FREEWAVE

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.

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.

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

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

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Preface

Contact FreeWave Technical Support

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

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

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

Other WAVECONTACT Information

Use the FreeWave http://support.freewave.com/ 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

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	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.

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.

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.

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)

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 1	WC20i-485-S - Solar Ready 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.

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)

3.1. Internal Connections

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

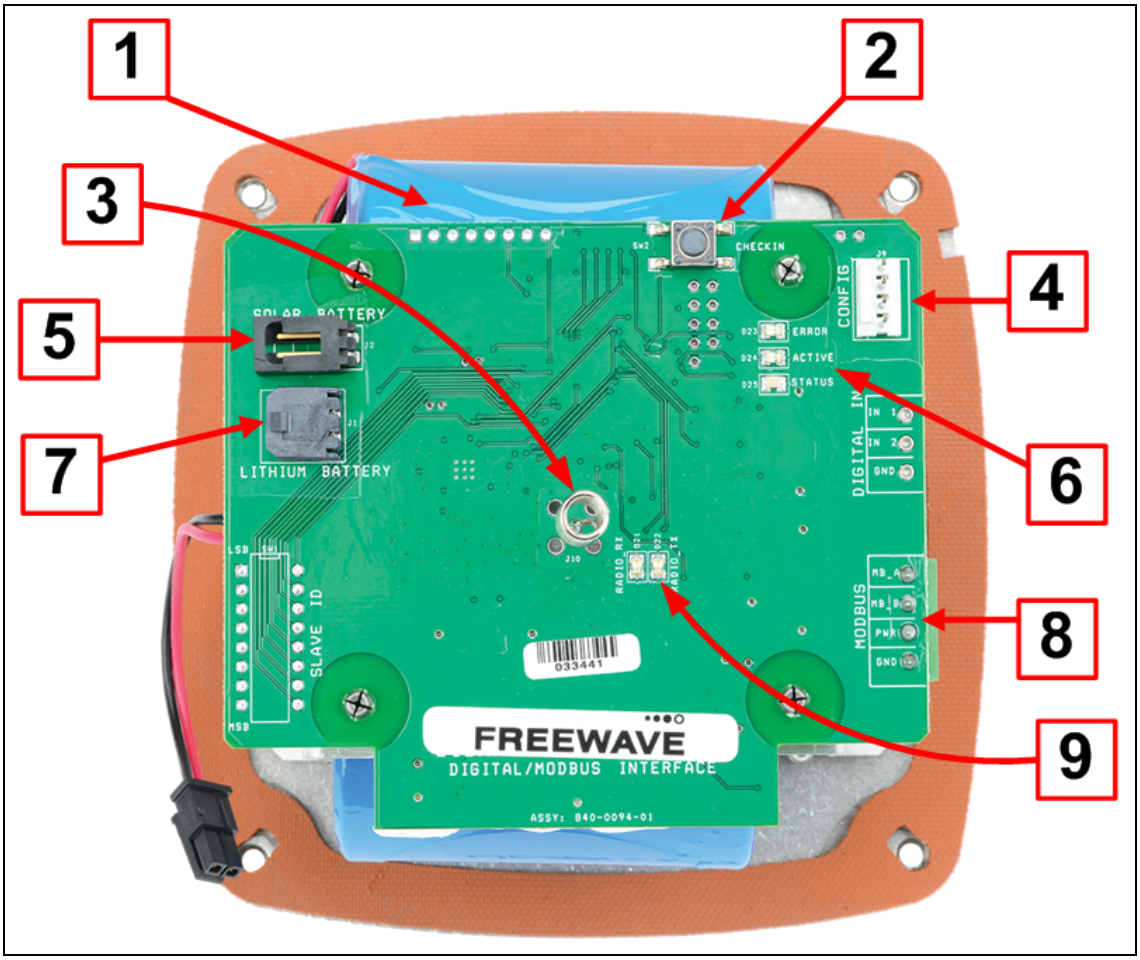


Figure 1: Internal Connections: WC20i-485 or WC20i-485-S Modular Endpoint

Internal 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 **Check-in** button to apply power to the configured sensor, read the sensor values, and send the collected sensor data to the Gateway. • When the sensor is detected, the **Status LED** blinks once and its data is read. • See LEDs (on page 79) for detailed information. • The WC20i sends the collected sensor data to the WC45i-Gateway.

Internal Connections: 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). **Note**: Debug and configuration information is available through WC Toolkit if a connection is made using the **RS232 Config / Debug** 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 **Internal Lithium Battery** 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.

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)

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.

