ZumLink Z9-C and Z9-T

Covers Model: Z9-C and Z9-T

User Manual

Safety Information

The products described in this manual can fail in a variety of modes due to misuse, age, or malfunction. Systems with these products must be designed to prevent personal injury and property damage during product operation and in the event of product failure.

STOP **Warning!**Remove power before connecting or disconnecting the interface or RF cables.

Warranty Information

FreeWave Technologies, Inc. warrants the FreeWave® ZumLink Z9-C and Z9-T (Product) against defects in materials and manufacturing for a period of one year 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).

In no event will FreeWave Technologies, Inc., its suppliers, or its licensors be liable for any damages arising from the use of or inability to use this Product. This includes business interruption, loss of business information, or other loss which may arise from the use of this Product. OEM customer's warranty periods can vary.

Warranty Policy will **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. This includes the addition of conformal coating.

Special Rate Replacement Option

A special rate replacement option is offered to non-warranty returns or upgrades. The option to purchase the replacement unit at this special rate is only valid for that RMA. The special replacement rate option expires if not exercised within 30 days of final disposition of RMA.

LUM0075AA Rev Feb-2016

ZumLink® Return Material Authorization (RMA) Policy and Procedures

This policy describes the responsibilities and procedures of the Customer and FreeWave when a **ZumLink**® device return is required.

When a request for a **ZumLink**® device replacement has been validated by FreeWave's Customer Support, FreeWave's policy for processing the device returned due to a fault is to replace the device with a new or refurbished device upon receipt of the reported faulty product.

> **Note**: This RMA policy is subject to change without notice.
> Detailed information about the FreeWave RMA policy can be found at www.freewave.com.

FreeWave Responsibilities

A failed **ZumLink**® product is inventoried at FreeWave. If FreeWave experiences a high degree of failures or a trend, FreeWave will perform a root-cause analysis and take appropriate corrective action(s).

In-Warranty Replacement Procedure

1. Customer contacts FreeWave Customer Support to report the non-functioning **ZumLink**® device.
2. FreeWave Customer Support:
   a. Validates that a device replacement is the appropriate action.
   b. Issues a FreeWave RMA number.
3. The Customer pays the shipping costs to return the **ZumLink**® device to FreeWave.
4. FreeWave sends a new or refurbished **ZumLink**® device to the Customer.

> **Important!**: Any visual or external damage noted on returned units may void the warranty.
> This will be communicated back to the customer and a Purchase Order (PO) will be requested from the customer for product replacement.

Out-of-Warranty ZumLink Replacement

This procedure describes the Customer and FreeWave Customer Support responsibilities for replacing an out-of-warranty **ZumLink** device.

Procedure

1. Customer contacts FreeWave Customer Support to report the non-functioning **ZumLink**® device.
2. FreeWave Customer Support:
   a. Validates that the device is out of warranty and if replacement is the appropriate action.
   b. Requests a PO number from the Customer (to bill the replacement **ZumLink**® device and shipping).
   c. Issues a FreeWave RMA number and advises the Customer to return the device to FreeWave.
3. FreeWave:
   a. Bills the Customer for the replacement **ZumLink**® device and shipping.
   b. Sends a new or refurbished **ZumLink**® device to the Customer.

Export Notification

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

FCC Notifications

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: 1) This device may not cause harmful interference and 2) this device must accept any interference received, including interference that may cause undesired operation.

The content of this guide covers FreeWave Technologies, Inc. models sold under FCC ID: KNYPMT0101AA.

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.

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: KNYPMT0101AA.**"

FCC Radiation Exposure Statement

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

FCC Notification of Power Warning

The ZumLink Z9-C and Z9-T covered in this document has a maximum transmitted output power of +30dBm.

The antennas used MUST provide a separation distance of at least 52 cm from all persons and MUST NOT be co-located or operate in conjunction with any other antenna or transmitter.

