

# WC20i-485 (Modbus) Modular Endpoints

For Models: WC20i-485 and WC20i-485-S

**User & Reference Manual** 



Part Number: LUM0093AA Revision: Apr-2018

#### **Safety Information**

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

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

FreeWave Technologies, Inc. warrants the FreeWave® WC20i-485 or WC20-485-S Modbus Modular Endpoint (Product) that you have purchased against defects in materials and manufacturing for a period of three years from the date of shipment, depending on model number. In the event of a Product failure due to materials or workmanship, FreeWave will, at its discretion, repair or replace the Product. For evaluation of Warranty coverage, return the Product to FreeWave upon receiving a Return Material Authorization (RMA). The replacement product will remain under warranty for 90 days or the remainder of the original product warranty period, whichever is longer.

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

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

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

FreeWave Technologies, Inc. 5395 Pearl Parkway, Suite 100 Boulder, CO 80301 303-381-9200 Toll Free: 1-866-923-6168 Fax: 303-786-9948

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

www.freewave.com

LUM0093AA Rev Apr-2018

Page 2 of 86

Copyright © 2018 FreeWave

# **Table of Contents**

Preface	. 5
1. Overview	. 7
2. Equipment	. 8
2.1. Included Equipment	. 9
2.1.1. Battery Powered WC20i	. 9
2.1.2. Solar Powered WC20i	. 9
2.1.3. User-supplied Equipment	. 9
3. WC20i-485 or WC20-485-S Connections	.10
3.1. Internal Connections	.11
3.2. Power Connection	13
3.2.1. Battery Connection	. 14
3.2.2. Solar Panel Connection	15
3.3. Sensor Connection - WC20i-485 / WC20i-485-S	.16
3.3.1. Modbus Sensor Connection	16
3.4. Sensor Cable Routing on the WC20i	. 17
4. WC Toolkit Installation	18
5. WC Toolkit Update	25
6. Configuration	.28
7. Modbus Program Steps Configuration	.34
7.1. Change the Address of Program Steps	.37
7.2. Create Program Steps	.40
7.3. Delete Program Steps	.43
7.3.1. Delete All Program Steps	45
7.4. Re-order Program Steps	.47
8. Mounting, Battery Replacement, Cleaning	.50
8.1. Direct Mount to Sensor with Short Conduit	51
8.2. Internal Lithium Battery Replacement	.52
8.3. Cleaning Instructions	53
9. Remote Modbus Registers - 485 Modbus	.54
9.1. Status Registers	54
10. WC Toolkit Software Environment	56
10.1. Device Configuration window	.57
10.1.1. Settings area	.60
10.1.2. Current Program Steps area	.63
11. WAVECONTACT Network Frequencies	66
11.1. Radio Network Group Selection: 0, 1, 2, or 3	.67
11.2. Radio Network Group Selection: 4, 5, 6, or 7	.68
11.3. Radio Network Group Selection: 8, 9, 10, 11	.69

LUM0093AA Rev Apr-2018

Page 3 of 86

Copyright © 2018 FreeWave

11.4. Radio Network Group Selection: 12, 13, 14, 15	70
11.5. Radio Network Group Selection: 16, 17, 18, or 19	71
11.6. Radio Network Group Selection: 20, 21, 22, 23	72
11.7. Radio Network Group Selection: 24, 25, 26, 27	73
11.8. Radio Network Group Selection: 28 or 29	74
Appendix A: Technical Specifications	75
Appendix B: Control Drawing: 960-0027-02	77
Appendix C: Connection Troubleshooting	78
Appendix D: LEDs	79
Appendix E: Available Accessories	80
Appendix F: FreeWave Legal Information	82

Page 4 of 86

Copyright © 2018 FreeWave

# Preface

# **Contact FreeWave Technical Support**

For up-to-date troubleshooting information, check the **Support** page at <u>www.freewave.com</u>. FreeWave provides technical support Monday through Friday, 8:00 AM to 5:00 PM Mountain Time (GMT -7).

- Call toll-free at 1-866-923-6168.
- In Colorado, call 303-381-9200.
- Contact us through e-mail at moreinfo@freewave.com.

# **Other WAVECONTACT Information**

Use the FreeWave <u>http://support.freewave.com/</u> website to download the latest version of these documents.

Registration is required to use this website.

Document	Description	FreeWave Part Number
User Manual	The User Manual provides setup, configuration, and safety information for the WC20i.	LUM0093AA
Quick Start Guide	The Quick Start Guide provides the out-of-the-box setup of the WC20i.	QSG0040AA

LUM0093AA Rev Apr-2018

Page 5 of 86

Copyright © 2018 FreeWave

Document	Description	FreeWave Part Number
User Manual	WC20i-Solar Installation User Manual           Note: This User Manual provides specific         information for installing the WC20i Solar Kits           available from FreeWave         Installation Solar Kits	LUM0097AA
Application Note	Intrinsically Safe Installation	LAN5509AA
Application Note	Remote Shutdown System	LAN5510AA

### **Document Styles**

This document uses these styles:

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

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

**Example**: Provides example information of the related text.

**FREEWAVE Recommends**: Identifies FreeWave recommendation information.

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

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

6.
UP
1 C

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.

LUM0093AA Rev Apr-2018

Page 6 of 86

Copyright © 2018 FreeWave

# 1. Overview

Thank you for purchasing the WC20i-485 or WC20i-485-S Modular Endpoint.

The WC20i-485 or WC20i-485-S Modular Endpoint is an intrinsically safe device with these features:

- RS485 connection to a single Modbus RTU sensor device
- Configurable Modbus register polling map
- Can power an attached Modbus sensor at 8V or 13V with configurable warm-up time
- Low power operation from an intrinsically safe, high capacity lithium primary battery pack.
- AES 128-bit Encryption
- Sends data to a WAVECONTACT Buffered WC45i-Gateway
- Optional: Solar battery system for routing Endpoints, high power draw sensors, or rapid data collection.

Note: See Available Accessories (on page 80) for additional equipment.

Note: The terms node and Endpoint are used interchangeably in this document.

Page 7 of 86

Copyright © 2018 FreeWave

# 2. Equipment

- Included Equipment (on page 9)
  - Battery Powered WC20i (on page 9)
  - Solar Powered WC20i (on page 9)
- User-supplied Equipment (on page 9)

LUM0093AA Rev Apr-2018

Page 8 of 86

Copyright © 2018 FreeWave

# 2.1. Included Equipment

#### 2.1.1. Battery Powered WC20i

This is the equipment included with a battery powered WC20i.

Battery Powered			
FreeWave Part #	Qty	Description	
WC20i-485	1	WC20i-485 Modular Endpoint	
QSG0040AA	1	Quick Start Guide	

#### 2.1.2. Solar Powered WC20i

This is the equipment included with a solar powered WC20i.

The WC20i can be purchased as:

- Bundled with the solar panel.
- Solar Ready without the solar panel.

Important!: Solar Ready WC20i Endpoints DO NOT come with internal batteries.

Solar Powered		
FreeWave Part #	Qty	Description
WC20i-485-Solar	1	WC20i-485-S - Solar Ready
	1	WC20i-Solar - WC20i Solar Panel kit with bracket, charger, and High Capacity battery pack
WC20i-485-S	1	WC20i-485-S - Solar Ready           Note: This is only the Solar Ready WC20i Endpoint.           It does NOT include the Solar Panel kit or internal batteries.
QSG0040AA	1	Quick Start Guide

### 2.1.3. User-supplied Equipment

- Philips screwdriver
- 4-pin to USB programming cable (FreeWave Part #: WC-USB-4PIN).
- Computer for WAVECONTACT device configuration.

Note: See Available Accessories (on page 80) for additional equipment.

LUM0093AA Rev Apr-2018

Page 9 of 86

Copyright © 2018 FreeWave

# 3. WC20i-485 or WC20-485-S Connections

- Internal Connections (on page 11)
- Power Connection (on page 13)
  - Battery Connection (on page 14)
  - Solar Panel Connection (on page 15)
- Sensor Cable Routing on the WC20i (on page 17)

Page 10 of 86

Copyright © 2018 FreeWave

### **3.1. Internal Connections**

These are the internal connections for the WC20i-485 or WC20i-485-S Modular Endpoint:



Figure 1: Internal Connections: WC20i-485 or WC20i-485-S Modular Endpoint

Internal Cor	Internal Connections: WC20i-485 or WC20i-485-S Modular Endpoint		
Location #	Title	Description	
1	Internal Lithium Battery Pack	This is the location of the Internal Lithium Battery Pack.	
2	Check-in button	On the WC20i, press the <b>Check-in</b> button to apply power to the configured sensor, read the sensor values, and send the collected sensor data to the Gateway.	
		<ul> <li>When the sensor is detected, the Status LED blinks once and its data is read.</li> </ul>	
		See LEDs (on page 79) for detailed information.	
		<ul> <li>The WC20i sends the collected sensor data to the WC45i- Gateway.</li> </ul>	

LUM0093AA Rev Apr-2018

Page 11 of 86

Copyright © 2018 FreeWave

Internal Co	nnections: WC20i-	485 or WC20i-485-S Modular Endpoint		
Location #	Title	Description		
3	Internal Antenna	The Internal Antenna communicates with the WC45i-Gateway.		
4	Config / Debug connector	This is the connection for the 4-pin to USB programming cable (FreeWave Part #WC-USB-4PIN).		
		<b>Note</b> : Debug and configuration information is available through WC Toolkit if a connection is made using the <b>RS232 Config / Debug</b> connector and the WC-USB-4PIN cable.		
5	Solar Battery connection	This is the connection for a solar panel or external battery.		
6	Status LEDs	See LEDs (on page 79) for detailed information.		
7	Internal Lithium Battery connection	The <b>Internal Lithium Battery</b> connection is the connection for the internal battery cable.		
8	Modbus Sensor connector	This is the connection for the Modbus sensor.		
9	Radio LEDs	See LEDs (on page 79) for detailed information.		

Page 12 of 86

Copyright © 2018 FreeWave

### **3.2. Power Connection**

**Important!**: Verify the items listed in Equipment (on page 8) are available before starting this procedure.

It is assumed that the reader and installer have completed the FreeWave WC20i installation and setup training to follow the procedures in this document.

Power is supplied using either a:

- Battery Connection (on page 14)
- Solar Panel Connection (on page 15)

Page 13 of 86

Copyright © 2018 FreeWave

#### 3.2.1. Battery Connection

Note: See Internal Lithium Battery Replacement (on page 52) to replace the battery.

- 1. All wiring should be neat and orderly.
- 2. Using the Philips screwdriver, remove the four screws holding down the WC20i cover and remove the cover.



Use the WC20i cover to hold the four screws while configuring the WC20i or when connecting or replacing the battery.

3. Verify the battery power wire is routed through the power cable hold-down clamp. (Figure 2)



**Warning!** The battery or solar power cable **MUST only be routed** through the power cable hold-down clamp and, as applicable, the solar power cable gland.



Figure 2: Battery Power Cable through the Power Cable Hold-down Clamp

- 4. Connect the battery power cable to the **Internal Lithium Battery** connection (**see #7** of Figure 1 on page 11).
- 5. Connect the 4-pin to USB programming cable to the **RS232 Config / Debug** connector (see #4 of Figure 1 on page 11).
- 6. Connect the USB end of the 4-pin to USB programming cable to the computer.
- 7. If this is the first time the WC20i is installed, wait for the drivers to install.

**Important!**: Depending on the computer and connection, the driver installation can take 3-6 minutes.

8. Continue with Sensor Connection - WC20i-485 / WC20i-485-S (on page 16).

Page 14 of 86

Copyright © 2018 FreeWave

#### 3.2.2. Solar Panel Connection

- 1. All wiring should be neat and orderly.
- 2. Using the Philips screwdriver, remove the four screws holding down the WC20i cover and remove the cover.



Use the WC20i cover to hold the four screws while configuring the WC20i or when connecting or replacing the battery.

3. Verify the solar power cable is routed through the power cable hold-down clamp and the power cable gland. (Figure 3)



**Warning!** The battery or solar power cable **MUST only be routed** through the power cable hold-down clamp and, as applicable, the solar power cable gland.



#### Figure 3: Solar Power Cable through the Power Cable Hold-down Clamp

- 4. Connect the solar power cable to the **Solar Battery** connection (**see #5** of Figure 1 on page 11).
- Connect the 4-pin to USB programming cable to the RS232 Config / Debug connector (see #4 of Figure 1 on page 11).
- 6. Connect the USB end of the 4-pin to USB programming cable to the computer.
- 7. If this is the first time the WC20i is installed, wait for the drivers to install.

**Important!**: Depending on the computer and connection, the driver installation can take 3-6 minutes.

8. Continue with Sensor Connection - WC20i-485 / WC20i-485-S (on page 16).

Page 15 of 86

Copyright © 2018 FreeWave

### 3.3. Sensor Connection - WC20i-485 / WC20i-485-S

### 3.3.1. Modbus Sensor Connection

- 1. Connect the sensor terminals: (Figure 4)
  - a. The **positive** Modbus terminal of the sensor is connected to the **Modbus A (+)** terminal on the WC20i Endpoint.
  - b. The **negative** Modbus terminal is connected to the **Modbus B (-)** terminal of the WC20i Endpoint.
  - c. The **power** Modbus terminal is connected to the **PWR** terminal of the WC20i Endpoint.
  - d. The **ground** Modbus terminal is connected to the **GND** terminal of the WC20i Endpoint.



Figure 4: MB\_A+ (positive), MB\_B- (negative), PWR (power), and GND (ground) Sensor Connection

 When the connection is made, continue with Sensor Cable Routing on the WC20i (on page 17).

LUM0093AA Rev Apr-2018

Page 16 of 86

Copyright © 2018 FreeWave

### 3.4. Sensor Cable Routing on the WC20i

**Note**: Many sensors are compatible with the FreeWave WC20i-485 or WC20i-485-S Modular Endpoint.

See <u>www.freewave.com</u> for the most up-to-date list of these sensors.

**Important!**: To ensure intrinsic safety is maintained, the installer is required to follow these procedures when connecting sensors to a WAVECONTACT Endpoint. See Figure 5 for the proper cable routing.

#### Procedure

- 1. All wiring should be neat and orderly.
- Verify the battery power wire is routed through the power cable hold-down clamp. (Figure 2) See Battery Connection (on page 14).
- 3. Strip the cable wires to the sensor so that there is minimal exposed un-insulated wire when inserted into the screw terminal.

**Important!**: For both the battery powered and solar powered WC20i, sensor wires entering the enclosure **MUST** be routed and connected as shown in Figure 5.



Figure 5: Correctly Routed Sensor Cable

- 4. Continue with either:
  - WC Toolkit Installation (on page 18)
  - Configuration (on page 28).

LUM0093AA Rev Apr-2018

Page 17 of 86

Copyright © 2018 FreeWave

# 4. WC Toolkit Installation

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

1. Click <u>http://support.freewave.com/</u>. The **FreeWave Support** site opens.

Important!: Registration is required to use this website.