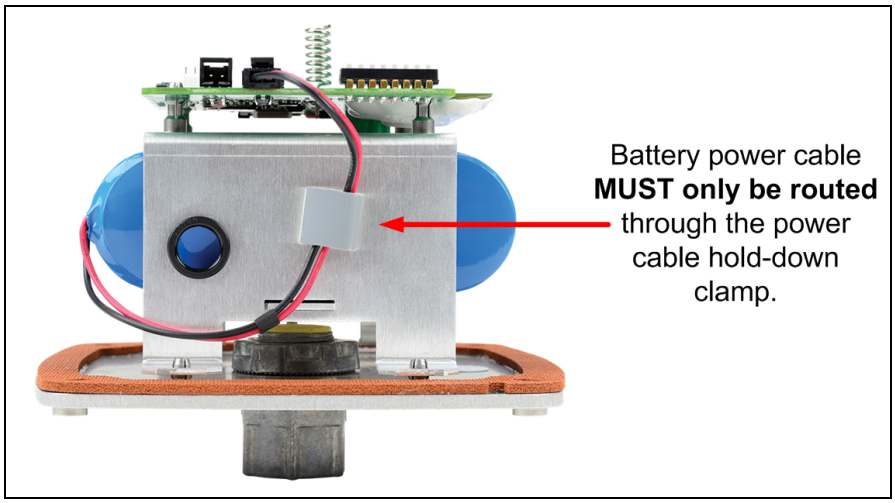


Figure 2: Battery Power Cable through the Power Cable Hold-down Clamp

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).

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.

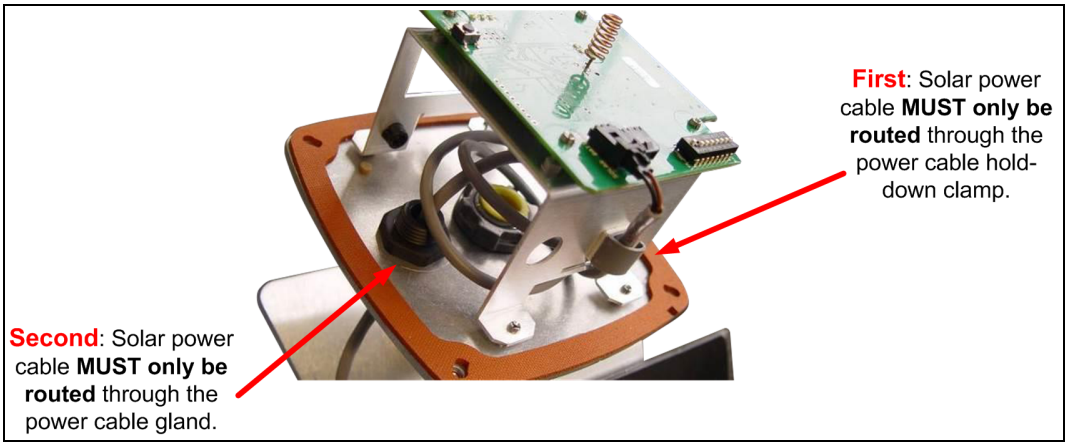


Figure 3: Solar Power Cable through the Power Cable Hold-down Clamp

4. Connect the solar power cable to the **Solar Battery** connection (**see #5** of Figure 1 on page 11).
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).

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.