IC Notifications

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Ce dispositif est conforme aux normes permis-exemptes du Canada RSS d'industrie. L'opération est sujette aux deux conditions suivantes : (1) ce dispositif peut ne pas causer l'interférence, et (2) ce dispositif doit accepter n'importe quelle interférence, y compris l'interférence qui peut causer le fonctionnement peu désiré du dispositif.

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. You can obtain corresponding source by contacting FreeWave and requesting the source on CD.

Restricted Rights

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

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

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

UL Power Source

Important!: Input power shall be derived from a single Class 2 power source.

ZumLink Z9-C and Z9-T Product Safety

Standards and Editions

- HazLoc Standards
  - UL 508
- Ordinary Location Standards
  - UL 60950, 2nd Edition
  - CAN/CSA-C22.2 No. 60950, 2nd Edition
  - IEC 60950, 2nd Edition
  - EN 60950, 2nd Edition

Table of Contents

Preface

Thank you for purchasing the FreeWave **ZumLink**.

Other **ZumLink Z9-C and Z9-T** Information

> **Tip!** Use the FreeWave www.freewave.com website to download the latest version of these documents.

Document	Description	FreeWave Part Number
User Manual	The User Manual provides detailed information about setup, drag-and-drop configuration, and safety information for the **ZumLink Z9-C and Z9-T**.	LUM0075AA
Quick Start Guide	The Quick Start Guide provides the out-of-the-box setup of the **ZumLink Z9-C and Z9-T**.	QSG0028AA

Contacting FreeWave Technical Support

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

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

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

Printing this Document

This document is set to print double-sided with a front cover and a back cover. Viewing this document online with a PDF viewer, may show pages intentionally left blank to accommodate the double-sided printing.

Document Styles

This document uses these styles:

- FreeWave applications appear as: **FreeWave**.
- Parameter setting text appears as: **[Page=radioSettings]**
- File names appear as: **configuration.cfg**.
- File paths appear as: **C:\Program Files (x86)\FreeWave Technologies**.
- User-entered text appears as: **xxxxxxxxx**.
- 3rd-party names appear as: **Notepad**®.

> **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.

Documentation Feedback

Send comments or questions about this document's content to techpubs@freewave.com. In the email, include the title of the document or the document's part number and revision letter (found in the footer).

1. ZumLink Z9-C and Z9-T CLI Access

This procedure provides a simple **Tera Term** access to the **ZumLink** CLI.

Note: This information in this document applies to FreeWave **ZumLink** Models **Z9-C** and **Z9-T**.

Procedure

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

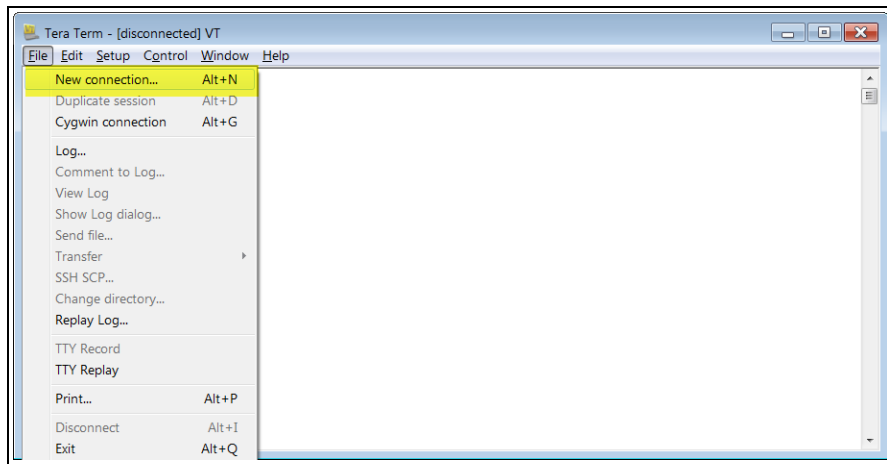1. Using the **Data Interface Connector** (see ZumLink Z9-C and Z9-T Data Interface Connector (on page 16) for location):

   a. Apply power to the **ZumLink**.

   b. Connect to the Serial Interface of the **ZumLink**.