FREEWAVE		SUPPORT REGISTER FREEWAVE.COM
_	How can we help?	
Q	Search the knowledge base	
Help Topics		Log In Username
		Password Remember Me Lost your password? Log In
		Can't Find it? Contact us! Phone: 1.866.923.6168 Email: <u>support@freewave.com</u>



2. Enter the User Name and Password.

FreeWave Technologies, Inc.

3. Click

A successful Login message briefly appears. The **Help Topics** window opens.

4. Click the **Software** link.

Help Topics		
1 III		With
Software	Path Study Request Form	log out
TumlQ App Server Software	MM2-M13 Series	
Training and Education	TumLink Series	Can't Find it? Contact us! Phone: 1.866.923.6168 Email: <u>support@freewave.com</u>
		•

Figure 7: Help Topics window

The **Software** window opens.

5. Click the **WAVECONTACT Toolkit** link.

FREEWAVE	SUPPORT	REGISTER	FREEWAVE.COM	
	Q Search	n the knowledge	base	
Software		Can't Find it:	? Contact us!	
Tool Suite		Phone: 1.866. Email: <u>suppor</u>	.923.6168 t@freewave.com	
WAVECONTACT Toolkit				-

Figure 8: Software window

The available software appears in the window.

6. Select and click the attachment.

Page 19 of 86

Copyright © 2018 FreeWave



#### Figure 9: WAVECONTACT Toolkit window

The **Opening** dialog box opens.

Opening FreeWave-V	VC-Toolkit-Installer-v2.1.2.83.zip										
You have chosen to	o open:										
🗼 FreeWave-WC-Toolkit-Installer-v2.1.2.83.zip											
which is: Compressed (zipped) Folder (8.8 MB)											
from: http://s	upport.freewave.com										
What should Firefo	What should Firefox do with this file?										
© <u>O</u> pen with	⊙ <u>O</u> pen with Windows Explorer (default)     ▼										
Save File											
Do this <u>a</u> uto	omatically for files like this from now on.										
	OK Cancel										

#### Figure 10: WC Toolkit Opening dialog box

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

#### 7. Click **OK**.

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

LUM0093AA Rev Apr-2018

Page 20 of 86

Copyright © 2018 FreeWave

Enter name of file to	o save to Computer → OS (C:) →	_WC Toolkit for FW	<ul> <li>✓</li> <li>✓</li></ul>	earch_WC Toolkit for FW 👂
Organize 🔻 Ne	w folder			
Desktop     Desktop     Desktop     Computer     OS (C:)     DVD RW Dri	ve (D:)	Name	tt	Date modified
File name:	FreeWave-WC-Toolkit	-Installer-v2.1.2.83.zip		•
Save as type:	Compressed (zipped) F	older (*.zip)		
Hide Folders			Sa	ve Cancel

Figure 11: 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 .exe file from the .zip file into a parent location.
- 12. Double-click the **.exe** file to run the WC Toolkit installer. The **Open File - Security Warning** dialog box opens.

Open File - Security Warning
Do you want to run this file?
Name:      FW\FreeWave WC Toolkit Installer v2.1.2.83.exe         Publisher:       SignalFire Telemetry, Inc.         Type:       Application         From:       C:\_WC Toolkit for FW\FreeWave WC Toolkit I
Run Cancel
While files from the Internet can be useful, this file type can potentially harm your computer. Only run software from publishers you trust. What's the risk?

Figure 12: Open File - Security Warning dialog box

13. Click Run.

The User Account Control dialog box opens.

LUM0093AA Rev Apr-2018

Page 21 of 86

Copyright © 2018 FreeWave



#### Figure 13: User Account Control dialog box

#### 14. Click Yes.

The WC Toolkit Setup Wizard starts.

🔂 Setup - FreeWave WC Toolkit	- • ×
Select Destination Location Where should FreeWave WC Toolkit be installed?	
Setup will install FreeWave WC Toolkit into the following folder.	
To continue, click Next. If you would like to select a different folder, click Bi	owse.
C:\Program Files (x86)\FreeWave\FreeWave WC Toolkit	Browse
At least 19.2 MB of free disk space is required.	
Next >	Cancel

Figure 14: WC Toolkit Setup Wizard - Select Destination Location window

15. Click **Next** to continue. The **Ready to Install** window opens.

LUM0093AA Rev Apr-2018

Page 22 of 86

Copyright © 2018 FreeWave

🔂 Setup - FreeWave WC Toolkit	• 💌
Ready to Install Setup is now ready to begin installing FreeWave WC Toolkit on your computer.	
Click Install to continue with the installation, or click Back if you want to review or change any settings.	
Destination location: C:\Program Files (x86)\FreeWave\FreeWave WC Toolkit	*
*	Ŧ
< Back Install C	ancel

Figure 15: WC Toolkit Setup Wizard - Ready to Install window

#### 16. Click Install.

The install process is very quick. The **Installation Complete** window opens.



#### Figure 16: WC Toolkit Setup Wizard - Installation Complete window

17. Click Finish to open WC Toolkit.

An Update message appears in the WC Toolkit window is an update is available.

Page 23 of 86

Copyright © 2018 FreeWave

FreeWave WC Toolkit v2.1.2.83	
File Options Updates Tools	Help Update Available
Auto-Detect Device COM Port: COM1   Refresh Select COM Port to Auto-Detect Auto-Detect Device on COM Port	<b>FREEWAVE</b> Customer Login: None
Select Device WC45i-Gateway	▼ Open Device Window

Figure 17: WC Toolkit - Update Available message

18. Continue with the WC Toolkit Update (on page 25) procedure.

Page 24 of 86

Copyright © 2018 FreeWave

# 5. WC Toolkit Update

If the WAVECONTACT device is connected to the internet, WC Toolkit automatically searches for an update for either the WC Toolkit itself or the connected device's firmware.

An **Update Available** message appears if an update is available.

**Note**: An **Update Available** message also appears in the Device Configuration window (on page 57) for any connected WAVECONTACT device when an update is available for that device. The update procedure is the same for the device and WC Toolkit.

 Open the WC Toolkit software. The Update Available message appears in the window. (Figure 18)

O FreeWave WC T	oolkit v2.1.	2.83		
File Options	Updates	Tools	Help	Update Available
Auto-Detect Device COM Port: COM1 Select COM Po Auto-Detect Dev	to Auto-Dete vice on COM P	Refresh ect Port	<b>FRI</b> Customer Lo	EEWAVE
WC45i-Gateway				Open Device Window



LUM0093AA Rev Apr-2018

Page 25 of 86

Copyright © 2018 FreeWave

2. Click the Update Available message link.

O FreeWave WC Toolkit v2.1.2.83	
File       Options       Updates       Tools       Help       Update Available         Auto-Detect       COM Port:       COM1       Refresh       Select COM Port to Auto-Detect       FREEWAVE         Auto-Detect       Auto-Detect Device on COM Port       Customer Login: None	Click this link.
Select Device WC45i-Gateway	

Figure 19: Click the Update Available message link

The Open File - Security Warning dialog box opens.



Figure 20: Open File - Security Warning dialog box

#### 3. Click Run.

The User Account Control dialog box opens.

Page 26 of 86

Copyright © 2018 FreeWave



Figure 21: User Account Control dialog box

4. Click Yes.

The WC Toolkit update process is very quick.

When the update is completed, WC Toolkit re-opens the **Select Device** window showing the updated software version in the WC Toolkit window. (Figure 22)

O FreeWave WC Toolkit	
File Options Updates Tools	Help
Auto-Detect Device COM Port: COM   Refresh Auto-Detect COM : Success Auto-Detect Device on COM Port	Customer Login: None
Select Device WC45i-Gateway	Open Device Window

#### Figure 22: Select Device window

5. Continue with Configuration of the WC20i-485 or WC20-485-S.

Page 27 of 86

Copyright © 2018 FreeWave

# 6. Configuration

**Important!**: The WC20i-485 or WC20i-485-S Endpoint must be configured with a list of Modbus registers to be read from the attached sensor using the WC Toolkit application prior to installation.

- The pre-configured set of registers is automatically read from the Modbus sensor device and forwarded to the Modbus Gateway on a pre-defined schedule (1 minute to 5 minutes is typical).
- The register data is then buffered in the Gateway and is available to be read by the RTU at any time.

Note: The terms node and Endpoint are used interchangeably in this document.

**FREEWAVE Recommends**: Install and configure the **WC45i** Gateway before any Endpoints to ensure the Endpoints have connectivity after installation.

Warning! Perform the Configuration steps in a safe location only.

**AVERTISSEMENT**: Suivez les étapes de cette section (Configuration) dans un endroit sûr uniquement.

The Endpoints **MUST BE** set up for correct operation **before** they are placed in the field. Configurable items include:

- Check-in period selection
- Modbus Slave ID setting
- Network selection

STOP

LUM0093AA Rev Apr-2018

Page 28 of 86

Copyright © 2018 FreeWave

- Network Group selection
- Radio Mode selection

**Important!**: The WC20i-485 or WC20i-485-S Modular Endpoint is configured using the **WC Toolkit**. See WC Toolkit Installation (on page 18) and WC Toolkit Update (on page 25).

**Warning!** Debug and configuration information is available if the 4-pin to USB programming cable is connected to the **RS232 Config / Debug** connector using the debug port on the main board.

The USB converter cable (FreeWave Part #WC-USB-4PIN) must be used for this interface. Debug and configuration is done using the WC Toolkit.

STOP

**Warning!** Only connect to the Config / Debug connector port in a safe area! **AVERTISSEMENT**: Branchez le port de déboggage que dans une zone secure.

#### Procedure

**Note**: The screenshots are examples only. The dialog boxes and windows appear differently on each computer.

1. Verify the WC Toolkit software is installed on the computer connected to the WC20i.

Note: See WC Toolkit Installation (on page 18) and WC Toolkit Update (on page 25).

- 2. Verify the Gateway is installed and configured before continuing with the Endpoint configuration.
- 3. Connect the WC-USB-4PIN 4-pin to USB programming cable to the computer and the WC20i.
- Open the WC Toolkit software. The Select Device window opens. (Figure 23)

O FreeWave WC Toolkit v
File Options Updates Tools Help Auto-Detect Device
COM Port: COM Refresh Auto-Detect COM Success
Auto-Detect Device on COM Port Customer Login: None
Select Device
WC45i-Gateway

#### Figure 23: Select Device window

LUM0093AA Rev Apr-2018

Page 29 of 86

Copyright © 2018 FreeWave

- 5. Click the **Refresh** button to have WC Toolkit search for and list the available COM ports reported by Windows and connected devices in the **COM Port** list box.
- 6. Click the **COM Port** list box arrow and select the COM port on the computer associated with the connected WC20i-485 or WC20-485-S.
- 7. Click the **Auto-Detect Device on COM Port** button to have WC Toolkit connect the device to the COM Port selected in the **COM Port** list box.

**Note**: Optional: Click the **Select Device** list box arrow and select the connected device. Click the **Open Device Window** button to open the Device Configuration window (on page 57).



Figure 24: Select Device list box

The Device Configuration window opens for the selected device.

Note: See Device Configuration window (on page 57) for detailed information.

LUM0093AA Rev Apr-2018

Page 30 of 86

Copyright © 2018 FreeWave

WC20i-Modbus 4 File Options S	85 ettings Update	s To	ols	Help		•	1		Passed		
		Curren	t Progr	am Ster	05					1	
2 COM Port: COM23	- Refresh	Baud	Rate			Comm	and Timeout (me)	100			
COM22 (	2000	LIART	Mode	ONIT		Comm	and Pause (me)	100			
COM23	Aberi	UANI	Mode		•	Comm	idilu rause (ilis)		, •	<b>I ←</b>	2
Open Close	Offline	Slavel	D 1	•	< Slave ID	) used fo	or all steps below				J
		Double	e-click a	a Step	to View Re	egisters					
Connect/L	lpdate		#	Func	Address	Count	Status	^	Run Modbus		
Product	MODBUS		1						Program Steps		
Node Name	not set		2								
Radio Connectivity	Connected -36d		3								
Mainboard Version	0.58		4								
Radio Version	2.50 (sleeping)		5						Check All		
Radio Address	27014		6								
Corporate ID	<encrypted></encrypted>		7						Uncheck All		
Radio Mode	Sleeping		8								
Radio Network	1		9					=	Move Up		
Radio Network Group	10		10								
Radio Power (dBm)	14		11						Move Down		
Checkin Interval	1 minute		12								
Modbus Baud Rate	9600		13						Incr. Address		
Modbus UART Mode	8N1		14								
Command Timeout (ms)	1000		15						Decr. Address		
Command Pause (ms)	100		16								
Sensor On Time (sec)	2		17						Delete		
Sensor Power Mode	HIGH		18								
			19						Delete All		
Set Encryption Key	Help		20								
5			21								
	Set		22								
Key: rreewave			23								
Settings			24								
Node Name	Set		25					-			
Radio Mode Sleeping	✓ Set							_	]		
6 Badio Network			Re	ead Cur	rent Progra	am Steps	from Device				
Badio Network Group	10 V Set			Write N	lew Progra	m Steps	to Device				
Charlie Interval 1 mi		-									
Sensor On Time (eec)		Fun	ction Ci	ode /	Address	Reg Co	unt Register Si	ze			
Sensor off fille (acc)	Alwaye Op		15	·		_	TODIL	•			
- Sensor	Aways On			1	Add New F	rogram :	Step		J		
Sensor Power Mode	HIGH - Set	Exa	mple: H	lolding	Register A	ddress 4	0001 is entered as	1			
Success											
										_	

#### Figure 25: Device Configuration window: WC20i-485 or WC20i-485-S

- 8. In the Set Encryption Key area (#5), change these settings:
  - a. In the **Key** text box, enter the encryption key for the device using 6 to 16 characters.
  - b. Click the **Set** button to save the information.

**Important!**: A Key CANNOT contain spaces or angle brackets. The Gateway and Endpoints only communicate if they are configured with the same **Key**. When setting up a new network, use this same encryption Key on all the devices.

**Note**: When the WC20i drops its network, it attempts to join networks using the same encryption **Key**.

Caution: It is possible to hide the encryption Key so it cannot be read. This is the most secure option, but if the Key is forgotten, there is no way to recover it. The Key must be reset on every device on the network.

LUM0093AA Rev Apr-2018

Page 31 of 86

Copyright © 2018 FreeWave

- 9. Optional: Click the **Settings** menu and select **Set Encryption Key Unrecoverable** to permanently hide the key.
- 10. In the **Settings** area (#6), change these settings:

**Note**: The **Network** settings are used to create separate networks using multiple Gateways (that are in close proximity to one another).

Important!: The Radio Network and Radio Network Group settings are selected by the user but MUST MATCH the existing Gateway network for successful communication between the Gateway and Endpoint. See WAVECONTACT Network Frequencies (on page 66) for additional information.