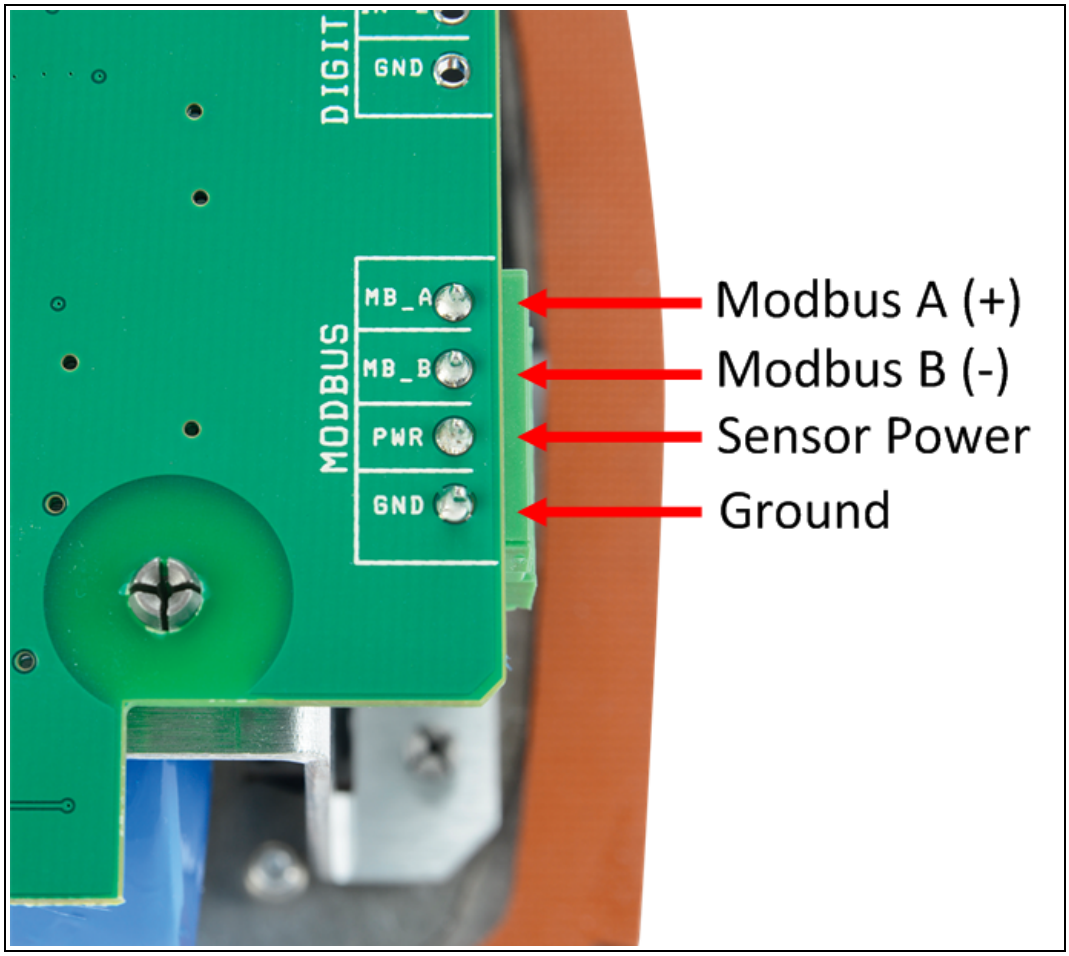


Figure 4: MB_A+ (positive), MB_B- (negative), PWR (power), and GND (ground) Sensor Connection

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

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 www.freewave.com 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.
2. 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.

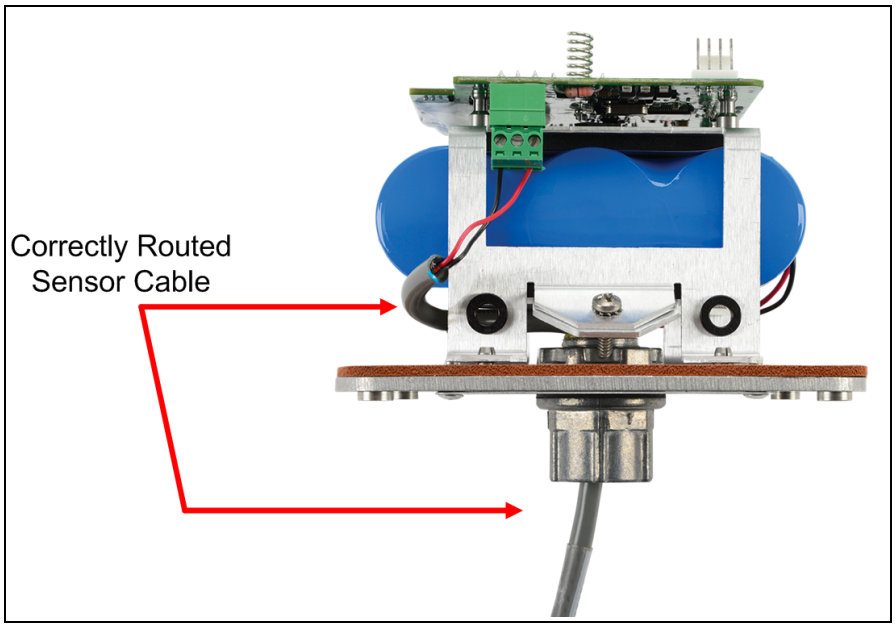


Figure 5: Correctly Routed Sensor Cable

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

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 http://support.freewave.com/.
   The **FreeWave Support** site opens.

   Important!: Registration is required to use this website.