2. If the **ZumLink** is connected to a computer, open a terminal program (e.g., **Tera Term**).

   Note: In this example procedure, **Tera Term** is used.

3. In **Tera Term**, on the **File** menu, select **New Connection**.

Figure 1: 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 **ZumLink** device is connected to.
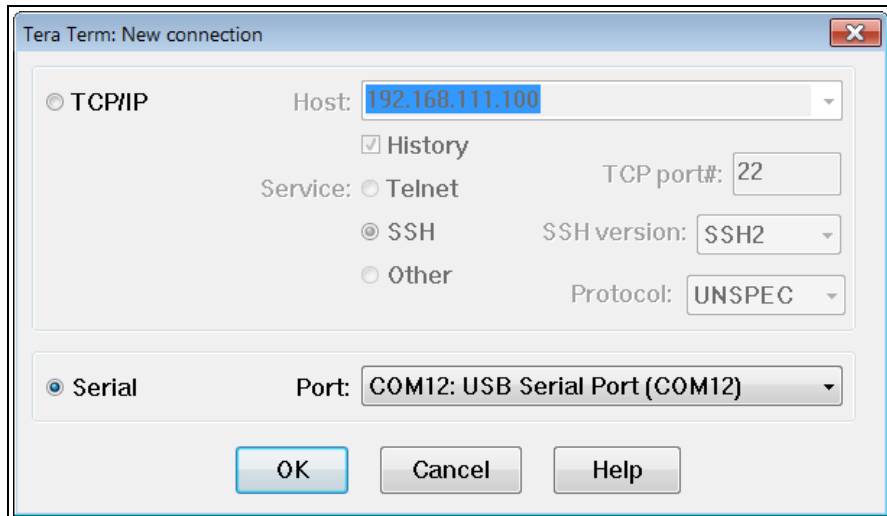
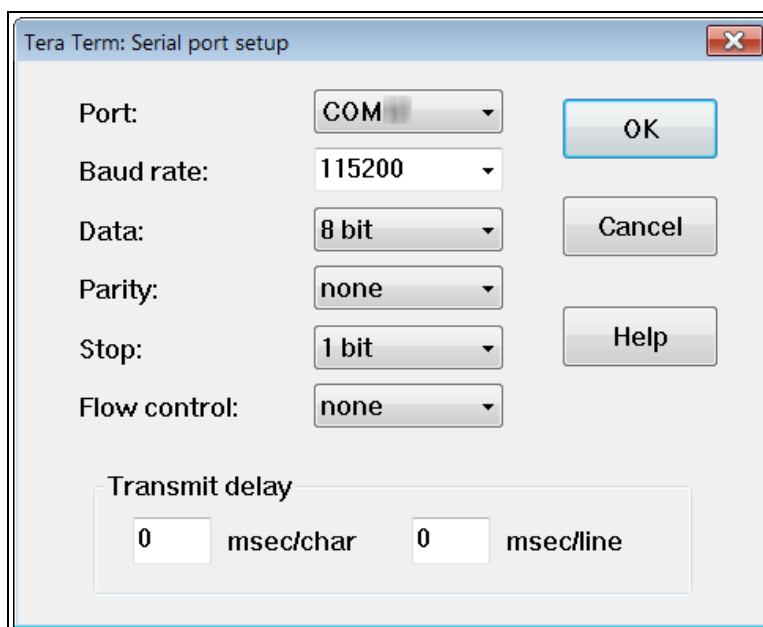**Figure 2: Select the ZumLink COM port**

5. Click **OK** to save the changes and close the dialog box.
   The **Tera Term** window shows the connected **ZumLink**.