- a. Optional: In the **Node Name** text box, enter a name for the Endpoint using a maximum of 10 characters.
- b. Click the **Set** button to save the information.
- c. Click the Radio Mode list box arrow and select either Sleeping or Non-Sleeping.

**Important!**: Use **Non-Sleeping** option ONLY if there is a solar kit attached to the WC20i. See Included Equipment (on page 9) for additional information.

- d. Click the **Radio Network** list box arrow and select 0 (zero) to 7 for the assigned number.
- e. Click the **Radio Network Group** list box arrow and select 0 (zero) to 29 for the network group assigned number.

Important!: The Radio Network and Radio Network Group settings are selected by the user but MUST MATCH the existing Gateway network for successful communication between the Gateway and Endpoint. See WAVECONTACT Network Frequencies (on page 66) for additional information.

- f. Click the **Set** button to save the information.
- g. Click the **Checkin Interval** list box arrow and select how often the Endpoint wakes up, reads the sensor values Modbus device, and transmits the register data to the Gateway.
- h. Click the **Set** button to save the information.
- i. In the **Sensor On time (sec)** text box, enter the number of seconds power is applied to the Modbus sensor prior to data collection.

**FREEWAVE Recommends**: Accept the default **Sensor On time (sec)** value of 2 seconds for most devices.

However, radar sensors often require a longer warm-up time.

**Note**: See the sensor manufacturer's documentation for more information on warm-up time for the specific sensor.

Page 32 of 86

Copyright © 2018 FreeWave

j. Optional: Select the **Sensor Always On** check box to make the sensor always have power no matter what type of power source is connected to the device.



- k. Click the **Set** button to save the information.
- I. Optional: Click the **Sensor Power Mode** list box arrow and select either HIGH or LOW volts for the WC20i.

**Note**: HIGH outputs 18.5 volts to the sensor and LOW outputs 12.5 volts. LOW results in longer battery life but some sensors require a higher voltage.

- m. Click the **Set** button to save the information.
- 11. On the WC20i, press the **Check-in** button to apply power to the configured sensor, read the sensor values, and send the collected sensor data to the Gateway.
- 12. Verify the Gateway is communicating with the Endpoints.

Note: A successful connection on the WAVECONTACT Endpoint is indicated with Green blinking ⊖ TX and ACT lights and a Red blinking ⊖ light for RX.

If the connection is NOT successful, a Green blinking  $\bigcirc$  TX light appears for 10 seconds.

**FREEWAVE Recommends**: Install and configure the **WC45i** Gateway before any Endpoints to ensure the Endpoints have connectivity after installation.

- 13. Continue with Modbus Program Steps Configuration (on page 34).
- 14. Close the WC Toolkit software.
- 15. Remove the WC-USB-4PIN 4-pin to USB programming cable from the computer and the WC20i.
- 16. As applicable, replace the Endpoint cover.
- 17. Install the WC20i using the Direct Mount to Sensor with Short Conduit (on page 51).
- 18. If this is a WC20i-485-S installation, follow the tank level manufacturer's installation procedures for the selected solar mounting kit listed in Available Accessories (on page 80).

LUM0093AA Rev Apr-2018

Page 33 of 86

Copyright © 2018 FreeWave

# 7. Modbus Program Steps Configuration

**Important!**: The register set to poll on each check-in must be defined using the Current Program Steps area (on page 63) area of the Device Configuration window.

A program step consists of one of these Modbus operation codes:

- **0x01** for MODBUS\_READ\_COIL (limit: 1 coil)
- 0x02 MODBUS\_READ\_INPUT (limit: 1 input)
- Ox03 for MODBUS\_READ\_HOLDING\_REGISTERS
- 0x04 for MODBUS\_READ\_INPUT\_REGISTERS
- Ox05 for MODBUS\_WRITE\_SINGLE\_COIL

**Note**: A maximum of 34 program steps can be programmed. Any response from a Modbus device (data or exception) is forwarded to the Modbus Gateway and cached.

Page 34 of 86

Copyright © 2018 FreeWave

#### Procedure

1. Open the Device Configuration window (on page 57).

	OWC20i-Modbus 4	85						[	1				
	File Options S	ettings Upo	late	s To	ols	Help					Passed	)	
2	COM Port: COM23	<ul> <li>Refresh</li> </ul>		Current Baud F	t Prog Rate	am Ster 9600	ps ) v	Comm	and Timeout (m	s) [10	00 -		
	COM23 (	Open		UART	Mode	8N1	•	Comm	and Pause (ms)	10	0 👻	Г	
	Open Close	Offline		Slavel	D 1	a Gan	< Slave IE	) used fo	r all steps below				3
	Connect/L	Jpdate		Double	H H	a Step		Count	Onton				
	Burdurt	MODBUS	=		#	Func	Address	Count	Status	-	Program Steps		
	Node Name	MODBUS	-1		2					- 11			
	Radio Connectivity	Connected -36d			3					- 11			
4	Mainhoard Version	0.58	-		4					- 11			
	Badio Version	2.50 (sleeping)			5						Check All		
	Radio Address	27014			6								
	Comorate ID	<encrypted></encrypted>			7						Uncheck All		
	Badio Mode	Sleeping			8								
	Badio Network	1			9						Move Up		
	Badio Network Group	10			10								
	Radio Power (dBm)	14			11						Move Down		
	Checkin Interval	1 minute			12								
	Modbus Baud Bate	9600			13					- 11	Incr Address		
	Modbus UART Mode	8N1			14								
	Command Timeout (ms)	1000			15						Decr. Address		
	Command Pause (ms)	1000			16								
	Sensor On Time (sec)	2			17						Delete		
	Sensor Power Mode	HIGH			18								
	School Forter Mode	man			19						Delete All		
	Set Encryption Key	He	lp		20								
					21								
J		Set			22								
	Key: freewave				23								
	Settinge				24								
	Node Name	Set			25					-			
	Derte Marte Character		=										
	Radio Mode Sleeping		-		R	ead Cur	rent Progra	am Steps	from Device		]		
U	Radio Network	1 V Sel				Write N	lew Progra	m Stens	to Device	_	1		
	Radio Network Group	10 -				THE P	ion riogia	in otopo	10 001100		J		
	Checkin Interval 1 mir	nute 👻 Set		Fund	ction C	iode /	Address	Reg Co	unt Register	Size			
	Sensor On Time (sec)	2		0x0	3	-			16-bit	-			
	Sensor	Always On Set									r		
						1	Had New H	rrogram S	otep	_			
	Sensor Power Mode	HIGH - Sel		Exar	nple: I	Holding	Register A	ddress 4	0001 is entered	as 1			
	Success		_										
1													

#### Figure 26: Device Configuration window: WC20i-485 or WC20i-485-S

- 2. In the Current Program Steps area (#3):
  - a. Click the **Read Current Program Steps from Device** button to view the current Program Steps in the table.
  - b. Optional: Click the **Baud Rate** list box arrow and select the baud rate for the RS485 Modbus port.
  - c. Optional: Click the **UART Mode** list box arrow and select the number of data bits, parity, and stop bits used with the RS485 Modbus port.
  - d. Optional: Click the **Command Timeout (ms)** list box arrow and select the number of mS the device waits for a response from the attached Modbus device before it times out the request.
  - e. Optional: Click the **Command Pause (ms)** list box arrow and select the number of mS the device pauses between each Modbus transaction.
  - f. In the Slave ID column / text box, enter the remote source Endpoint Modbus Slave ID.

Important!: Each remote device connected to the Gateway MUST have a unique Modbus Slave ID (1-240). Verify there are no duplicate Slave IDs in a given network. The Gateway only caches one set of data for each Slave ID. A duplicate is overwritten. See Remote Modbus Registers - 485 Modbus (on page 54) for Modbus details.

- g. Optional: Complete any of these procedures:
  - Create Program Steps (on page 40)
  - Change the Address of Program Steps (on page 37)
  - Delete Program Steps (on page 43)
  - Re-order Program Steps (on page 47)
- 3. Click the **Write New Program Steps to Device** button to save the changes to the WC20i every time the Program Steps are changed.
- 4. Click the **Run Modbus Program Steps** button to run the Program Steps to poll the Modbus device on each check-in.
- 5. On the WC20i, press the **Check-in** button to apply power to the configured sensor, read the sensor values, and send the collected sensor data to the Gateway.
- 6. Verify the Gateway is communicating with the Endpoints.

Note: A successful connection on the WAVECONTACT Endpoint is indicated with Green blinking ⊖ TX and ACT lights and a Red blinking ⊖ light for RX.

If the connection is NOT successful, a Green blinking  $\bigcirc$  TX light appears for 10 seconds.

**FREEWAVE Recommends**: Install and configure the **WC45i** Gateway before any Endpoints to ensure the Endpoints have connectivity after installation.

- 7. Close the WC Toolkit software.
- 8. Remove the WC-USB-4PIN 4-pin to USB programming cable from the computer and the WC20i.
- 9. As applicable, replace the Endpoint cover.
- 10. Install the WC20i using the Direct Mount to Sensor with Short Conduit (on page 51).
- 11. If this is a WC20i-485-S installation, follow the tank level manufacturer's installation procedures for the selected solar mounting kit listed in Available Accessories (on page 80).

LUM0093AA Rev Apr-2018

Page 36 of 86

Copyright © 2018 FreeWave
## 7.1. Change the Address of Program Steps

1. In the **Registers** table, click the check box next to the program step to change its address.

COM Port: COM26 Open COM26 Open Open Close Connect/Update Product MOE Node Name not s Radio Connectivity DISC Radio Version 0.53 Radio Version 2.50 Radio Address 3327 Corporate ID < Enc Radio Mode Slee Radio Network 0 Radio Network 0	Offline Offline BUS 2DI et cONNECTED (sleeping) '2 rypted>	Report Addre 3010- 3012 3013 3014 3015 3016- 3018 3019 3020	ed Ser ss 3011 3017	nsor Va	lues Description Counter1 ( Counter1 S Avg. Freq Inst. Freq1	n counts) State 1 (Hz x 10	Va 0 0	lue		^
COM Port: COM26 COM26 Open Open Close Connect/Update Product MOD Node Name not s Radio Connectivity DISC Mainboard Version 0.53 Radio Address 3322 Corporate ID <enc Radio Mode Slee Radio Notwork 0 Radio Network 00</enc 	Refresh     Offline     Offline     BUS 2DI     et     cONNECTED     (sleeping)     '2     rypted>	Addre 3010- 3012 3013 3014 3015 3016- 3018 3019 3020	3011 3017		Description Counter1 Counter1 Avg. Freq Inst. Freq1	n counts) State 1 (Hz x 10	Va 0 0	lue		•
COM26 Open Open Close Connect/Update Product MOD Node Name not s Radio Connectivity DISC Mainboard Version 0.53 Radio Address 3322 Corporate ID <enc Radio Mode Slee Radio Network 0 Radio Network 00</enc 	Offline BUS 2DI et cONNECTED (sleeping) 2 rypted>	3010- 3012 3013 3014 3015 3016- 3018 3019 3020	3011 3017		Counter1 Counter1 Avg. Freq1 Inst. Freq1	counts) State 1 (Hz x 10	0			
Open         Close           Connect/Update         MOD           Node Name         not s           Radio Connectivity         DISC           Mainboard Version         0.53           Radio Version         2.50           Radio Address         3327           Corporate ID <enc< td="">           Radio Mode         Slee           Radio Network         0</enc<>	Offline BUS 2DI et cONNECTED (sleeping) 2 2 rypted>	3012 3013 3014 3015 3016- 3018 3019 3020	3017		Counter1 Avg. Freq Inst. Freq1	State 1 (Hz x 10	0			-
Connect/Update Product MOD Node Name not s Radio Connectivity DISC Mainboard Version 0.53 Radio Version 2.50 Radio Address 3327 Corporate ID < Enc Radio Mode Siee Radio Network 0 Radio Network Group 0	BUS 2DI et :ONNECTED (sleeping) '2 :rypted>	3013 3014 3015 3016- 3018 3019 3020	3017		Avg. Freq Inst. Freq1	1 (Hz x 10	)) 0			
Connect/Update Product MOE Node Name not s Radio Connectivity DISC Mainboard Version 0.53 Radio Version 2.50 Radio Address 3327 Corporate ID <enc 0="" 0<="" group="" mode="" network="" radio="" slee="" td=""><td>BUS 2DI et CONNECTED (sleeping) '2 aypted&gt;</td><td>3014 3015 3016- 3018 3019 3020</td><td>3017</td><td></td><td>Inst. Freq1</td><td></td><td><i>,</i> 0</td><td></td><td></td><td></td></enc>	BUS 2DI et CONNECTED (sleeping) '2 aypted>	3014 3015 3016- 3018 3019 3020	3017		Inst. Freq1		<i>,</i> 0			
Product MOE Node Name not s Radio Connectivity DISC Mainboard Version 0.53 Radio Version 2.50 Radio Address 3327 Corporate ID <enc Radio Mode Slee Radio Network 0 Radio Network 00</enc 	BUS 2DI et CONNECTED (sleeping) 22 crypted>	3015 3016- 3018 3019 3020	3017			(Hz x10	) 0			Ξ
Product MOE Node Name not s Radio Connectivity DISC Mainboard Version 0.53 Radio Address 3327 Corporate ID <enc Radio Mode Slee Radio Network 0 Radio Network Group 0</enc 	BUS 2DI et CONNECTED (sleeping) 22 crypted>	3016- 3018 3019 3020	3017		Counts/Mi	nute1 (x	10) 0			
Node Name     not s       Radio Connectivity     DISC       Mainboard Version     0.53       Radio Address     3322       Corporate ID <enc< td="">       Radio Mode     Slee       Radio Network     0       Radio Network     0</enc<>	et CONNECTED (sleeping) '2 :rypted>	3018 3019 3020			Counter2	counts)	0			
Radio Connectivity     DISC       Mainboard Version     0.53       Radio Version     2.50       Radio Address     3321       Corporate ID <enr< td="">       Radio Mode     Slee       Radio Network     0       Radio Network Group     0</enr<>	(sleeping) 2 rypted>	3019 3020			Counter2	State	0			
Mainboard Version 0.53 Radio Version 2.50 Radio Address 3327 Corporate ID <enc Radio Mode Slee Radio Network 0 Radio Network Group 0</enc 	(sleeping) '2 :rypted>	3020			Avg. Freq	2 (Hz x 10	)) 0			
Radio Version     2.50       Radio Address     3327       Corporate ID <enc< td="">       Radio Mode     Slee       Radio Network     0       Radio Network Group     0</enc<>	(sleeping) 2 rypted>	0001			Inst. Freq2	(Hz x10	) 0			-
Radio Address     3327       Corporate ID <enc< td="">       Radio Mode     Slee       Radio Network     0       Radio Network Group     0</enc<>	2 rypted>	•			/ /M		1		•	
Corporate ID <enc Radio Mode Slee Radio Network 0 Radio Network Group 0</enc 	:rypted>									_
Radio Mode Slee Radio Network 0 Radio Network Group 0					Update	Reported	d Digital Input V	alues		
Radio Network 0 Radio Network Group 0	ping	Current	Proce	am Sto	08					
Radio Network Group 0		Current	rriogi	an ste	- D					
		Baud F	Rate	960	•	Comm	and Timeout (m	s) 100	<u> </u>	
Hadio Power (dBm) 14		UART	Mode	8N1	•	Comm	and Pause (ms)	100	) 🔻	
Uneckin Interval 1 mir	ute	*Slave	ID set	ting us	ed for all M	ndhue et	ens helow			
Modbue Raud Pate 0000		Daula	ali-l	- C+		aister	spa below		Run Modb	US
Modbus LIART Mode 0N1		Double	-click	a step	to view Re	gisters			Program Ste	:ps
Command Timeout (ms) 1000			#	Func	Address	Count	Status	^		
Command Pause (ms) 100			1	01	14	1	Unknown		Check A	
Sensor On Time (sec) 2			2	02	22	1	Unknown	=	Uncheck	All
Sensor Power Mode HIGI	4		3	03	40000	5	Unknown		Chonook	
Set Encryption Key	Help		4	04	30011	3	Unknown		Mayer	
our enoryprorn noy			5	05	0	1	Unknown		Move Up	
	Set		5						Move Dov	vn
Key: freewave			0							
			0						Incr. Addre	SS
Settings			10							
Node Name	Set		11						Decr. Addre	ess
Radio Mode Sleeping	▼ Set		12							
Radio Network 0			13					-	Delete	
Radio Network Group 0	▼ Set		R	ead Cu	rrent Progra	m Steps	from Device		Delete A	
Checkin Interval 1 minute	✓ Set					in otops	NOW DOMOG			
Slave ID* 1	Set			Write	New Progra	m Steps	to Device			
Sensor On Time (sec) 2		Fund	tion C	ode	Address	Reg Co	unt Register	Size		
Sensor Alway	s On Set	0x0	3	•	0	1	16-bit	-		