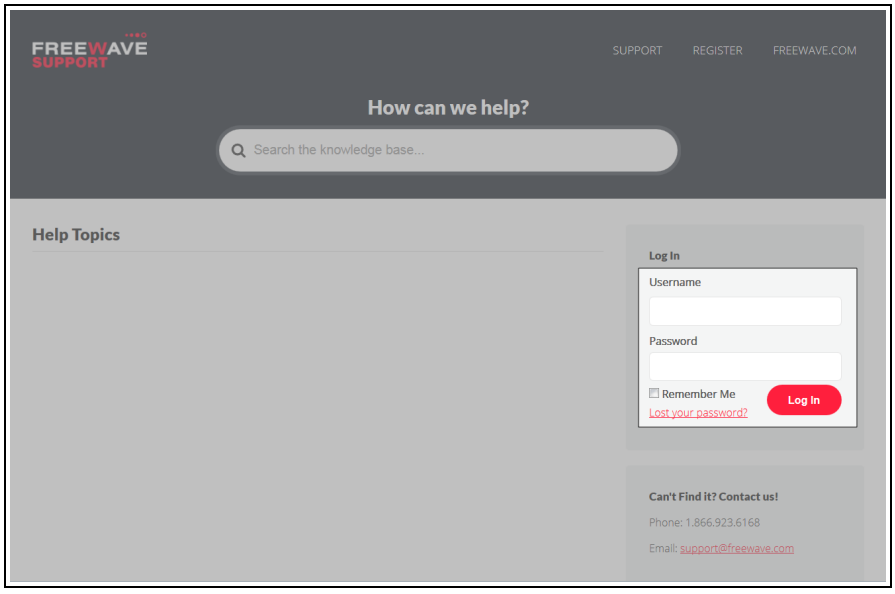


Figure 6: FreeWave Login window

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

3. Click 

.
A successful Login message briefly appears.
The **Help Topics** window opens.
4. Click the **Software** link.

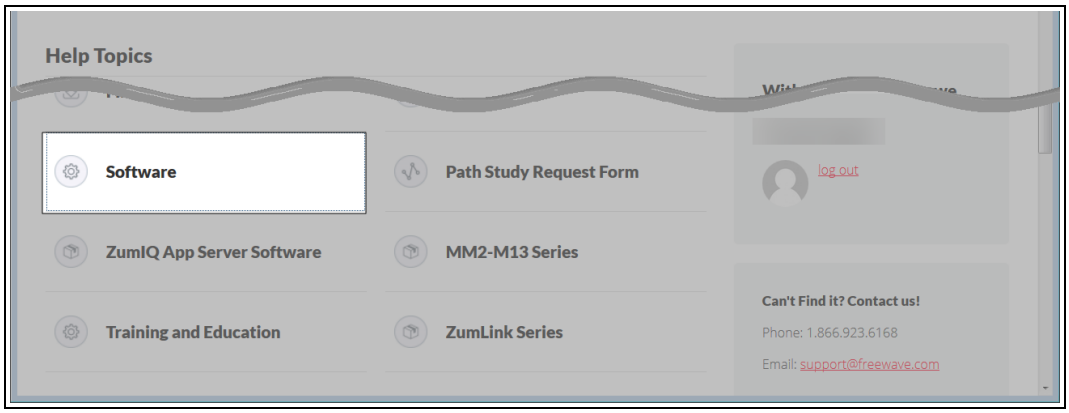


Figure 7: Help Topics window

The **Software** window opens.
5. Click the **WAVECONTACT Toolkit** link.

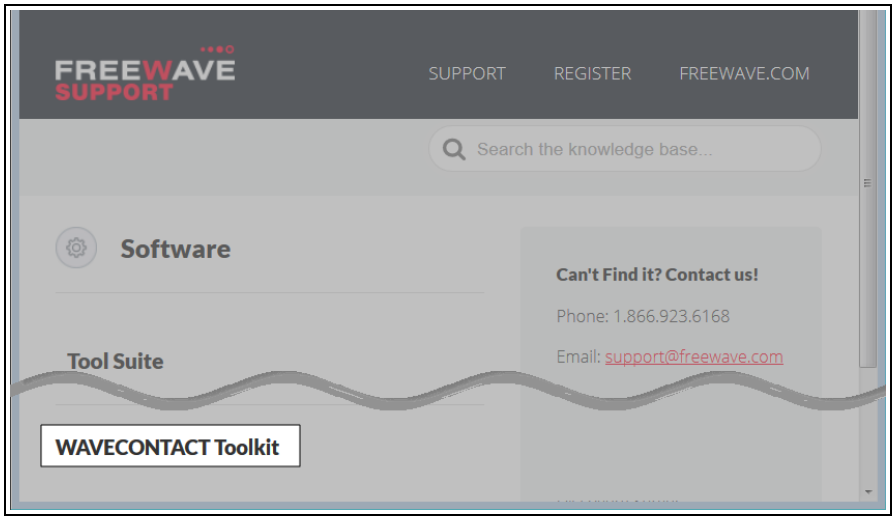


Figure 8: Software window

The available software appears in the window.
6. Select and click the attachment.