6. In the **Tera Term** window, click the **Setup** menu and select **Serial Port**.
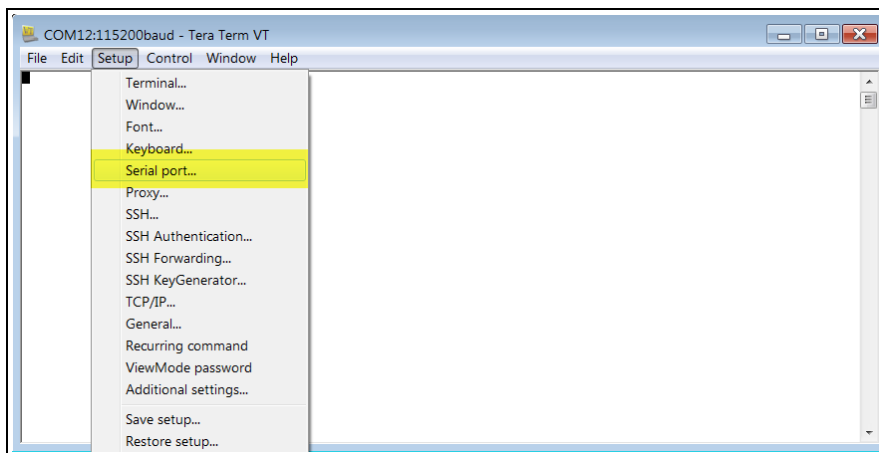
Figure 3: Serial menu > Setup Port

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

Note: The image shows the default **ZumLink** settings.

Figure 4: Tera Term: Serial Port Setup dialog box with default settings

7. Verify, and change if required, the serial port settings (except the **Port** setting) of the connected **ZumLink** so the settings are the same as the defaults shown in the image.
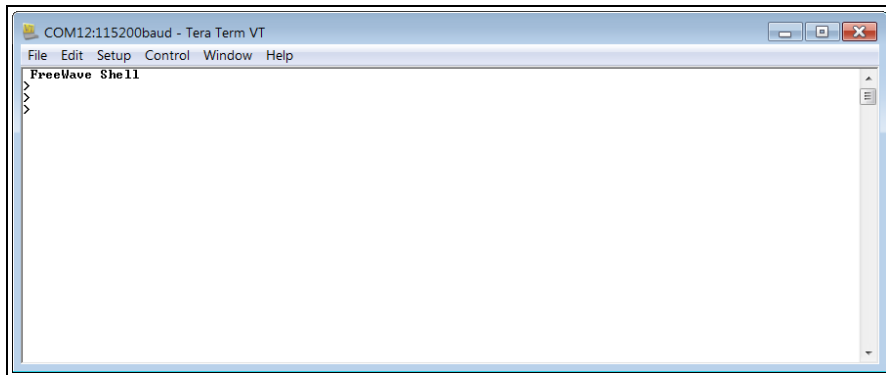
   Example: If the **Baud Rate** is 9600, click the list box arrow and select 115200.

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

9. On the **ZumLink**, pull the **Pin 2-Interrupt** line low to activate the **FreeWave Shell** and disrupt data flow.
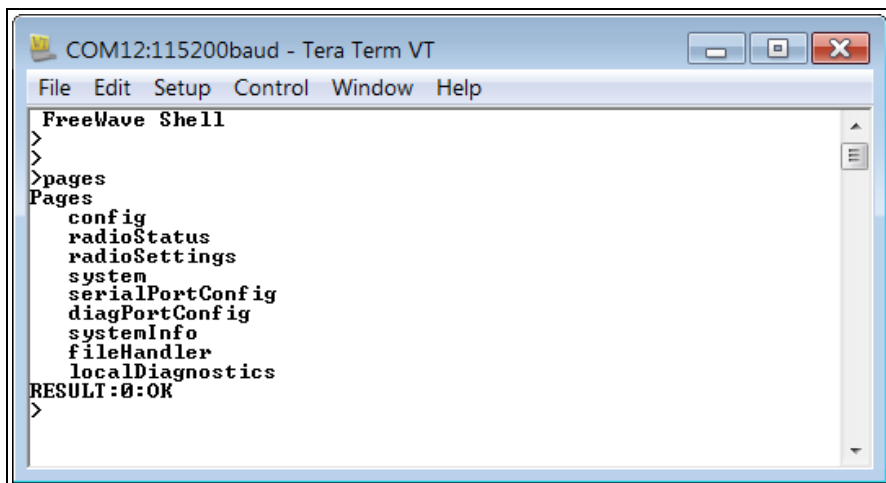
10. In **Tera Term**, press <Enter>.
     The **FreeWave Shell** returns.