#### Figure 27: Selected Program Step in the WC20i-485-2DI Device Configuration window

- 2. Click the **Incr. Address** button to increase the address value of the selected Program Step.
- 3. Click the **Decr. Address** button to decrease the address value of the selected Program Step.

LUM0093AA Rev Apr-2018

Page 37 of 86

Copyright © 2018 FreeWave

ne Options S	ettings Opt	ates	10	UIS	пер						<b>a</b> 33
		5	Report	ted Ser	nsor Va	lues					
COM Port: COM26	✓ Refresh		Addre	ess		Description	n	V	/alue		-
COM26 C	)pen		3010	3011		Counter1 (	(counts)	0	)		
			3012			Counter1	State	0	)		
Open Close	Offline		3013			Avg. Freq	1 (Hz x 10	)) (	)		
			3014			Inst. Freq1	(Hz x10	) (	)		=
Connect/U	pdate		3015			Counts/Mi	inute1 (x	10) 0	)		
Product	MODBUS 2DI		3016	-3017		Counter2 (	(counts)	0			
Node Name	not set		3018			Counter2	State	0			
Radio Connectivity	DISCONNECTED		3019			Avg. Freq	2 (Hz x10	)) (	)		
Mainboard Version	0.53		3020			Inst. Freq2	2 (Hz x10	) 0			
Radio Version	2.50 (sleeping)		1001			C		101 0			
Radio Address	33272										
Corporate ID	<encrypted></encrypted>					Update	Reported	d Digital Input	Values		
Radio Mode	Sleeping		0		~						
Radio Network	0		Curren	t Progr	am Ste	ps			_		
Radio Network Group	0		Baud I	Rate	9600	) 🔻	Comm	and Timeout (	ms) 100	0 🔻	
Radio Power (dBm)	14		UART	Mode	8N1	-	Comm	and Pause (m	s) 100	-	
Checkin Interval	1 minute		+01	ID				and a local sector			
State Change Checkin	Off		Slave	ID set	ting use	ed for all M	oabus st	eps below		Run Mo	odbus
Modbus Baud Rate	9600	-	Double	e-click	a Step	to View Re	gisters			Program	Steps
	1000			#	Func	Address	Count	Status	*		
Command Timeout (Ms)	100			1	01	14	1	Unknown		Check	k All
Sensor On Time (eec)	2			2	02	22	1	Unknown	-		-1. 01
Sensor Power Mode	► HIGH			3	03	40000	5	Unknown	=	Unche	CK All
				4	04	30011	3	Unknown			
Set Encryption Key	He	Р	<b>V</b>	5	05	1	1	Unknown		Move	e Up
				6						Move	Down
Key: Freewowe	Set			7							
ney. neewave				8							
Settings				9						Incr. Ac	aress
Node Name	Set			10						Decr. A	ddress
Radio Mode Sleeping	✓ Set			11							
Radio Network	• •	ור		12					-	Dele	ete
Radio Network Group	0 v				- 10		0	from Devile		Delet	o. All
Checkin Interval 1 min	ute 👻 Set	<b>1</b>		Re	ead Cur	rent Progra	im Steps	from Device		Delet	e Mi
Slave ID*	1 Set			_	Write N	New Progra	m Steps	to Device			
Sensor On Time (sec)	2	ר	Fun	ction C	ode /	Address	Reg Co	unt Registe	er Size		
Sensor	Always On Set		(DxC	13	•	0	1	16-bit	•		
Sensor Power Mode	HIGH 🔻 Set	5				Add New F	rogram \$	Step			
2		5	_								

Figure 28: Selected Program Step with Increased Address Value

- 4. Click the **Write New Program Steps to Device** button to save the changes to the WC20i every time the Program Steps are changed.
- 5. Click the **Run Modbus Program Steps** button to run the Program Steps to poll the Modbus device on each check-in.
- 6. On the WC20i, press the **Check-in** button to apply power to the configured sensor, read the sensor values, and send the collected sensor data to the Gateway.
- 7. Verify the Gateway is communicating with the Endpoints.

**Note**: A successful connection on the WAVECONTACT Endpoint is indicated with Green blinking  $\ominus$  TX and ACT lights and a Red blinking  $\ominus$  light for RX.

If the connection is NOT successful, a Green blinking  $\ominus$  TX light appears for 10 seconds.

Page 38 of 86

Copyright © 2018 FreeWave

**FREEWAVE Recommends**: Install and configure the **WC45i** Gateway before any Endpoints to ensure the Endpoints have connectivity after installation.

- 8. Close the WC Toolkit software.
- 9. Remove the WC-USB-4PIN 4-pin to USB programming cable from the computer and the WC20i.
- 10. As applicable, replace the Endpoint cover.
- 11. Install the WC20i using the Direct Mount to Sensor with Short Conduit (on page 51).
- 12. If this is a WC20i-485-S installation, follow the tank level manufacturer's installation procedures for the selected solar mounting kit listed in Available Accessories (on page 80).

Page 39 of 86

Copyright © 2018 FreeWave

### 7.2. Create Program Steps

**Note**: A maximum of 34 program steps can be programmed.

Any response from a Modbus device (data or exception) is forwarded to the Modbus Gateway and cached.

#### Procedure

- 1. Click the **Function Code** list box arrow and select the operation code for the step. The options are:
  - **0x01** for MODBUS\_READ\_COIL (limit: 1 coil)
  - **0x02** MODBUS\_READ\_INPUT (limit: 1 input)
  - 0x03 for MODBUS\_READ\_HOLDING\_REGISTERS
  - 0x04 for MODBUS\_READ\_INPUT\_REGISTERS
  - 0x05 for MODBUS\_WRITE\_SINGLE\_COIL
- 2. In the **Address** text box, enter the Modbus Register Address of the connected Modbus device.
- 3. Depending on the Function Code list box selection, complete one of these steps:
  - In the Reg Count text box, enter the number of consecutive Modbus blocks to read or write.

Note: The **Reg Count** text box is only available if **0x03** or **0x04** is selected in the **Function Code** list box.

• In the **Coil Value** text box, enter corresponding coil ID number of the connected Modbus device.

Note: The Coil Value text box is only available if 0x05 is selected in the Function Code list box.

4. Optional: Click the **Register Size** list box arrow and select the designated register size in bits.

The **Device Configuration** window is similar to Figure 29.

Page 40 of 86

Copyright © 2018 FreeWave

ile Options S	ettings	Update	es To	ols	Help					Pas	se
			Report	ed Ser	nsor Va	lues					
COM Port: COM26		lefresh	Addre			Description		Value			
COM26 (	)pen		2010	2011		Countral	• • • • • • • • • •	Value	·		
			2012	3011		Counter1	Counts)	0			
Open Close	Of	fline	2012			Ave Erec	1/U=	» 0			
			3013			Inet Freq1	(12 × 10	, U			Ξ
Connect/U	pdate		3015			Counts/Mi	nute1 (r	, C			
Deadland	MODBUS	201	3016	3017		Counter2 (	counts)	0			
-roduct	MODBUS.	201	3018			Counter2	State	0			
Node Mame	DISCONNE	CTED	3019			Ava, Frea	2 (Hz x 10	)) 0			
Valid Connectivity	0.53		3020			Inst. Freq2	(Hz x10	) 0			
Radio Version	2.50 (sleep	ina)	1011			C		n n			-
Radio Address	33272	g/	•							•	
Corporate ID	<encrypted< td=""><td></td><td></td><td>_</td><td></td><td>Update</td><td>Reported</td><td>Digital Input Valu</td><td>Jes</td><td></td><td></td></encrypted<>			_		Update	Reported	Digital Input Valu	Jes		
Radio Mode	Sleeping										_
Radio Network	0		Current	t Progr	am Ste	ps					
Radio Network Group	0		Baud F	Rate	9600	) -	Comm	and Timeout (ms)	100	• 0	
Radio Power (dBm)	14		UART	Mode	8N1	-	Comm	and Pause (ms)	100		
Checkin Interval	1 minute		0/411	mode	UNI	•	Comm		100		
State Change Checkin	Off		*Slave	ID set	ting use	ed for all M	odbus ste	eps below		Bun Modbu	
Modbus Baud Rate	9600		Double	e-click	a Step	to View Re	gisters			Program Step	ps
Modbus UART Mode	8N1			#	Func	Address	Count	Statue			
Command Timeout (ms)	1000				01	14	- Courie	Jidius		Check All	
Command Pause (ms)	100			1	01	14	1	Unknown		CHECK /	
Sensor On Time (sec)	2			2	02	40000	5	Unknown	=	Uncheck A	. ]
Sensor Power Mode	HIGH			4	04	30011	3	Unknown			
Set Encryption Key		Help		5	05	0	1	Unknown	LU.	Move Up	
				6				C. I.			
		Set		7					-	Move Down	n
Key: freewave				8					-		
Cattinger				9					-	Incr. Addres	s]
Node Name		Set		10					-		5
				11					-	Decr. Addres	35
Radio Mode Sleeping		Set		12							
Radio Network	• 0	C-4		13					-	Delete	
Radio Network Group	0 👻	Set		Re	ead Cur	rent Progra	m Steps	from Device		Delete All	
Checkin Interval 1 min	ute 👻	Set									_
Slave ID*	1	Set			Write N	New Progra	m Steps	to Device			
Sensor On Time (sec)	2		Fund	ction C	ode /	Address	Coil Valu	Je Register Si	ize		
Sensor /	Always On	Set	0x0	5	•	0	1	16-bit	-		
Sensor Power Mode	HIGH 👻	Set		_		Add New F	rogram S	itep			
State Change Checkin	0 <del>//</del> –	Set	Exar	mole: H	loldina	Register A	ddress 40	0001 is entered as	:1		

Figure 29: Example: WC20i-485-2DI Device Configuration window with Program Steps

5. Click the Add New Program Step button to add a new Program Step to the table.

Note: If the step is valid, it is added to the **Registers** table in the next available slot.



Use the Re-order Program Steps (on page 47) procedure to change the order of the program steps in the table.

6. Click the **Write New Program Steps to Device** button to save the changes to the WC20i every time the Program Steps are changed.

LUM0093AA Rev Apr-2018

Page 41 of 86

Copyright © 2018 FreeWave

This document is the property of FreeWave Technologies, Inc. and contains proprietary information owned by FreeWave. This document cannot be reproduced in whole or in part by any means without written permission from FreeWave Technologies, Inc.

- 7. Click the **Run Modbus Program Steps** button to run the Program Steps to poll the Modbus device on each check-in.
- 8. On the WC20i, press the **Check-in** button to apply power to the configured sensor, read the sensor values, and send the collected sensor data to the Gateway.
- 9. Verify the Gateway is communicating with the Endpoints.

**Note**: A successful connection on the WAVECONTACT Endpoint is indicated with Green blinking  $\bigcirc$  TX and ACT lights and a Red blinking  $\bigcirc$  light for RX.

If the connection is NOT successful, a Green blinking  $\ominus$  TX light appears for 10 seconds.

**FREEWAVE Recommends**: Install and configure the **WC45i** Gateway before any Endpoints to ensure the Endpoints have connectivity after installation.

- 10. Close the WC Toolkit software.
- 11. Remove the WC-USB-4PIN 4-pin to USB programming cable from the computer and the WC20i.
- 12. As applicable, replace the Endpoint cover.
- 13. Install the WC20i using the Direct Mount to Sensor with Short Conduit (on page 51).
- 14. If this is a WC20i-485-S installation, follow the tank level manufacturer's installation procedures for the selected solar mounting kit listed in Available Accessories (on page 80).