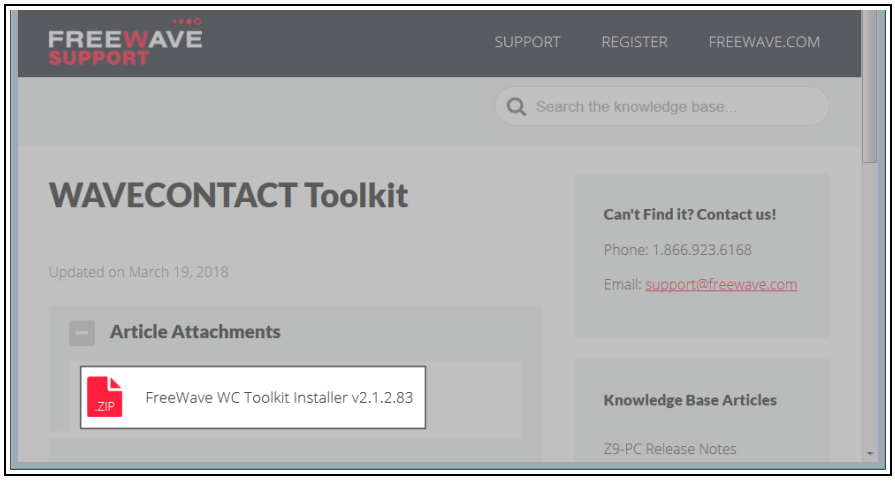


Figure 9: WAVECONTACT Toolkit window

The **Opening** dialog box opens.

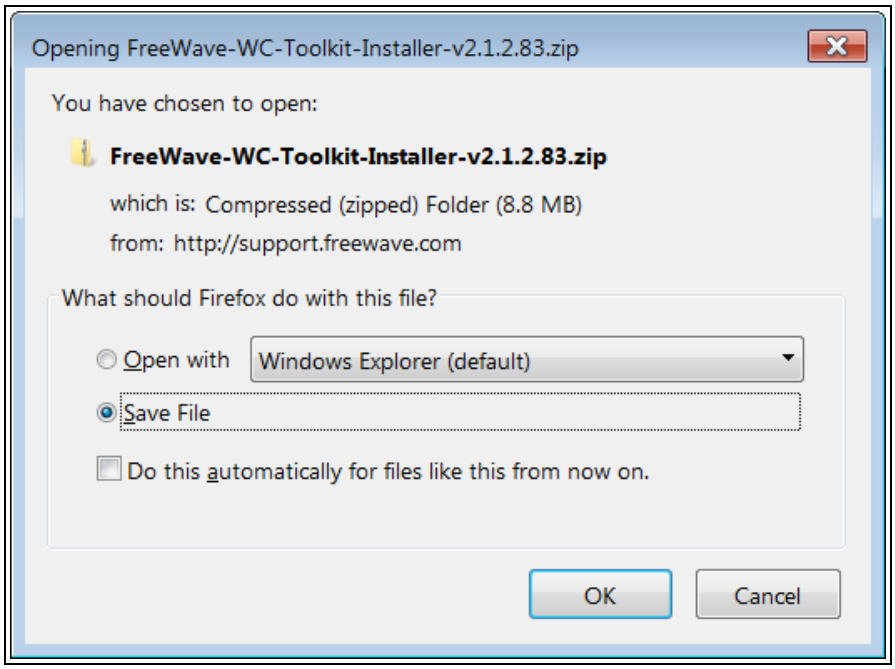


Figure 10: WC Toolkit Opening dialog box

> **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.

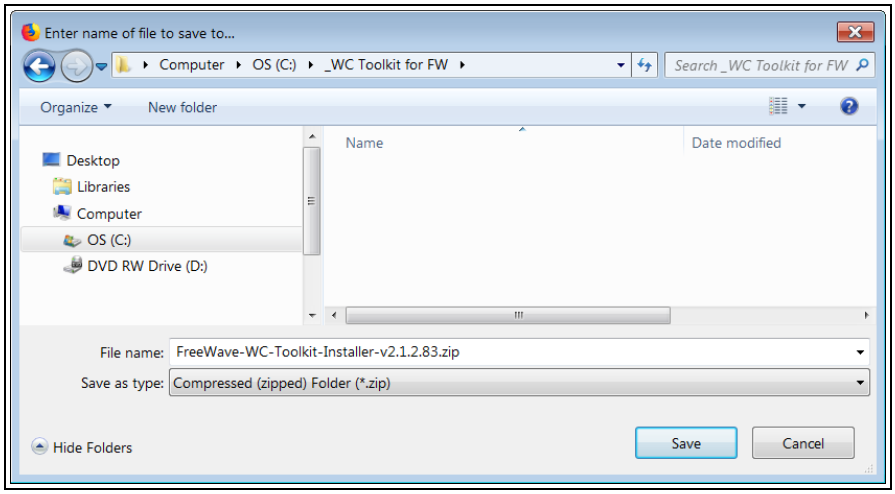


Figure 11: Enter name of file to save to dialog box

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.