Figure 5: FreeWave Shell in Tera Term

11. At the >, type **pages** and press <Enter>.
     The available **ZumLink** information appears.

Figure 6: Pages information

12. Type **radiosettings** and press <Enter>.
     The **ZumLink radioSettings** appear.

Figure 7: ZumLink radioSettings

13. Set the **txPower** between 0 (zero) and 30 dBm.

14. Select one radio and set the **radioMode** as a Gateway.

15. Set the other radios in the network with a **radioMode** of Endpoint.

16. Set the **networkId** to be the same on all radios in the network.

17. On each Endpoint, set the **nodeId** to a unique number (between 2 and 65535) in the network.

> **Important!**: The Gateway has a **nodeId** of 1.
> This **nodeId** CANNOT be changed.

18. Type Save (for the settings to remain after a power cycle) and press <Enter>.

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

> **Tip!** Type help to view additional information about the ZumLink settings.

2. Approved Antennas

2.0.1 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 and equal to or lower gain than those listed in the tables.
- The antenna gain CANNOT exceed 7.15dBi for omni-directional.
- The overall system EIRP does not exceed 36dBm.

Warning!FreeWave approval is required prior to using any antenna other than those listed in this section. A proper combination with the **ZumLink** is required to ensure the system meets FCC requirements.

2.1 ZumLink 900MHz Antennas

The **ZumLink** 900MHz is approved by the FCC for use with omni-directional antennas that use 7.15dBi gain or less.

2.1.1 900MHz Omni-Directional Antennas

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

900MHz Omni-Directional Antennas			
Gain (dBd)	**Gain (dBi)**	**Manufacturer**	**Manufacturer Model Number**
5.00	7.15	Antenex	EB8965C
3	5.15	Maxrad	MAX-9053
-0.15	2.0	Mobile Mark	PSKN3-925S
-2.15	0	Mobile Mark	PSTG0-915SE

3. ZumLink Z9-C and Z9-T Data Interface Connector

Note: The ZumLink radio has a 14-pin header.
FreeWave defines TTL as 0 (zero) to 3.3VDC.