## 7.3. Delete Program Steps

1. In the **Registers** table, click the check box next to the program step to delete.

ile Options	Settings	Update	es To	ols	Help					P	asse
			Repor	ted Se	nsor Va	lues					
COM Port: COM26		efresh	Adda	224		Descriptio	0	Value	<u> </u>		
COM26	Open		2010	2011		Countral	 (	0	·		-
			3010	-3011		Counter1	(Counts)	0			- 11
Open Clos	e Of	line	2012			Aug Ereg	31dte 1 /U=1/	)) O			- 11
			2013			Avg. Freq	1 (H2 X IU	), U			E
Connect/	Update		3014			Counte/M	inute1 (v	10) 0			- 11
	MODELLO		3016	.3017		Counter2	(counte)	0			- 11
Product	MODBOS		3018	5017		Counter?	State	0			
Node Name	not set	CTED	3019			Avg Freg	2 (Hz x 10	)) (j			
Nacio Connectivity	DISCONNE	CIED	3020			Inst Free2	2 (Hz x 10	) 0			
Padia Varria	0.00 2.50 (slace)	201	2021			C	- ( A - O	10\ 0			Ψ.
Padio Address	2.00 (sieep	iig)	•				11	1			P
Comorate ID	JJZ/Z					Undato	Reporter	Digital logut Valu			
Badio Mode	Sleeping					opuare	neponet	a orgital imput valu	00		
Radio Network	0		Currer	nt Progr	am Ste	ps					
Radio Network Group	0		Baud	Rate	960	-	Comm	and Timeout (ms)	1000	•	
Radio Power (dBm)	14		LIADT	Mad	000		Com	and Druge (na)	1000		
Checkin Interval	1 minute		UARI	wode	811	•	Comm	and Pause (ms)	100	•	
State Change Checkin	Off		*Slave	e ID set	ting use	ed for all M	odbus ste	eps below		Due Mar	
Modbus Baud Rate	9600		Doubl	e-click	a Step	to View Re	egisters			Program 9	Steps
Modbus UART Mode	8N1						Court	Charle and			
Command Timeout (ms)	1000			#	Func	Address	Count	Status		<b>a</b> :	A.II.
Command Pause (ms)	100			1	01	14	1	Unknown		Check	All
Sensor On Time (sec)	2			2	02	22	1	Unknown	=	Unched	k All
Sensor Power Mode	HIGH			3	03	40000	5	Unknown			
Set Encryption Key		Help		4	04	30011	3	Unknown		Move	Un
out anotypion noy				5	05	0	1	Unknown	-	Move	ορ
		Set		6						Move D	own
Key: freewaye		501		/					-		
				8					-	Incr. Adv	Iress
Settings				10					-		
Node Name		Set		10					-	Decr. Ad	dress
Radio Mode Sleeping	, •	Set		12							
Radio Network	0 -			12					-	Delet	e
Radio Network Group	0 -	Set		- 13 	and Cur	rent Proces	am Sterre	from Device		Delete	All
Checkin Interval 1 mi	nute 👻	Set		rie rie	Jau Cul	rone mogra	an oteps	nom Device		00000	
Slave ID*	1	Set			Write N	New Progra	am Steps	to Device			
Sensor On Time (sec)	2		Fun	ction C	ode	Address	Reg Co	unt Register Si	7e		
Sensor	Always On	Set	0x	03	•	0	1	16-bit	•		
Sensor Power Mode	HIGH 🔻	Set				Add New F	orogram S	Step			
					-						



- 2. Click the **Delete** button to IMMEDIATELY remove the selected Program Step from the table.
- 3. Click the **Write New Program Steps to Device** button to save the changes to the WC20i every time the Program Steps are changed.
- 4. Click the **Run Modbus Program Steps** button to run the Program Steps to poll the Modbus device on each check-in.
- 5. On the WC20i, press the **Check-in** button to apply power to the configured sensor, read the sensor values, and send the collected sensor data to the Gateway.

6. Verify the Gateway is communicating with the Endpoints.

**Note**: A successful connection on the WAVECONTACT Endpoint is indicated with Green blinking  $\ominus$  TX and ACT lights and a Red blinking  $\ominus$  light for RX. If the connection is NOT successful, a Green blinking  $\ominus$  TX light appears for 10 seconds.

**FREEWAVE Recommends**: Install and configure the **WC45i** Gateway before any Endpoints to ensure the Endpoints have connectivity after installation.

- 7. Close the WC Toolkit software.
- 8. Remove the WC-USB-4PIN 4-pin to USB programming cable from the computer and the WC20i.
- 9. As applicable, replace the Endpoint cover.
- 10. Install the WC20i using the Direct Mount to Sensor with Short Conduit (on page 51).
- 11. If this is a WC20i-485-S installation, follow the tank level manufacturer's installation procedures for the selected solar mounting kit listed in Available Accessories (on page 80).

Page 44 of 86

Copyright © 2018 FreeWave

#### 7.3.1. Delete All Program Steps

1. Click the **Check All** button to select all the current Program Steps in the table.

ile Options S	ettings	Update	es Too	ols	Help					Pa	sse
			Report	ed Ser	nsor Va	lues					
COM Port: COM26		Refresh	Addre			Description		Value			
COM26 C	Den		2010	2011		Counter1 (	·	0	-		
			2012	3011		Counter1 (	Counts)	0			
Open Close	e O	fline	2012			Ava Erect	1 /Un v 1/	)) O			
			3013			Inst Freq1	(Hz v10	) O			Ξ
Connect/U	pdate		3015			Counts/Mi	nute1 (x	) 0			
Product	MODBUS	201	3016-	3017		Counter2 (	counts)	0			
Vode Name	not set	201	3018			Counter2	State	0			
Radio Connectivity	DISCONN	ECTED	3019			Avg. Freq2	2 (Hz x 10	)) 0			
Mainboard Version	0.53		3020			Inst. Freq2	(Hz x10	) 0			_
Radio Version	2.50 (sleen	ina)	2021			C		10) 0			-
Radio Address	33272						11	1		•	
Corporate ID	<encrypted< td=""><td>d&gt;</td><td></td><td></td><td></td><td>Update</td><td>Reported</td><td>d Digital Input Valu</td><td>Jes</td><td></td><td></td></encrypted<>	d>				Update	Reported	d Digital Input Valu	Jes		
Radio Mode	Sleeping										-
Radio Network	0		Current	t Progr	am Ste	ps					
Radio Network Group	0		Baud F	Rate	9600	J 🗸	Comm	and Timeout (ms)	100	• 0	
Radio Power (dBm)	14		UART	Mode	8N1	•	Comm	and Pause (ms)	100	-	
Checkin Interval	1 minute		5		Unit	· ·			100		
State Change Checkin	Off		*Slave	ID set	ting use	ed for all Mo	odbus ste	eps below		Run Modb	us
Modbus Baud Rate	9600		Double	-click	a Step	to View Re	gisters			Program Ste	eps
Modbus UART Mode	8N1			#	Func	Address	Count	Status			
Command Timeout (ms)	1000			1	01	14	1	Upknown		Check A	
Command Pause (ms)	100			2	02	22	1	Unknown			
Sensor On Time (sec)	2			3	03	40000	5	Unknown	Ξ	Uncheck	AI
bensor Power Mode	HIGH			4	04	30011	3	Unknown			
Set Encryption Key		Help		5	05	0	1	Unknown		Move Up	)
				6							
		Set		7						Move Dov	vn
Key: freewave				8							
Settings				9						Incr. Addre	SS
Node Name	_	Set		10						Decr. Addr	
Radio Mode Sleeping	-	Set		11					_	Deci. Addie	.35
				12					_	D	_
Radio Network	• •	Set		13					*	Delete	
Radio Network Group	• 0			Be	ead Cur	rrent Progra	m Steps	from Device		Delete A	1
Checkin Interval 1 min	ute 👻	Set									
Slave ID*	1	Set			Write N	New Progra	m Steps	to Device			
Sensor On Time (sec)	2		Fund	tion C	ode	Address	Reg Co	unt Register S	ize		
Sensor /	Always On	Set	0x0	3	•	0	1	16-bit	•		
Sensor Power Mode	HIGH 🔻	Set				Add New P	rogram S	Step			
State Change Checkin	Off 👻	Set	Exar	nole: H	loldina	Register A	ddress 4	0001 is entered as	1		

Figure 31: All Program Step Selected in the WC20i-485-2DI Device Configuration window

- 2. Click the **Delete All** button to IMMEDIATELY remove all selected Program Steps from the table.
- 3. Click the **Write New Program Steps to Device** button to save the changes to the WC20i every time the Program Steps are changed.
- 4. Click the **Run Modbus Program Steps** button to run the Program Steps to poll the Modbus device on each check-in.
- 5. On the WC20i, press the **Check-in** button to apply power to the configured sensor, read the sensor values, and send the collected sensor data to the Gateway.

FreeWave Technologies, Inc.

6. Verify the Gateway is communicating with the Endpoints.

**Note**: A successful connection on the WAVECONTACT Endpoint is indicated with Green blinking  $\ominus$  TX and ACT lights and a Red blinking  $\ominus$  light for RX. If the connection is NOT successful, a Green blinking  $\ominus$  TX light appears for 10 seconds.

**FREEWAVE Recommends**: Install and configure the **WC45i** Gateway before any Endpoints to ensure the Endpoints have connectivity after installation.

- 7. Close the WC Toolkit software.
- 8. Remove the WC-USB-4PIN 4-pin to USB programming cable from the computer and the WC20i.
- 9. As applicable, replace the Endpoint cover.
- 10. Install the WC20i using the Direct Mount to Sensor with Short Conduit (on page 51).
- 11. If this is a WC20i-485-S installation, follow the tank level manufacturer's installation procedures for the selected solar mounting kit listed in Available Accessories (on page 80).

Page 46 of 86

Copyright © 2018 FreeWave

## 7.4. Re-order Program Steps

1. In the **Registers** table, click the check box next to the program step to move.

ile Options S	ettings	Update	es Too	ols	Help					Р	asse
			Report	ed Ser	nsor Va	lues					
COM Port: COM26		Refresh	Addre	ss		Description	n	Valu	ie.		
COM26 C	pen		2010	2011		Counter1	(oourte)	0			
			2010-	3011		Counter1	counts) State	0			
Open Close	0	fline	2012			Ava Emer	Jidie 1 /H₂ ∪ 1/	)) O			
			3013			Inst Freq	(Hz v 10	, U			E
Connect/U	pdate		3014			Counts/Mi	inute1 fx	, U			
Desident	MODBUS	201	3016-	3017		Counter?	(counts)	0			
Produčt Nada Nama	INIODBUS	201	3018			Counter2	State	0			
Radio Connectivity	DISCONN		3019			Avg. Fread	2 (Hz x 10	)) 0			
Mainboard Version	0.53		3020			Inst. Frea2	(Hz x10	) 0			
Radio Version	2.50 (elecer	ina)	2021			C		10\ 0			*
Radio Address	23272	y/	•				11	ſ			•
Comorate ID	<encrypter< td=""><td>15</td><td></td><td></td><td></td><td>Undate</td><td>Reporter</td><td>l Digital Input Val</td><td>lies</td><td></td><td>_</td></encrypter<>	15				Undate	Reporter	l Digital Input Val	lies		_
Radio Mode	Sleeping					opuate	. ioponet	a orgital impat val			
Radio Network	0		Current	Progr	am Step	ps					
Radio Network Group	0		Baud P	Rate	9600	-	Comm	and Timeout (ms)	100	•	
Radio Power (dBm)	14		LIART	Mode	ONIT		Comm	and Pause (ma)	100		
Checkin Interval	1 minute		UART	Mode	OIN I	•	Comm	anu rause (ms)	100	•	
State Change Checkin	Off		*Slave	ID set	ting use	ed for all M	odbus ste	eps below		Bun Mar	lhue
Modbus Baud Rate	9600		Double	-click	a Step	to View Re	gisters			Program S	Steps
Modbus UART Mode	8N1			#	Euro	Address	Count	Charture			•
Command Timeout (ms)	1000			#	runc	Audress	Count	JIdlus	_	Charle	All
Command Pause (ms)	100			1	01	14	1	Unknown		Check	All
Sensor On Time (sec)	2			2	02	22	1	Unknown	=	Unchec	k Al
Sensor Power Mode	HIGH			3	03	40000	2	Unknown			
Set Encryption Key		Help		4	05	30011	3	Unknown		Move	Jo
				5	00	0	1	UNKNOWN	_		-12
		Set		7					-	Move D	own
Key: freewave				8					-		
				9					-	Incr. Add	ress
Settings				10					-		
Node Name		Set		11					-	Decr. Add	dress
Radio Mode Sleeping	-	Set		12							
Radio Network	0 👻			13					-	Delet	е
Radio Network Group	) –	Set		Re	ad Cur	rent Progra	m Steps	from Device		Delete	All
Checkin Interval 1 min	ute 👻	Set									
Slave ID*	1	Set			Write N	New Progra	m Steps	to Device			
Sensor On Time (sec)	2		Fund	tion C	ode /	Address	Reg Co	unt Register S	lize		
Sensor	Wways On	Set	0x0	3	•	0	1	16-bit	•		
Sensor Power Mode	HIGH 🔻	Set				Add New F	rogram S	itep			
State Change Checkin	Off 👻	Set	Exan	nple: H	lolding	Register A	ddress 4	0001 is entered a	s 1		

#### Figure 32: Selected Program Step in the WC20i-485-2DI Device Configuration window

- 2. Click the **Move Up** button to move a selected Program Step up in the program to its new location.
- 3. Click the **Move Down** button to move a selected Program Step down in the program to its new location.

LUM0093AA Rev Apr-2018

Page 47 of 86

Copyright © 2018 FreeWave

				0.0	neth						400
COM But COOMOD			Report	ed Ser	nsor Va	lues					
COM Port: COM26	- Refres	h	Addre	ess		Description	n		Value		
COM26 C	Open		3010	3011		Counter1	(counts)		0		
			3012			Counter1	State		0		
Open Close	Ottline		3013			Avg. Freg	1 (Hz x10	))	0		
_			3014			Inst. Freq1	(Hz x10	)	0		Ξ
Connect/L	lpdate		3015			Counts/Mi	inute1 (x	10)	0		
Product	MODBUS 2DI		3016	3017		Counter2	(counts)		0		
Node Name	not set		3018			Counter2	State		0		
Radio Connectivity	DISCONNECTE	D	3019			Avg. Freq2	2 (Hz x 10	))	0		
Mainboard Version	0.53		3020			Inst. Freq2	2 (Hz x10	)	0		
Radio Version	2.50 (sleeping)		1001			C /M		10)	^		
Radio Address	33272										
Corporate ID	<encrypted></encrypted>					Update	Reported	d Digital Input	Values		
Radio Mode	Sleeping		~		~						
Radio Network	0		Curren	t Progr	am Ste	ps			_		
Radio Network Group	0		Baud	Rate	9600	) –	Comm	and Timeout	(ms) 100	• 00	
Radio Power (dBm)	14		UART	Mode	8N1	-	Comm	and Pause (n	ns) 100	) 🔹	
Checkin Interval	1 minute					10					
State Change Checkin	Off		-Slave	ID set	ting use	ed for all M	odbus st	eps below		Run Mo	dbus
Modbus Baud Rate	9600		Double	e-click	a Step	to View Re	gisters			Program	Steps
Modbus UART Mode	8N1			#	Func	Address	Count	Status	*		
Command Timeout (ms)	1000			1	01	14	1	Unknown		Check	c All
Command Pause (ms)	2			2	02	22	1	Unknown			
Sensor On Time (SEC)	4 HIGH	_		3	03	40000	5	Unknown	E	Unched	ck All
School Tower Mode			<b>V</b>	4	05	0	1	Unknown			
Set Encryption Key	Н	elp		5	04	30011	3	Unknown		Move	Up
				6						Move	Jown
Kou Fragment	Se	st		7						Movel	20mil
Ney. neewave				8							
Settings		_		9						Incr. Ad	aress
Node Name	Se	at		10						Decr. Ad	dress
Radio Mode Sleeping	▼ Se	at		11							-
Radio Network	0 -			12					-	Dele	te
Radio Network Group	0 <del>•</del> Se	et				ment Des	- Charge	from Devices		Deloto	- ΔII
Checkin Interval 1 min	ute 👻 Se	et		r(e	au Cui	rent Progra	in steps	nom Device		Delete	
Slave ID*	1 Se	at			Write N	New Progra	m Steps	to Device			
Sensor On Time (sec)	2		Fun	ction C	ode	Address	Reg Co	unt Regis	ter Size		
Sensor	Always On Se	et	(Def	13	•	0	1	16-bi	• •		
Sensor Power Mode	HIGH V	et l				- Add New P	maram	Sten	•••	l	
State Change Checkin		-		malari	Joldio -	Desister A	ddroon 4	0001 in onter-	nd na 1	J	

Figure 33: Selected Program Step Moved Up

- 4. Click the **Write New Program Steps to Device** button to save the changes to the WC20i every time the Program Steps are changed.
- 5. Click the **Run Modbus Program Steps** button to run the Program Steps to poll the Modbus device on each check-in.
- 6. On the WC20i, press the **Check-in** button to apply power to the configured sensor, read the sensor values, and send the collected sensor data to the Gateway.
- 7. Verify the Gateway is communicating with the Endpoints.