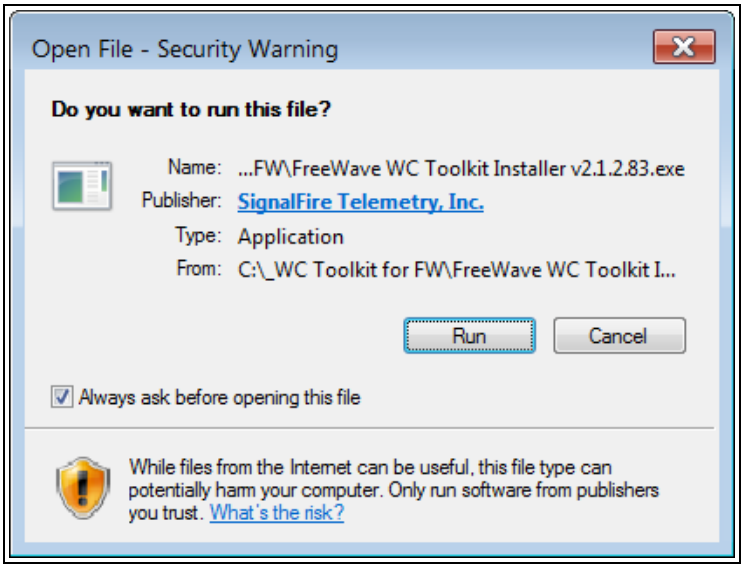


Figure 12: Open File - Security Warning dialog box

13. Click **Run**.
    The **User Account Control** dialog box opens.

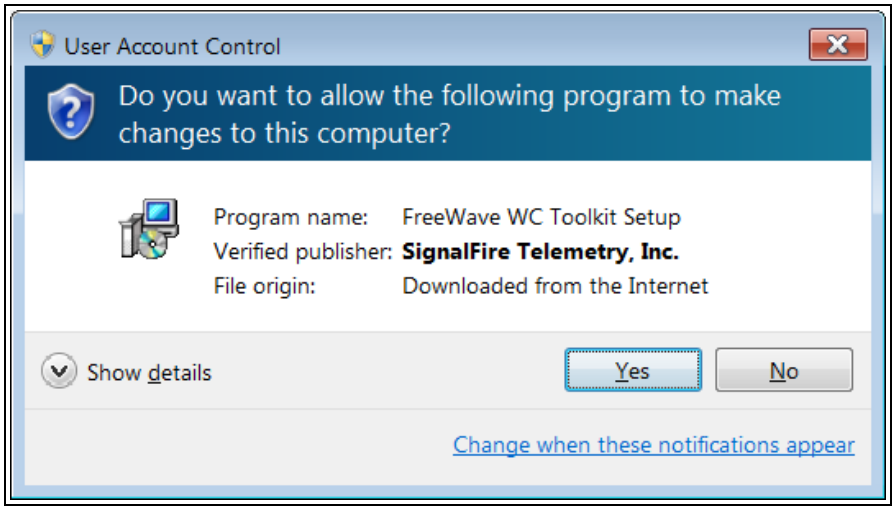


Figure 13: User Account Control dialog box

14. Click **Yes**.
    The **WC Toolkit Setup Wizard** starts.

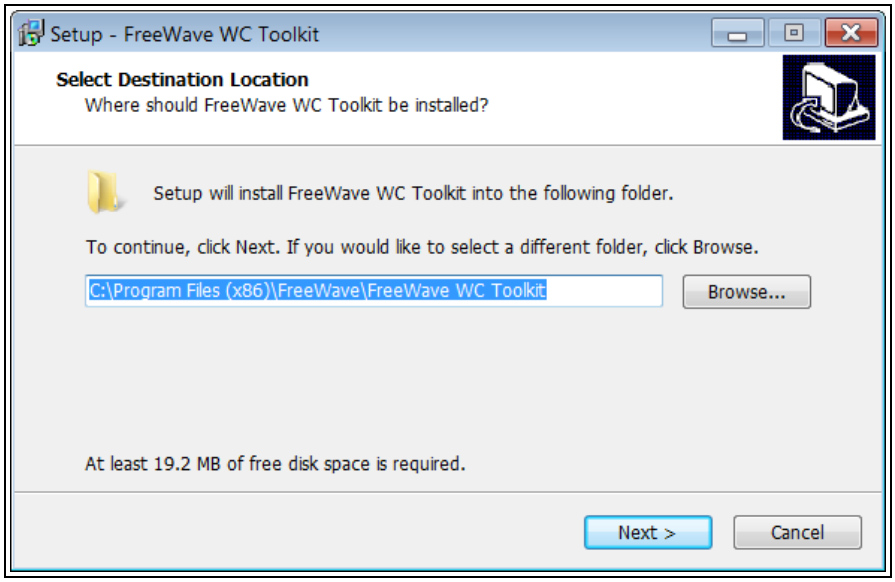


Figure 14: WC Toolkit Setup Wizard - Select Destination Location window