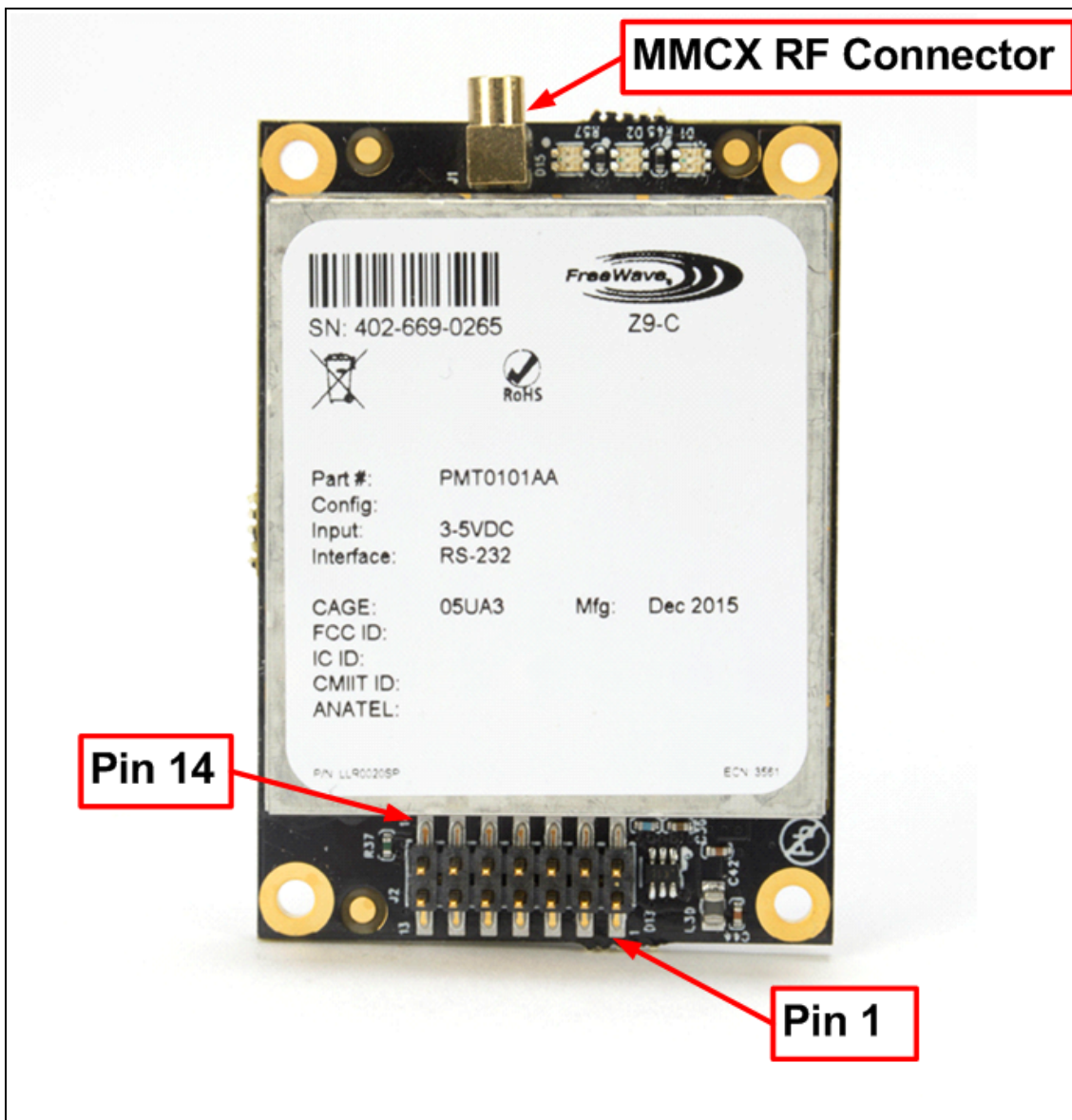|	ZumLink Z9-C and Z9-T Data Interface Connector			
Pin #	Signal Description and Name	Radio Input / Output	Z9-C Signal Level	Z9-T Signal Level
1	Power (B+)	Input	+3 to +5VDC (±10%)	+3 to +5VDC (±10%)
2	Interrupt	Input	TTL	TTL
3	Data Terminal Ready (DTR)	Input	RS-232	TTL
4	Ground (GND)	N/A		
5	Transmitted Data (TXD)	Output	RS-232	TTL
6	Radio Reset	Input	TTL	TTL
7	Received Data (RXD)	Input	RS-232	TTL
8	Carrier Detect (CD)	Output	RS-232	TTL
9	Request To Send (RTS)	Input	RS-232	TTL
10	Clear To Send (CTS)	Output	RS-232	TTL
11	Diagnostic Received Data (Diag RX)	Input	RS-232	TTL
12	Diagnostic Transmitted Data (Diag TX)	Output	RS-232	TTL
13	Ground (GND)	N/A		
14	Unused	N/A		

**Figure 8: ZumLink Z9-C and Z9-T MMCX RF Connector,
Pin 1, and Pin 14 of Data Interface Connector**

4. **ZumLink Z9-C and Z9-T** Settings and Descriptions

These are the **Page Settings** for the **ZumLink Z9-C and Z9-T**:

systemInfo

System Info - ZumLink Z9-C and Z9-TZumLink Z9-PE Settings and Descriptions		
Page	**CLI Command**	**Description**
[Page=systemInfo]	systemInfo.deviceId=	This is the Modbus ID selected for the device. • This number is used to identify the **ZumLink Z9-C and Z9-T** for polling. • This number MUST be unique to all devices in the **ZumLink** network. • The valid entry range is 1 to 255. **Note**: The default value is 1.
[Page=systemInfo]	systemInfo.deviceName=	This is a site name only for the user's reference.