**Note**: A successful connection on the WAVECONTACT Endpoint is indicated with Green blinking  $\ominus$  TX and ACT lights and a Red blinking  $\ominus$  light for RX.

If the connection is NOT successful, a Green blinking  $\bigcirc$  TX light appears for 10 seconds.

Page 48 of 86

Copyright © 2018 FreeWave

**FREEWAVE Recommends**: Install and configure the **WC45i** Gateway before any Endpoints to ensure the Endpoints have connectivity after installation.

- 8. Close the WC Toolkit software.
- 9. Remove the WC-USB-4PIN 4-pin to USB programming cable from the computer and the WC20i.
- 10. As applicable, replace the Endpoint cover.
- 11. Install the WC20i using the Direct Mount to Sensor with Short Conduit (on page 51).
- 12. If this is a WC20i-485-S installation, follow the tank level manufacturer's installation procedures for the selected solar mounting kit listed in Available Accessories (on page 80).

Page 49 of 86

Copyright © 2018 FreeWave

# 8. Mounting, Battery Replacement, Cleaning

- The WC20i:
  - comes with a watertight 1/2" NPT female conduit fitting on the bottom mounting plate.
  - is directly mounted to the sensor with a short section of conduit.
- Direct Mount to Sensor with Short Conduit (on page 51)
- Internal Lithium Battery Replacement (on page 52)
- Cleaning Instructions (on page 53)

Note: See Available Accessories (on page 80) for additional equipment.

Page 50 of 86

Copyright © 2018 FreeWave

## 8.1. Direct Mount to Sensor with Short Conduit

This mounting method uses a short conduit run from the sensor and the unit is held in place by the conduit.



Figure 34: WC20i-485 or WC20i-485-S Modular Endpoint Direct Mount

Page 51 of 86

Copyright © 2018 FreeWave

#### 8.2. Internal Lithium Battery Replacement

**Warning!** Use of any battery other than the WAVECONTACT Internal Lithium Battery Pack (FreeWave Part # WC-3BAT-IS) will impair the protection provided by the equipment. **AVERTISSEMENT**: L'utilisation d'une pile autre que la référence WAVECONTACT Internal Lithium Battery Pack (FreeWave Part # WC-3BAT-IS compromettra la protection fournie par l'équipement.

**Note**: See Available Accessories (on page 80) for the FreeWave Part # to order the correct replacement battery.

**Warning!** If the Internal Lithium Battery Pack is installed, the External Solar Battery system or other power source **MUST NOT BE** connected!

**Note**: Battery Packs can be changed with the Endpoint in place.

1. Using the Philips screwdriver, remove the four screws holding down the WC20i cover and remove the cover.



Use the WC20i cover to hold the four screws while configuring the WC20i or when connecting or replacing the battery.

- 2. Depress the locking clip on the **Internal Lithium Battery** connection and unplug the battery from the PCB.
- 3. Loosen the screw holding the battery door and slide the old battery out.
- 4. Slide in the new battery pack and tighten the battery door screw.
- 5. Connect the battery to the PCB battery connector.
- 6. Place the cover back on the WC20i.
- 7. Tighten the cover of the WC20i with the four screws removed in Step 1.

Page 52 of 86

Copyright © 2018 FreeWave

This document is the property of FreeWave Technologies, Inc. and contains proprietary information owned by FreeWave. This document cannot be reproduced in whole or in part by any means without written permission from FreeWave Technologies, Inc.

#### 8.3. Cleaning Instructions

The outside of the enclosure may be cleaned with water, mild soap, and a damp cloth as needed.

**Caution**: High pressure washing is NOT recommended.

#### Warning! Electrostatic Discharge Hazard!

Care must be taken to avoid the potential of creating a change on the enclosure or antenna. Do NOT wipe with a dry cloth.



Do NOT brush against the enclosure with clothing or gloves. **AVERTISSEMENT**: Risque de décharge électrostatique! Il faut veiller à éviter tout risque de changement de l'enceinte ou de l'antenne.

Ne pas essuyer avec un chiffon sec.

Ne pas brosser contre l'enceinte avec des vêtements ou des gants.

Page 53 of 86

Copyright © 2018 FreeWave

# 9. Remote Modbus Registers - 485 Modbus

The WC20i sends data to a WC45i-Gateway.

Every check-in period, the sensors are read and data is sent to the Gateway. The Gateway saves the data under the set Modbus ID in 16-bit registers.

- The data sent to the Gateway is available at the Gateway in registers where it is read by a Modbus RTU master device.
- The Endpoint must have a unique (to the network it is in) Modbus Slave ID.
  - The Gateway uses this Slave ID to store its unique data.

Note: The terms node and Endpoint are used interchangeably in this document.

## 9.1. Status Registers

**Important!**: The Status Registers are only available from the 49988-499999 (9987-9998) address range.

Modbus - WC20i-485 / WC20i-485-S Status Registers									
Register Number	Register Address (Offset)	Description							
49988	9987 or 65524	Major revision number for the mainboard.							
49989	9988 or 65525	Minor revision number for the mainboard.							
49990	9989 or 65526	Major revision number for the radio.							
49991	9990 or 65527	Minor revision number for the radio.							

LUM0093AA Rev Apr-2018

Page 54 of 86

Copyright © 2018 FreeWave

Modbus - WC20i-485 / W	C20i-485-S Status Re	egisters
Register Number	Register Address (Offset)	Description
49992	9991 or 65528	High 16-bits of the WC20i Endpoint address.
49993	9992 or 65529	Low 16-bits of the WC20i Endpoint address (the radio ID).
49994	9993 or 65530	Slave ID read back.
49995	9994 or 65531	Received signal strength of the last packet from the slave.
49996	9995 or 65532	Battery voltage (in millivolts) of the Modbus client.
49997	9996 or 65533	Minutes until this slave will time out unless new data is received.
49998	9997 or 65534	Number of registers cached for this slave device.
49999	9998 or 65535	Remote device type.
		• 45 for the WC20i-485 or WC20i-485-S

Page 55 of 86

Copyright © 2018 FreeWave

# 10. WC Toolkit Software Environment

The WC Toolkit software environment uses these windows to configure all WAVECONTACT devices:

• Device Configuration window (on page 57)

Page 56 of 86

Copyright © 2018 FreeWave

#### 10.1. Device Configuration window

The **Device Configuration** window is used to configure the settings on the WC20i-485 or WC20i-485-S Modular Endpoint.

#### Access and Window Description

1. Verify the WC Toolkit software is installed on the computer connected to the WC20i.

Note: See WC Toolkit Installation (on page 18) and WC Toolkit Update (on page 25).

- 2. Verify the Gateway is installed and configured before continuing with the Endpoint configuration.
- 3. Connect the WC-USB-4PIN 4-pin to USB programming cable to the computer and the WC20i.
- Open the WC Toolkit software. The Select Device window opens. (Figure 35)

O FreeWave WC Toolkit v	
File Options Updates Tools	Help
COM Port: COM   Refresh Auto-Detect COM : Success	FREEWAVE
Auto-Detect Device on COM Port	Customer Login: None
Select Device	
WC45i-Gateway	Open Device Window

Figure 35: Select Device window

- 3. Click the **Refresh** button to have WC Toolkit search for and list the available COM ports reported by Windows and connected devices in the **COM Port** list box.
- 4. Click the **COM Port** list box arrow and select the COM port on the computer associated with the connected WC20i-485 or WC20-485-S.
- 5. Click the **Auto-Detect Device on COM Port** button to have WC Toolkit connect the device to the COM Port selected in the **COM Port** list box.

Note: Optional: Click the Select Device list box arrow and select the connected device.

The Device Configuration window opens for the selected device.

LUM0093AA Rev Apr-2018

Page 57 of 86

Copyright © 2018 FreeWave



Figure 36: Device Configuration window: WC20i-485 or WC20i-485-S

Device Configu	ration window: W	/C20i-485 or WC20i-485-S
Control Area	Control Title	Control Description
1 - Status of Last Operation text box		The <b>Status of Last Operation</b> text box indicates whether the last command from the WC Toolkit to the connected device is <b>Active</b> or has <b>Passed</b> .
		<b>Note</b> : A <b>Firmware Update Available</b> message appears in this text box when the WC Toolkit has detected that a newer version of firmware is available for download than what is installed on the device.
		Note: This information is read-only.

LUM0093AA Rev Apr-2018

Page 58 of 86

Copyright © 2018 FreeWave

Device Configu	iration window: W	/C20i-485 or WC20i-485-S
Control Area	Control Title	Control Description
2 - Serial Port Settings area		The <b>Serial Port Settings</b> area shows the connected COM port and is used to re-connect to the COM port if the connection is lost.
2 - Serial Port Settings area	COM Port list box	Click the <b>COM Port</b> list box arrow and select the COM port on the computer associated with the connected WC20i-485 or WC20-485-S.
2 - Serial Port Settings area	Refresh button	Click the <b>Refresh</b> button to have WC Toolkit search for and list the available COM ports reported by Windows and connected devices in the <b>COM Port</b> list box.
2 - Serial Port Settings area	COM text box	The <b>COM</b> text box shows the COM port the WAVECONTACT device is connected to.
		Note: This information is read-only.
2 - Serial Port Settings area	Open button	Click the <b>Open</b> button to re-connect the WAVECONTACT device to the COM port.
2 - Serial Port Settings area	Close button	Click the <b>Close</b> button to disconnect the WAVECONTACT device from the COM port.
2 - Serial Port Settings area	Offline button	Click the <b>Offline</b> button to disconnect the WAVECONTACT device from the COM port but continue to configure the device offline.
2 - Serial Port Settings area	Connect / Update button	Click the <b>Connect / Update</b> button to re-connect to the COM port of the WAVECONTACT device.
		<b>Note</b> : When the connection is made to the IP Address, full access to the Gateway is available as if a direct serial connection is used. This includes full remote configuration capability.
3 - <b>Reported</b> Values area		The <b>Reported Values</b> area shows the reported data values from the attached sensor.
		Note: This information is read-only.
3 - Current Program Stops		The <b>Current Program Steps</b> area is used to define the Modbus operation codes for each poll check-in.
Jicha		<b>Note</b> : See the Current Program Steps area (on page 63) for detailed information about the settings.

LUM0093AA Rev Apr-2018

Page 59 of 86

Copyright © 2018 FreeWave

Device Configu	Device Configuration window: WC20i-485 or WC20i-485-S								
Control Area	Control Title	Control Description							
4 - Information area		The Information area of the Device Configuration window shows connection information about the connected WAVECONTACT device.           Note: This information is read-only.							
5 - <b>Set</b> Encryption Key area		The <b>Set Encryption Key</b> area is used to activate and define the encryption key for the WAVECONTACT device.							
5 - <b>Set</b> Encryption Key area	Help button	Click to open the Encryption <b>Help</b> message.							
5 - <b>Set</b> Encryption Key area	<b>Key</b> text box	In the <b>Key</b> text box, enter the encryption key for the device using 6 to 16 characters.           Important!: A Key CANNOT contain spaces or angle brackets.           The Gateway and Endpoints only communicate if they							
5 - Set Encryption Key area	Set button	Click the <b>Set</b> button to save the information.							
6 - <b>Settings</b> area		The <b>Settings</b> area is used to define the radio mode and radio network.           Note: See the Settings area (on page 60) for detailed information about the settings.							

#### 10.1.1. Settings area

The **Settings** area is used to define the radio mode and radio network.

Device Configuration window: Settings area							
Control Title	Control Description						
Set button	Click the Set button to save the information.						
Node Name text box	Optional: In the <b>Node Name</b> text box, enter a name for the Endpoint using a maximum of 10 characters.						

LUM0093AA Rev Apr-2018

Page 60 of 86

Copyright © 2018 FreeWave

Device Configuration window: Settings area								
Control Title	Control Description							
Radio Mode list box	Click the <b>Radio Mode</b> list box arrow and select either <b>Sleeping</b> or <b>Non-Sleeping</b> .							
	<ul> <li>Sleeping: Select Sleeping to reduce power consumption and to use the designated Checkin Interval list box to connect with the Gateway.</li> </ul>							
	<ul> <li>Non-Sleeping: Select Non-Sleeping to always be in communication with the Gateway.</li> </ul>							
	Non-Sleeping devices automatically act as Mesh Endpoint / Repeaters between other Endpoints and the Gateway.							
	Note: The default value is Sleeping.							
Radio Network list box	Click the <b>Radio Network</b> list box arrow and select 0 (zero) to 7 for the assigned number.							
	Note: The default value is 1.							
	Important!: The Radio Network and Radio Network Group settings are selected by the user but MUST MATCH the existing Gateway network for successful communication between the Gateway and Endpoint. See WAVECONTACT Network Frequencies (on page 66) for additional information.							
Radio Network Group list box	Click the <b>Radio Network Group</b> list box arrow and select 0 (zero) to 29 for the network group assigned number.							
	Note: The default value is 10.							
	Important!: The Radio Network and Radio Network Group settings are selected by the user but MUST MATCH the existing Gateway network for successful communication between the Gateway and Endpoint. See WAVECONTACT Network Frequencies (on page 66) for additional information.							