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

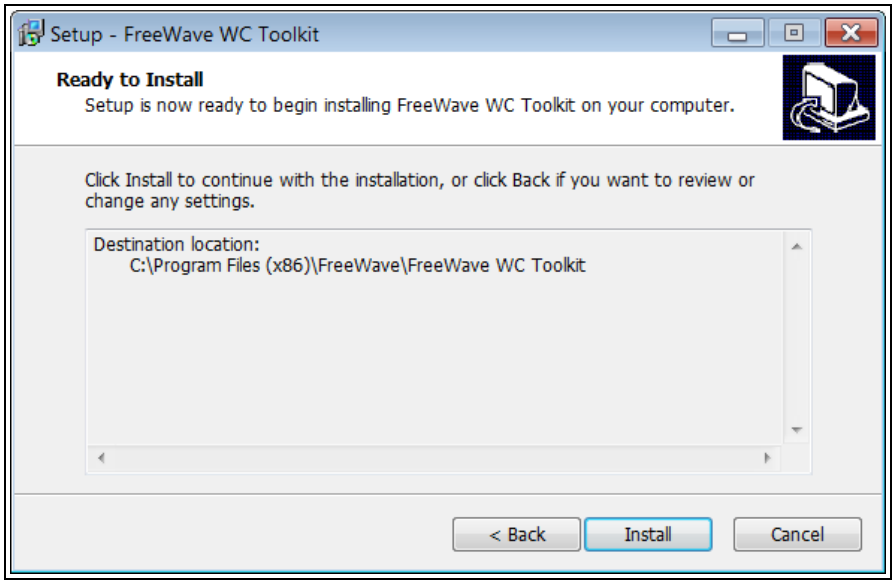


Figure 15: WC Toolkit Setup Wizard - Ready to Install window

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

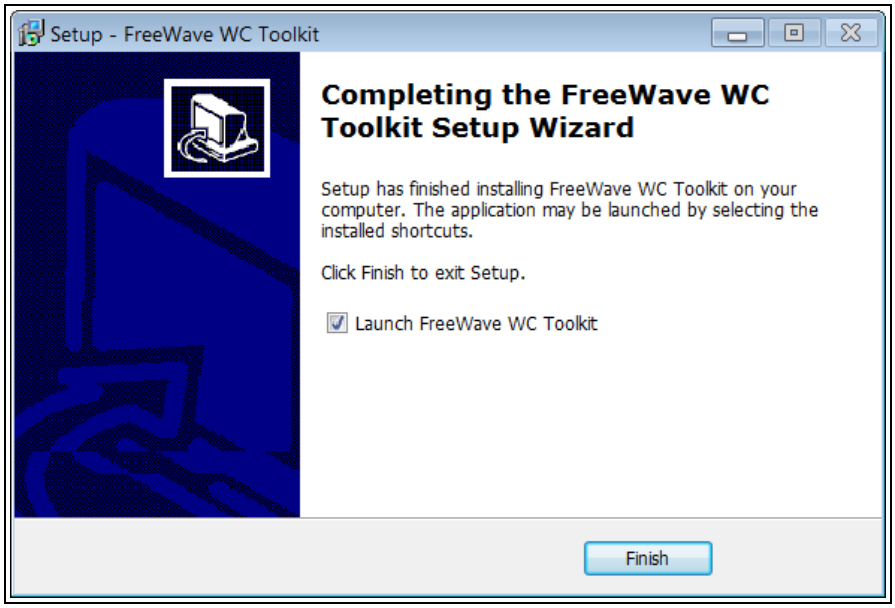


Figure 16: WC Toolkit Setup Wizard - Installation Complete window

17. Click **Finish** to open WC Toolkit.
    An **Update** message appears in the WC Toolkit window is an update is available.