System Info - ZumLink Z9-C and Z9-TZumLink Z9-PE Settings and Descriptions		
Page	**CLI Command**	**Description**
		FreeWave Recommends: Use a name relevant to the site's location (e.g., Site 5).
[Page=systemInfo]	systemInfo.deviceFirmwareVersion=	This setting identifies the ZumLink firmware version.
[Page=systemInfo]	systemInfo.macAddress=	This setting designates the MAC Address of the ZumLink.

radioSettings

radioSettings - ZumLink Settings and Descriptions		
Page	**CLI Command**	**Description**
[Page=radioSettings]	radioSettings.txPower=	**900MHz** • This setting defines the transmit power. • A higher power can be used to increase link margin. • Use lower a transmit power to reduce interference when multiple radio links are in close proximity. • Enter 0 (zero) to 30 **Note**: The default value is 5.
[Page=radioSettings]	radioSettings.rfDataRate=	**Note**: This is a ZumLink Golden Setting. This setting defines the RF link data rate speed in bits per second. A higher data rate provides more throughput at the expense of link distance or fade margin. **Important!**: Both the Gateway and Endpoint radios MUST use the same value for this setting. The options are:

radioSettings - ZumLink Settings and Descriptions		
Page	**CLI Command**	**Description**
		• RATE_1M • RATE_500K • RATE_250K • RATE_115.2K **Note**: The default value is RATE_1M.
[Page=radioSettings]	radioSettings.mode=	This setting designates the device as a Gateway or Endpoint unit. • Each network should have only ONE Gateway unit. • The remaining units should be configured as Endpoints. **Note**: The Gateway device will always have a **nodeId** of value 1. **FreeWave Recommends**: Use the default settings for normal operation. The options are: • Endpoint • Gateway **Note**: The default value is Endpoint.
[Page=radioSettings]	radioSettings.networkId=	This is the Network Identifier. • This setting can be used to subdivide traffic on radio units. • Radio units can only communicate with other units that have the same **networkId** setting. **Note**: If radios are on the same frequency they will still receive data from radios of a different **networkId**, but the data is dropped. Enter any number between 1 and 65533.

radioSettings - ZumLink Settings and Descriptions		
Page	**CLI Command**	**Description**
		Note: The default value is 51966.
[Page=radioSettings]	radioSettings.nodeId=	This setting defines the Node ID. ● Each radio with the same **networkId** must have a unique **nodeId**. ● Enter any number between 1 and 65533. **Note**: The default value is 64206. The Gateway device will always have a **nodeId** of value 1.
[Page=radioSettings]	radioSettings.radioFrequency=	This setting designates the Operating Center Frequency in MHz. ● This parameter ONLY takes effect when **radioHoppingMode=Hopping_Off**. ● All radios in a network must have the same frequency. ● Enter a frequency between 903.25 and 926.75. **Note**: The default value is 915.000.
[Page=radioSettings]	radioSettings.radioHoppingMode=	This parameter is used to enable or disable frequency hopping. ● For **rfDataRate** values less then 500kbs, the **radioHoppingMode** is forced **On**. ● For all other rates, the **radioHoppingMode** is optional. ● For **rfDataRate** values greater than 500kbs, the choice of hopping mode should be selected based on network frequency planning and channel conditions. **Important!**: Both the Gateway and Endpoint radios MUST use the same value for this setting. The format of the option is: ● Hopping_Off

radioSettings - ZumLink Settings and Descriptions		
Page	**CLI Command**	**Description**
		• Hopping_On **Example**: radioSettings.radioHoppingMode=Hopping_On. **Note**: The default value is Hopping_Off.
[Page=radioSettings]	radioSettings.beaconInterval=	The **beaconInterval** controls how often a Gateway radio sends out a beacon packet and changes to the next radio frequency in the hopping pattern. • A longer **beaconInterval** will give the system better throughput in channel environments where interference is minimal. • Throughput can be improved in some situations with shorter beacon intervals. **Important!**: Both the Gateway and Endpoint radios MUST use the same value for this setting. The options are: • ONE_SEC • FIVE_SECS • TEN_SECS • ONE_HUNDRED_MS • TWO_HUNDRED_MS • FOUR_HUNDRED_MS **Example**: radioSettings.beaconInterval=TEN_SECS. **Note**: The default value is ONE_HUNDRED_MS.
[Page=radioSettings]	lnaBypass=	LNA Bypass • The options are 0 (zero) and 1.