Page 61 of 86

Copyright © 2018 FreeWave

Device Configur	ation window: Settings area					
Control Title	Control Description					
Checkin Interval list box	Click the Checkin Interval list box arrow and select how often the Endpoint wakes up, reads the sensor values Modbus device, and transmits the register data to the Gateway. The options are: • 5 seconds • 15 seconds • 10 minutes • 15 minutes • 2 minutes • 4.5 minutes Note: The default value is 5 seconds.					
Sensor On Time (sec) text box	In the <b>Sensor On time (sec)</b> text box, enter the number of seconds power is applied to the Modbus sensor prior to data collection.  FREEWAVE Recommends: Accept the default Sensor On time (sec) value of 2 seconds for most devices. However, radar sensors often require a longer warm-up time. Contact the sensor manufacturer for details.					
Sensor Always On check box	Select the <b>Sensor Always On</b> check box to make the sensor always have power no matter what type of power source is connected to the device. <b>Note</b> : Having the <b>Sensor Always On</b> selected is useful for rapid data collection on a sensor that has a long warm-up time. However, it will shorten the battery life <b>dramatically</b> unless a <b>Solar</b> <b>Powered WC20i</b> is used.					
Sensor Power Mode list box	Click the <b>Sensor Power Mode</b> list box arrow and select either HIGH or LOW volts for the WC20i.           Note: HIGH outputs 18.5 volts to the sensor and LOW outputs 12.5 volts.           LOW results in longer battery life but some sensors require a higher voltage.					

Page 62 of 86

Copyright © 2018 FreeWave

#### 10.1.2. Current Program Steps area

Device Configuration window: Current Program Steps area								
Control Area	Control Title	Control Description						
3 - Current Program Steps		The <b>Current Program Steps</b> area is used to define the Modbus operation codes for each poll check-in.						
3 - Current Program Steps	Baud Rate list box	Click the <b>Baud Rate</b> list box arrow and select the baud rate for the RS485 Modbus port.						
3 - Current Program Steps	UART Mode list box	Click the <b>UART Mode</b> list box arrow and select the number of data bits, parity, and stop bits used with the RS485 Modbus port.						
3 - Current Program Steps	Command Timeout (ms) list box	Click the <b>Command Timeout (ms)</b> list box arrow and select the number of mS the device waits for a response from the attached Modbus device before it times out the request. The options are: 500						
3 - Current Program Steps	Command Pause (ms) list box	Click the <b>Command Pause (ms)</b> list box arrow and select the number of mS the device pauses between each Modbus transaction. The options are: • 50 • 100 • 150 • 200 • 250						
3 - Current Program Steps	Slave ID text box	In the <b>Slave ID</b> column / text box, enter the remote source Endpoint Modbus Slave ID. Important!: Verify there are no duplicate Slave IDs in a given network. The Gateway only caches one set of data for each Slave ID. A duplicate is overwritten.						
3 - Current Program Steps	Registers table	The <b>Registers</b> table shows the available Program Steps of the connected Modbus device.						
3 - Current Program Steps	Run Modbus Program Steps button	Click the <b>Run Modbus Program Steps</b> button to run the Program Steps to poll the Modbus device on each check-in.						

LUM0093AA Rev Apr-2018

Page 63 of 86

Copyright © 2018 FreeWave

Device Configur	Device Configuration window: Current Program Steps area							
Control Area	Control Title	Control Description						
3 - Current Program Steps	Check All button	Click the <b>Check All</b> button to select all the current Program Steps in the table.						
3 - Current Program Steps	Uncheck All button	Click the <b>Uncheck All</b> button to clear all of the selected Program Steps in the table.						
3 - Current Program Steps	Move Up button	Click the <b>Move Up</b> button to move a selected Program Step up in the program to its new location.						
3 - Current Program Steps	Move Down button	Click the <b>Move Down</b> button to move a selected Program Step down in the program to its new location.						
3 - Current Program Steps	Incr. Address button	Click the <b>Incr. Address</b> button to increase the address value of the selected Program Step.						
3 - Current Program Steps	Decr. Address button	Click the <b>Decr. Address</b> button to decrease the address value of the selected Program Step.						
3 - Current Program Steps	Delete button	Click the <b>Delete</b> button to IMMEDIATELY remove the selected Program Step from the table.						
3 - Current Program Steps	Delete All button	Click the <b>Delete All</b> button to IMMEDIATELY remove all selected Program Steps from the table.						
3 - Current Program Steps	Read Current Program Steps from Device button	Click the <b>Read Current Program Steps from Device</b> button to view the current Program Steps in the table.						
3 - Current Program Steps	Write New Program Steps to Device button	Click the <b>Write New Program Steps to Device</b> button to save the changes to the WC20i every time the Program Steps are changed.						
3 - Current Program Steps	Function Code list box	Click the Function Code list box arrow and select the operation code for the step. The options are: • 0x01 for MODBUS_READ_COIL (limit: 1 coil) • 0x02 MODBUS_READ_INPUT (limit: 1 input) • 0x03 for MODBUS_READ_HOLDING_REGISTERS • 0x04 for MODBUS_READ_INPUT_REGISTERS • 0x05 for MODBUS_WRITE_SINGLE_COIL						
3 - Current Program Steps	Address text box	In the <b>Address</b> text box, enter the Modbus Register Address of the connected Modbus device.						
3 - Current Program Steps	Coil Count text box	Note: The Coil Count text box is only visible when 0x01 is selected in the Function Code list box. The default value is 1. This information is read-only.						

LUM0093AA Rev Apr-2018

Page 64 of 86

Copyright © 2018 FreeWave

Device Configuration window: Current Program Steps area							
Control Area	Control Title	Control Description					
3 - Current Program Steps	Input Count text box	Note: The Input Count text box is only visible when 0x02 is selected in the Function Code list box. The default value is 1. This information is read-only.					
3 - Current Program Steps	Reg Count text box	In the <b>Reg Count</b> text box, enter the number of consecutive Modbus blocks to read or write.					
		Note: The <b>Reg Count</b> text box is only available if 0x03 or 0x04 is selected in the <b>Function Code</b> list box.					
3 - Current Program Steps	Coil Value text box	In the <b>Coil Value</b> text box, enter corresponding coil ID number of the connected Modbus device.					
		<b>Note</b> : The <b>Coil Value</b> text box is only available if <b>0x05</b> is selected in the <b>Function Code</b> list box.					
3 - Current Program Steps	Register Size list box	Click the <b>Register Size</b> list box arrow and select the designated register size in bits. The default value is 16-bit.					
		Note: The <b>Register Size</b> list box is only available if <b>0x03</b> or <b>0x04</b> is selected in the <b>Function Code</b> list box.					
3 - Current Program Steps	Add New Program Step button	Click the <b>Add New Program Step</b> button to add a new Program Step to the table.					

Page 65 of 86

Copyright © 2018 FreeWave

# **11. WAVECONTACT Network Frequencies**

The frequencies used by the WAVECONTACT network vary depending on the **Radio Network** and **Radio Network Group** selected in the Device Configuration window (on page 57).

**Example**: Using the Radio Network Group Selection: 0, 1, 2, or 3 (on page 67) table, the Radio Network and Radio Network Group settings of 0 (zero) and 0 (zero) (respectively) uses the frequencies between 908.20 and 918.20. The Radio Network and Radio Network Group settings of 0 (zero) and 2 (respectively) uses 905.00 to 915.00.

- Radio Network Group Selection: 0, 1, 2, or 3 (on page 67)
- Radio Network Group Selection: 4, 5, 6, or 7 (on page 68)
- Radio Network Group Selection: 8, 9, 10, 11 (on page 69)
- Radio Network Group Selection: 12, 13, 14, 15 (on page 70)
- Radio Network Group Selection: 16, 17, 18, or 19 (on page 71)
- Radio Network Group Selection: 20, 21, 22, 23 (on page 72)
- Radio Network Group Selection: 28 or 29 (on page 74)

LUM0093AA Rev Apr-2018

### 11.1. Radio Network Group Selection: 0, 1, 2, or 3

In the Device Configuration window (on page 57), these are the **High** and **Low Frequencies** when the **Radio Network Group** list box selection is 0, 1, 2, or 3.

Radio Network selection	Radio Network Group selection: 0 or 1	Low Frequency	High Frequency	Radio Network selection	Radio Network Group selection: 2 or 3	Low Frequency	High Frequency
0	0	908.20	918.20	0	2	905.00	915.00
1	0	908.40	918.40	1	2	905.20	915.20
2	0	908.60	918.60	2	2	905.40	915.40
3	0	908.80	918.80	3	2	905.60	915.60
4	0	909.00	919.00	4	2	905.80	915.80
5	0	909.20	919.20	5	2	906.00	916.00
6	0	909.40	919.40	6	2	906.20	916.20
7	0	909.60	919.60	7	2	906.40	916.40
0	1	909.80	919.80	0	3	906.60	916.60
1	1	910.00	920.00	1	3	906.80	916.80
2	1	910.20	920.20	2	3	907.00	917.00
3	1	910.40	920.40	3	3	907.20	917.20
4	1	910.60	920.60	4	3	907.40	917.40
5	1	910.80	920.80	5	3	907.60	917.60
6	1	911.00	921.00	6	3	907.80	917.80
7	1	911.20	921.20	7	3	908.00	918.00

Page 67 of 86

## 11.2. Radio Network Group Selection: 4, 5, 6, or 7

In the Device Configuration window (on page 57), these are the **High** and **Low Frequencies** when the **Radio Network Group** list box selection is 4, 5, 6, or 7.

Radio Network selection	Radio Network Group selection: 4 or 5	Low Frequency	High Frequency	Radio Network selection	Radio Network Group selection: 6 or 7	Low Frequency	High Frequency
0	4	908.20	918.20	0	6	905.00	915.00
1	4	908.40	918.40	1	6	905.20	915.20
2	4	908.60	918.60	2	6	905.40	915.40
3	4	908.80	918.80	3	6	905.60	915.60
4	4	909.00	919.00	4	6	905.80	915.80
5	4	909.20	919.20	5	6	906.00	916.00
6	4	909.40	919.40	6	6	906.20	916.20
7	4	909.60	919.60	7	6	906.40	916.40
0	5	909.80	919.80	0	7	906.60	916.60
1	5	910.00	920.00	1	7	906.80	916.80
2	5	910.20	920.20	2	7	907.00	917.00
3	5	910.40	920.40	3	7	907.20	917.20
4	5	910.60	920.60	4	7	907.40	917.40
5	5	910.80	920.80	5	7	907.60	917.60
6	5	911.00	921.00	6	7	907.80	917.80
7	5	911.20	921.20	7	7	908.00	918.00

Copyright © 2018 FreeWave

This document is the property of FreeWave Technologies, Inc. and contains proprietary information owned by FreeWave. This document cannot be reproduced in whole or in part by any means without written permission from FreeWave Technologies, Inc.

Page 68 of 86

## 11.3. Radio Network Group Selection: 8, 9, 10, 11

In the Device Configuration window (on page 57), these are the **High** and **Low Frequencies** when the **Radio Network Group** list box selection is 8, 9, 10, or 11.

Radio Network selection	Radio Network Group selection: 8 or 9	Low Frequency	High Frequency	Radio Network selection	Radio Network Group selection: 10 or 11	Low Frequency	High Frequency
0	8	908.20	918.20	0	10	905.00	915.00
1	8	908.40	918.40	1	10	905.20	915.20
2	8	908.60	918.60	2	10	905.40	915.40
3	8	908.80	918.80	3	10	905.60	915.60
4	8	909.00	919.00	4	10	905.80	915.80
5	8	909.20	919.20	5	10	906.00	916.00
6	8	909.40	919.40	6	10	906.20	916.20
7	8	909.60	919.60	7	10	906.40	916.40
0	9	909.80	919.80	0	11	906.60	916.60
1	9	910.00	920.00	1	11	906.80	916.80
2	9	910.20	920.20	2	11	907.00	917.00
3	9	910.40	920.40	3	11	907.20	917.20
4	9	910.60	920.60	4	11	907.40	917.40
5	9	910.80	920.80	5	11	907.60	917.60
6	9	911.00	921.00	6	11	907.80	917.80
7	9	911.20	921.20	7	11	908.00	918.00

Page 69 of 86

LUM0093AA Rev Apr-2018

#### 11.4. Radio Network Group Selection: 12, 13, 14, 15

In the Device Configuration window (on page 57), these are the **High** and **Low Frequencies** when the **Radio Network Group** list box selection is 12, 13, 14, or 15.

Radio Network selection	Radio Network Group selection: 12 or 13	Low Frequency	High Frequency	Radio Network selection	Radio Network Group selection: 14 or 15	Low Frequency	High Frequency
0	12	908.20	918.20	0	14	905.00	915.00
1	12	908.40	918.40	1	14	905.20	915.20
2	12	908.60	918.60	2	14	905.40	915.40
3	12	908.80	918.80	3	14	905.60	915.60
4	12	909.00	919.00	4	14	905.80	915.80
5	12	909.20	919.20	5	14	906.00	916.00
6	12	909.40	919.40	6	14	906.20	916.20
7	12	909.60	919.60	7	14	906.40	916.40
0	13	909.80	919.80	0	15	906.60	916.60
1	13	910.00	920.00	1	15	906.80	916.80
2	13	910.20	920.20	2	15	907.00	917.00
3	13	910.40	920.40	3	15	907.20	917.20
4	13	910.60	920.60	4	15	907.40	917.40
5	13	910.80	920.80	5	15	907.60	917.60
6	13	911.00	921.00	6	15	907.80	917.80
7	13	911.20	921.20	7	15	908.00	918.00

#### 11.5. Radio Network Group Selection: 16, 17, 18, or 19

In the Device Configuration window (on page 57), these are the **High** and **Low Frequencies** when the **Radio Network Group** list box selection is 16, 17, 18, or 19.

Radio Network selection	Radio Network Group selection: 16 or 17	Low Frequency	High Frequency	Radio Network selection	Radio Network Group selection: 18 or 19	Low Frequency	High Frequency
0	16	908.20	918.20	0	18	905.00	915.00
1	16	908.40	918.40	1	18	905.20	915.20
2	16	908.60	918.60	2	18	905.40	915.40
3	16	908.80	918.80	3	18	905.60	915.60
4	16	909.00	919.00	4	18	905.80	915.80
5	16	909.20	919.20	5	18	906.00	916.00
6	16	909.40	919.40	6	18	906.20	916.20
7	16	909.60	919.60	7	18	906.40	916.40
0	17	909.80	919.80	0	19	906.60	916.60
1	17	910.00	920.00	1	19	906.80	916.80
2	17	910.20	920.20	2	19	907.00	917.00
3	17	910.40	920.40	3	19	907.20	917.20
4	17	910.60	920.60	4	19	907.40	917.40
5	17	910.80	920.80	5	19	907.60	917.60
6	17	911.00	921.00	6	19	907.80	917.80
7	17	911.20	921.20	7	19	908.00	918.00

#### 11.6. Radio Network Group Selection: 20, 21, 22, 23

In the Device Configuration window (on page 57), these are the **High** and **Low Frequencies** when the **Radio Network Group** list box selection is 20, 21, 22, or 23.

