.5458	

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

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

Appendix A: Technical Specifications

Note: Specifications are subject to change without notice. For the most up-to-date specifications information, see the product's data sheet available at www.freewave.com.

- [Data Transmission \(on page 101\)](#)
- [General Information \(on page 101\)](#)
- [Interfaces \(on page 102\)](#)
- [Power Requirements \(on page 102\)](#)
- [Receiver \(on page 102\)](#)
- [Transmitter \(on page 103\)](#)

Data Transmission

Data Transmission	
Specification	Description
Type	Frequency Hopping Spread Spectrum
Modulation	• 2 level GFSK • 8-ary FSK
Link Throughput	Maximum of 2.2 Mbps
Error Detection	• ARQ • CRC • Retransmit on error
Hopping Rates	400, 200, 100, 50, 25 ms
Hopping Channels	• Maximum of 110 channels • RF Data Rate (on page 72) dependent
Hopping Patterns	• Maximum of 16 patterns • RF Data Rate (on page 72) dependent
Protocol	Adaptive Spectrum Learning (ASL)
User Interface Rate	• 3 Mbps - TTL • 5 Mbps - RS232

General Information

General Information	
Specification	Description
Operating Temperature	• -40°C to +85°C • -40°F to +185°F
Humidity	0 to 95% non-condensing
Dimensions	• 50.8 L x 36.07 W x 8.90 H (mm) • 2.0 L x 1.42 W x 0.35 H (in)
Weight	15 g (0.03 lbs)
Reliability	91,328 hour MTBF
Safety	Class I, Division 2, Groups A-D
UL	
RoHS	Directive 2011/65/EU

Interfaces

Interfaces	
Specification	Description
Data Connectors	14-pin dual row header for power, data, and diagnostics 2 mm pin spacing - Either two RS232 or two TTL serial interfaces
Diagnostics Interface	Serial, RS232, or TTL
RF Connector	MMCX

Power Requirements

Operating State	Description			
Operating Voltage	+3 to +5 VDC			
Current Consumption	Operating Voltage	Transmit Current	Receive Current	Idle Current
	+3 VDC	843 mA	30 mA	13 mA
	+5 VDC	680 mA	30 mA	13 mA

Receiver

Receiver		
Specification	Description	
IF Selectivity	> 40 dB	
System Gain	135 dB	
Sensitivity	115.2 kbps	-105 dBm
	250 kbps	-102 dBm
	500 kbps	-99 dBm
	1 Mbps	-95 dBm
	1.5 Mbps (Beta)	-90 dBm
	4 Mbps	-83 dBm

Transmitter

Transmitter	
Specification	Description
Frequency Range	902 to 928MHz Z9-T-THA: 920 to 925 MHz
Frequency Stability	15ppm
Output Power	10mW to 1W - User selectable
Output Impedance	50 ohms
Range	97 km (60 miles), clear line of sight
Channel Spacing	230.4 kHz 345.6 kHz 691.2 kHz 1382.4 kHz 1612.8 (Beta) kHz 3225.6 kHz
RF Data Rate	115.2 kbps 250 kbps 500 kbps 1 Mbps 1.5 Mbps (Beta) 4 Mbps

Appendix B: LEDs

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

Note: See [Z9-C or Z9-T Ports \(on page 13\)](#) for additional information.

Normal Operation

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

Appendix C: FreeWave Legal Information

Export Notification

FreeWave Technologies, Inc. products may be subject to control by the Export Administration Regulations (EAR) and/or the International Traffic in Arms Regulations (ITAR). Export, re-export, or transfer of these products without required authorization from the U.S. Department of Commerce, Bureau of Industry and Security, or the U.S. Department of State, Directorate of Defense Trade Controls, as applicable, is prohibited. Any party exporting, re-exporting, or transferring FreeWave products is responsible for obtaining all necessary U.S. government authorizations required to ensure compliance with these and other applicable U.S. laws. Consult with your legal counsel for further guidance.

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FreeWave products are designed and manufactured in the United States of America.



Warning! DO NOT OPEN THE ZumLink Z9-C or Z9-T WHEN AN EXPLOSIVE ATMOSPHERE IS PRESENT.

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.

FCC Notifications**FCC Supplier's Declaration of Conformity**

FreeWave Technologies, Inc.

5395 Pearl Parkway, Boulder, CO 80301

Phone Number: 303.381.9200

Website: www.freewave.com

declare under our sole responsibility that the product Models: Z9-C or Z9-T complies with Part 15 of 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 Part 15 Class A

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

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 22.94 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 22.94 cm from all persons and **MUST NOT** be co-located or operate in conjunction with any other antenna or transmitter.

Argentina CNC**Identificación CNC**

- **Z9-C:** Contiene CNC ID: C-21611
- **Z9-T:** Contiene CNC ID: C-21612

ISED 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. CAN ICES-3 (A)/NMB-3(A)

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. CAN ICES-3 (A)/NMB-3(A)

ISED Host Installation and Label

The content of this documentation covers FreeWave Technologies, Inc. models sold under IC: 2329B-PMT0101AB.

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**".

ISED 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 7.9 inches (20cm) 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 7.9 pouces (20cm) séparant l'antenne d'une personne présente en conformité avec les limites permises d'exposition du grand public.

Professional Installation

All models sold under the listed IC ID must be professionally installed.

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

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Thailand

"เครื่องโทรคมนาคมและอุปกรณ์นี้มีความสอดคล้องตามมาตรฐานหรือข้อกำหนดทางเทคนิคของกสทช"

This telecommunication equipment conforms to the standard or technical requirements of NBTC.

"เครื่องวิทยุคมนาคมนี้มีระดับการแผ่คลื่นแม่เหล็กไฟฟ้าสอดคล้องตามมาตรฐานความปลอดภัยต่อสุขภาพของมนุษย์จากการใช้เครื่องวิทยุคมนาคมที่คณะกรรมการกิจการโทรคมนาคมแห่งชาติประกาศกำหนด"

(This radio communication equipment has the electromagnetic field strength in compliance with the Safety Standard for the Use of Radio communication Equipment on Human Health announced by the National Telecommunications Commission.)

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:
 - UL 60950-1
 - IEC/EN 60950-1
 - CAN/CSA C22.2 No. 60950-1-07.
- Input voltage for the Z9-C or Z9-T is +3 to +5 VDC.

UL and Safety Notification

Z9-C or Z9-T is a Recognized component under UL File Numbers: e484141 and e327789.

**Standards and Editions**

- HazLoc Standards
 - 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

- 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.
- The temperature test was conducted at a rated supply voltage and the maximum surface temperature of 61C was recorded at 60C ambient temperature.

DRAFT

FREEWAVE