radioSettings - ZumLink Settings and Descriptions		
Page	**CLI Command**	**Description**
		• When set to a value of 1, the LNA of the radio module is bypassed. • It can be useful to bypass the LNA if there is a presence of strong signals in band and packet reception is not good. **Note**: The default value is 0 (zero).

config

config - ZumLink Settings and Descriptions		
Page	**CLI Command**	**Description**
[Page=config]	config.factoryDefaults=	This setting identifies the ZumLink factory defaults.
[Page=config]	config.save=	This setting saves changes made to the ZumLink configuration.

Appendix A: ZumLink Z9-C and Z9-T 900MHz Technical Specifications

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

ZumLink Z9-C and Z9-T and ZumLink Z9-xx 900MHz Technical Specifications	
Specification	**Description**
Interfaces	
Data Connector	• Z9-C - RS-232 , Dual row 14-pin header, 2mm pin spacing • Z9-T - TTL, Dual row 14-pin header, 2mm pin spacing
Serial Interface - Baud Rates	• RS-232 - 9600 to 921,600 bps • TTL - 9600 to 3,000,000 bps
RF Connector	MMCX
Transmitter	
Frequency Range	902 to 928MHz
Output Power	10mW to 1W User selectable
Data Link Range	40 miles with clear Line of Sight
Modulation	• GFSK • 8-ary FSK
Channel Sizes	• 115.2kHz • 345.6kHz • 691.2kHz

ZumLink Z9-C and Z9-T and ZumLink Z9-xx 900MHz Technical Specifications	
Specification	**Description**
	• 1382.4kHz • 3225.6kHz
RF Data Rate	• 115.2kbps • 250kbps • 500kbps • 1000kbps • 4000kbps
Hopping Channels	User selectable 	**Data Rate (kbps)**	**Hopping Channels**
115.2	110
250	73
500	37
1000	18
4000	8	
Hopping Patterns	Maximum of 16 patterns **Note**: There are less with larger channel bandwidths. User selectable
Hopping Rates	• 25ms • 50ms • 100ms • 200ms • 400ms User selectable
Occupied Bandwidth		**Occupied Bandwidth**	
Data Rate (kbps)	**Occupied BW (kHz)**
115.2	136
250	295
500	630
1000	1230
4000	3150	
Receiver	
Sensitivity	-106 dBm @ 115.2kbps for BER 10^{-4}
IF Selectivity	>40dB

ZumLink Z9-C and Z9-T and ZumLink Z9-xx 900MHz Technical Specifications	
Specification	**Description**
System Gain	Maximum of 136dB
Data Transmission	
Error Detection	CRC, FEC and ARQ
Link Throughput	Maximum of 2000kbps
Data Encryption	AES 128
Protocol	Proprietary CSMA
Power Requirements	
Operating Voltage	+3 to +5VDC (±10%)
Tx Current	Using maximum Tx Power, the **ZumLink Z9-C and Z9-T** has this Tx Current: • 1230 mA @ 3VDC • 680 mA @ 5VDC
Rx Current	• 30 mA @ 3VDC • 13 mA @ 5VDC
Idle Current	• 30 mA @ 3VDC • 13 mA @ 5VDC
General Information	
Operating Temperature Range	-40 °C to +85 °C -40° F to 185° F
Humidity	0 to 95% non-condensing
Dimensions	50.8mm Long x 35.56mm Wide x 9.65mm High 2" Long x 1.4" Wide x 0.38" High
Weight	15g 0.53lb.