Radio Network selection	Radio Network Group selection: 20 or 21	Low Frequency	High Frequency	Radio Network selection	Radio Network Group selection: 22 or 23	Low Frequency	High Frequency
0	20	908.20	918.20	0	22	905.00	915.00
1	20	908.40	918.40	1	22	905.20	915.20
2	20	908.60	918.60	2	22	905.40	915.40
3	20	908.80	918.80	3	22	905.60	915.60
4	20	909.00	919.00	4	22	905.80	915.80
5	20	909.20	919.20	5	22	906.00	916.00
6	20	909.40	919.40	6	22	906.20	916.20
7	20	909.60	919.60	7	22	906.40	916.40
0	21	909.80	919.80	0	23	906.60	916.60
1	21	910.00	920.00	1	23	906.80	916.80
2	21	910.20	920.20	2	23	907.00	917.00
3	21	910.40	920.40	3	23	907.20	917.20
4	21	910.60	920.60	4	23	907.40	917.40
5	21	910.80	920.80	5	23	907.60	917.60
6	21	911.00	921.00	6	23	907.80	917.80
7	21	911.20	921.20	7	23	908.00	918.00
## 11.7. Radio Network Group Selection: 24, 25, 26, 27

In the Device Configuration window (on page 57), these are the **High** and **Low Frequencies** when the **Radio Network Group** list box selection is 24, 25, 26, or 27.

Radio Network selection	Radio Network Group selection: 24 or 25	Low Frequency	High Frequency	Radio Network selection	Radio Network Group selection: 26 or 27	Low Frequency	High Frequency
0	24	908.20	918.20	0	26	905.00	915.00
1	24	908.40	918.40	1	26	905.20	915.20
2	24	908.60	918.60	2	26	905.40	915.40
3	24	908.80	918.80	3	26	905.60	915.60
4	24	909.00	919.00	4	26	905.80	915.80
5	24	909.20	919.20	5	26	906.00	916.00
6	24	909.40	919.40	6	26	906.20	916.20
7	24	909.60	919.60	7	26	906.40	916.40
0	25	909.80	919.80	0	27	906.60	916.60
1	25	910.00	920.00	1	27	906.80	916.80
2	25	910.20	920.20	2	27	907.00	917.00
3	25	910.40	920.40	3	27	907.20	917.20
4	25	910.60	920.60	4	27	907.40	917.40
5	25	910.80	920.80	5	27	907.60	917.60
6	25	911.00	921.00	6	27	907.80	917.80
7	25	911.20	921.20	7	27	908.00	918.00

## 11.8. Radio Network Group Selection: 28 or 29

In the Device Configuration window (on page 57), these are the **High** and **Low Frequencies** when the **Radio Network Group** list box selection is 28 or 29.

Radio Network selection	Radio Network Group selection: 28 or 29	Low Frequency	High Frequency	
0	28	908.20	918.20	
1	28	908.40	918.40	
2	28	908.60	918.60	
3	28	908.80	918.80	
4	28	909.00	919.00	
5	28	909.20	919.20	
6	28	909.40	919.40	
7	28	909.60	919.60	
0	29	909.80	919.80	
1	29	910.00	920.00	
2	29	910.20	920.20	
3	29	910.40	920.40	
4	29	910.60	920.60	
5	29	910.80	920.80	
6	29	911.00	921.00	
7	29	911.20	921.20	

Page 74 of 86

Copyright © 2018 FreeWave

## **Appendix A: Technical Specifications**

**Warning!** Use of this equipment in a manner not specified by the manufacturer may impair the protection provided by the equipment.

The use of any parts not supplied by the manufacturer violates the safety rating of the equipment.

**AVERTISSEMENT**: L'utilisation de cet équipement d'une manière non spécifiée par le fabricant peut nuire à la protection fournie par l'équipement.

L'utilisation de pièces non fournies par le fabricant est contraire à la cote de sécurité de l'équipement.

**Important!**: The associated apparatus provides intrinsically safe outputs.

L'appareil associé fournit des sorties à sécurité intrinsèque.

See the Control Drawing: 960-0027-02 (on page 77) for requirements when used in a Class I Division 1 area.

Technical Specifications: WC20i-485 or WC20i-485-S Modular Endpoint					
Specification	Description				
Transmitter					
Frequency	902-928 MHz, FHSS, license-free ISM band compliant with FCC Part 15				
Range	Maximum of ½ mile				
Data Update Rates	User selectable				
	<ul> <li>5 seconds to 1 hour, typical</li> </ul>				
Networks	Maximum of 65,520 separate networks				
Receiver					

LUM0093AA Rev Apr-2018

STOP

Page 75 of 86

Copyright © 2018 FreeWave

Technical Specifications: WC20i-485 or WC20i-485-S Modular Endpoint					
Specification	Description				
Sensitivity	-109dB				
Interfaces					
Data Interface	Wireless, available as Modbus registers at Gateway				
Internal Diagnostics	Battery voltage				
	Signal Strength				
	Error conditions				
Power Requirements					
Battery Pack	3 X D Lithium battery pack, field replaceable.				
	FreeWave Part #: WC-3BAT-IS				
	<b>Note</b> : C1D1 certified when used with FreeWave system. Replacement can be performed safely in hazardous locations.				
	Optional: C1D1 solar / battery module				
	<b>Note</b> : See Solar Powered WC20i (on page 9) for additional information.				
Battery Life	1–10 years, depending on the sensor type and reporting frequency.				
Radio Power	40mW				
Sensor Power	Powers both the radio system and the sensor / transmitter.				
	User configurable for 18 and 12.5V.				
	Note: Barriers and external power are not required.				
General Information					
Operating Temperature	-40°C to 60°C				
Humidity	0% - 100% condensing				
Enclosure Size	3.5 H × 5.0 W × 5.0 L (in)				
Safety Rating	Intrinsically Safe				

Page 76 of 86

Copyright © 2018 FreeWave

## Appendix B: Control Drawing: 960-0027-02



Figure 37: Control Drawing: WC20i-485 / WC20i-485-S

Page 77 of 86

Copyright © 2018 FreeWave

# **Appendix C: Connection Troubleshooting**

Verify the connection between the Gateway and Endpoint:

- Check the LEDs on the Endpoint.
  - If LEDs don't indicate linked, double check radio settings.
  - See LEDs (on page 79).
- If the Endpoint is linking, use the 4-pin to USB programming cable to connect to Gateway and examine the Endpoints reporting to that Gateway.
- If the Endpoints are reporting in, double check that the Modbus IDs and registers are correct in the Modbus master.

Page 78 of 86

Copyright © 2018 FreeWave

This document is the property of FreeWave Technologies, Inc. and contains proprietary information owned by FreeWave. This document cannot be reproduced in whole or in part by any means without written permission from FreeWave Technologies, Inc.

## **Appendix D: LEDs**

These are the WC20i LEDs available for field diagnostics.

WC20i LEDs			
Radio LEDs	Description		
	<ul> <li>The Radio TX LED Flashes green <sup>&gt;o</sup> &lt; each time a radio packet is sent.</li> <li>This LED is rapidly Green blinking <sup>⊖</sup> while searching for the radio network.</li> </ul>		
	<ul> <li>The Radio RX LED is Red blinking</li></ul>		
Status LEDs			
	<ul> <li>The ERROR LED Red blinking          to indicate an error condition.</li> </ul>		
Check-in button			
	<ul> <li>On the WC20i, press the Check-in button to apply power to the configured sensor, read the sensor values, and send the collected sensor data to the Gateway.</li> </ul>		

Page 79 of 86

Copyright © 2018 FreeWave

# Appendix E: Available Accessories

Available Accessories				
FreeWave Part #	Description			
WC-USB-4PIN	4-pin to USB programming cable			
WC-3BAT-IS	Replacement Battery for WC20i-485 or WC20i-485-S Modular Endpoint			
WC-2BAT-RECH	Rechargeable Battery - Not Intrinsically Safe / Not C1D1			
	Important!: The WC-2BAT-RECH replaces the standard 3 D-cell lithium battery pack (WC-3BAT-IS) when the user wants to use DC power to supply the WC20i.			
	<b>Caution</b> : DC Power (10-30VDC) MUST be connected to the screw terminal block on the battery pack.			
WC20i-S-CBL10	10 ft. Extension Cable for solar module			
WC20i-Solar	WC20i Solar Panel kit with bracket, charger, and High Capacity battery pack			
	<b>Note</b> : This does NOT include the WC20i Endpoint. It is only the Solar Panel with its accompanying equipment.			

These accessories are available from FreeWave for the WAVECONTACT products.

LUM0093AA Rev Apr-2018

Page 80 of 86

Copyright © 2018 FreeWave

Available Accessories				
FreeWave Part #	Description			
Tank Level Solar Panel Mounting Kits				
<b>Note</b> : These mounting kits fit all FreeWave <b>WC20i-Solar</b> Panel Kits. Select a mounting kit based on the model of the attached sensor.				
WC20i-B-R5300 Rosemount 5300				
WC20I-B-YOKO	Yokogawa EJA Series			
WC20i-BKT-VEGA	Vega Single Chamber Radar			

Page 81 of 86

Copyright © 2018 FreeWave

## **Appendix F: FreeWave Legal Information**

#### **Export Notification**

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

#### **FCC Notifications**

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

The content of this guide covers FreeWave Technologies, Inc. models sold under FCC ID: W8V-WC20I.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of these measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

**Important!**: Only the supplied coil antenna, which is permanently soldered to the PCB, may be used. This antenna has a maximum gain of 3dB.

#### FCC Notification of Power Warning

LUM0093AA Rev Apr-2018

Page 82 of 86

Copyright © 2018 FreeWave

The WC20i-485 or WC20-485-S Modbus Modular Endpoint covered in this document has a maximum transmitted output power of +14dBm.

The antennas used MUST provide a separation distance of at least 20 cm from all persons and MUST NOT be co-located or operate in conjunction with any other antenna or transmitter.

#### **IC Notifications**

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a maximum (or lesser) gain approved for this transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.r.i.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industri e Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les ri sques de brouillage radioélectrique à l'intention des autres utilisat eurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établisseme nt d'une communication satisfaisante.

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.

Important!: This label MUST BE visible when the WAVECONTACT product is installed.

		Boulder, CO USA www.freewave.com	" S/	N:	0000001
	CLASS I, DIVISION 1 GROUPS C, D TEMP CODE: T3 AMBIENT TEMP: -40°C to +60°C CONFORMS TO UL STD 913 CERTIFIED TO CAN/CSA STD C22.2 NO. 157 FCC ID: W8V-WC20I IC: 8373A-WC20I		ENTITY PARAMETERS         Exi           INPUT POWER:         OUTPUT (J11): Voc           Vmax = 5.9 Vdc         = 14.7 Vdc Isc =           Imax = 3.1 A Pmax         119.14 mA Ca =           = 0.8 W Ci = 29.43         3.86 uF La = 10.02           uF Li = 13.5 uH         mH		
INTRINSICALLY SAFE SECURITE INTRINSEQUE INTRINSICALLY WHEN CONNECTED PER FREEWAVE DRA 960-0027-02	WARNING: POTENTIAL ELECTROSTATIC DISCHAI HAZARD! SEE INSTRUCT	RGE IONS	AVERTISSEMENT: DANGER POTENTIEL DE DECHARGES ELECTROSTATIQUES: VOIR LES INSTRUCTIONS		
WARNING: USE OF ANY BATTERY OTHER THAN FREEWAVE WC-3BAT-IS or WC20i- Solar MAY IMPAIR INTRINSIC SAFETY		ISSEMENT: LA SUBSTITUTIO MPOSANTS PEUT COMPRON ITE INTRINSEQUE	WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY		IING: SUBSTITUTION OF ONENTS MAY IMPAIR VSIC SAFETY

#### WC20i-485-ETL C1D1

Important!: This label MUST BE visible when the WAVECONTACT product is installed.

Page 83 of 86

Copyright © 2018 FreeWave

FREEWAV Model: WC20i-Solar	Boulder, CO USA www.freewave.com	S/N: 00000001
Intertek 4003827	CLASS I, DIVISION 1 GROUPS C, D TEMP CODE: T3 AMBIENT TEMP: -40°C to +60°C CONFORMS TO UL STD 913 CERTIFIED TO CAN/CSA STD C22.2 NO. 157	ENTITY PARAMETERS Exi OUTPUT: Voc = 5.9 Vdc Isc = 3.06 A Pout = 0.8 W Ca = 999.9 uF La = 15.2 uH
INTRINSICALLY SAFE SECURITE INTRINSEQUE	WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY	AVERTISSEMENT: LA SUBSTITUTION DE COMPOSANTS PEUT COMPROMETTRE LA SECURITE INTRINSEQUE

#### WC20i-Solar ETL C1D1 Label

#### **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.

#### Product Safety

**Note**: Debug and configuration information is available if the 4-pin to USB programming cable is connected to the **RS232 Config / Debug** connector using the debug port on the main board. The USB converter cable (FreeWave Part #WC-USB-4PIN) must be used for this interface. Debug and configuration is done using the WC Toolkit.

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

**Warning!** Only connect to the Config / Debug connector port in a safe area! **AVERTISSEMENT**: Branchez le port de déboggage que dans une zone secure.

**Warning!** Use of this equipment in a manner not specified by the manufacturer may impair the protection provided by the equipment.



The use of any parts not supplied by the manufacturer violates the safety rating of the equipment. **AVERTISSEMENT**: L'utilisation de cet équipement d'une manière non spécifiée par le fabricant peut nuire à la protection fournie par l'équipement.

L'utilisation de pièces non fournies par le fabricant est contraire à la cote de sécurité de l'équipement.



**Warning!** Perform the Configuration steps in a safe location only. **AVERTISSEMENT**: Suivez les étapes de cette section (Configuration) dans un endroit sûr uniquement.

LUM0093AA Rev Apr-2018

Page 84 of 86

Copyright © 2018 FreeWave

STOP

**Warning!** Use of any battery other than the WAVECONTACT Internal Lithium Battery Pack (FreeWave Part # WC-3BAT-IS) will impair the protection provided by the equipment. **AVERTISSEMENT**: L'utilisation d'une pile autre que la référence WAVECONTACT Internal Lithium Battery Pack (FreeWave Part # WC-3BAT-IS compromettra la protection fournie par l'équipement.

**Warning!** If the Internal Lithium Battery Pack is installed, the External Solar Battery system or other power source **MUST NOT BE** connected!

#### Warning! Electrostatic Discharge Hazard!

Care must be taken to avoid the potential of creating a change on the enclosure or antenna. Do NOT wipe with a dry cloth.



Do NOT brush against the enclosure with clothing or gloves. **AVERTISSEMENT**: Risque de décharge électrostatique! Il faut veiller à éviter tout risque de changement de l'enceinte ou de l'antenne. Ne pas essuyer avec un chiffon sec. Ne pas brosser contre l'enceinte avec des vêtements ou des gants.

Important!: The associated apparatus provides intrinsically safe outputs. L'appareil associé fournit des sorties à sécurité intrinsèque. See the Control Drawing: 960-0027-02 (on page 77) for requirements when used in a Class I Division 1 area.

Page 85 of 86

Copyright © 2018 FreeWave

# FREEWAVE