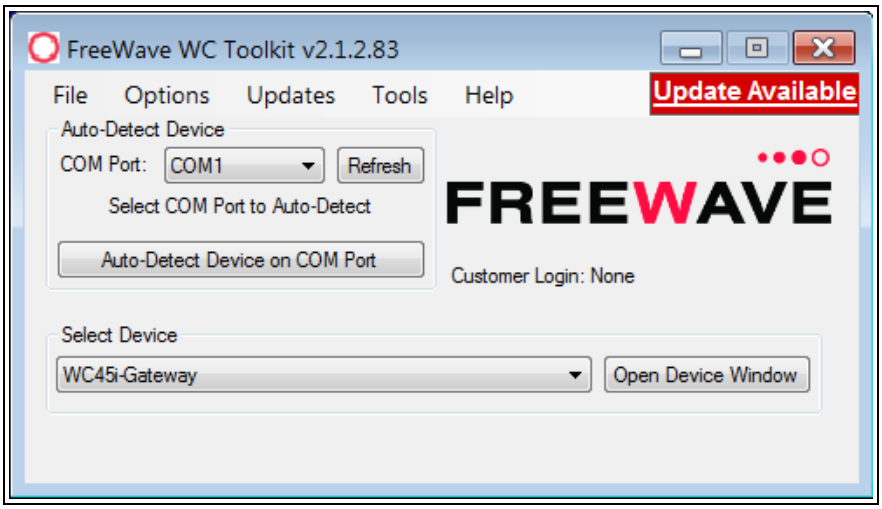


Figure 17: WC Toolkit - Update Available message

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

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.

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

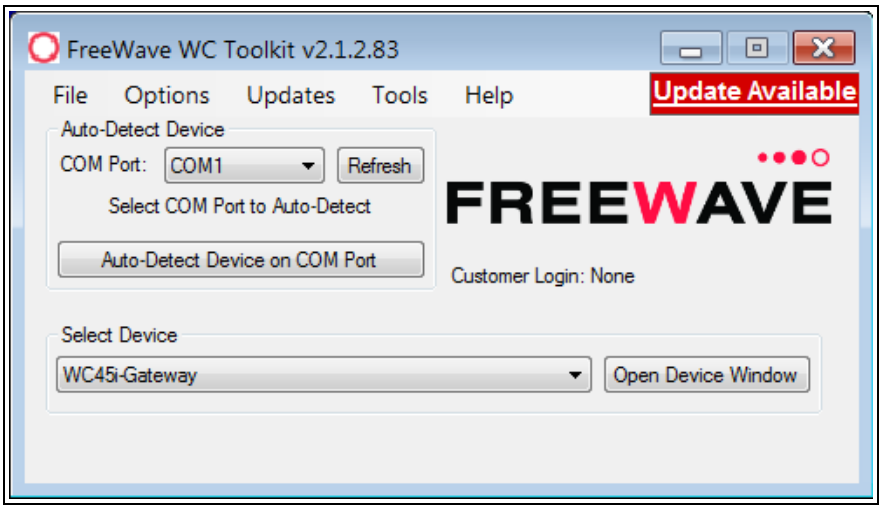


Figure 18: WC Toolkit - Update Available message

2. Click the **Update Available** message link.

Figure 19: Click the Update Available message link

The **Open File - Security Warning** dialog box opens.

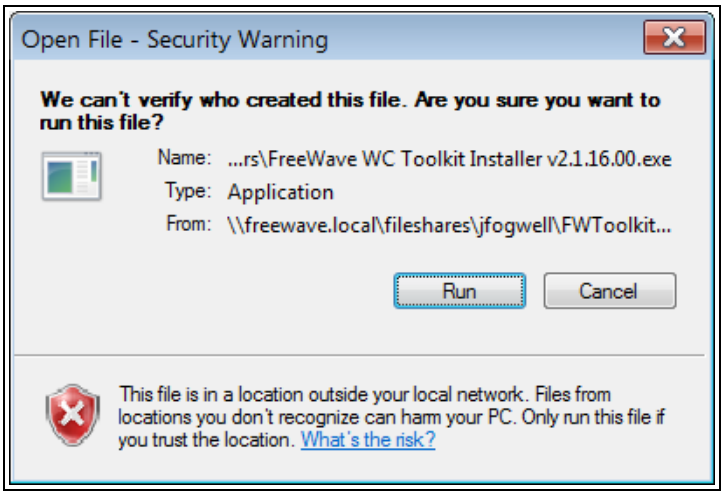


Figure 20: Open File - Security Warning dialog box

3. Click **Run**.
   The **User Account Control** dialog box opens.

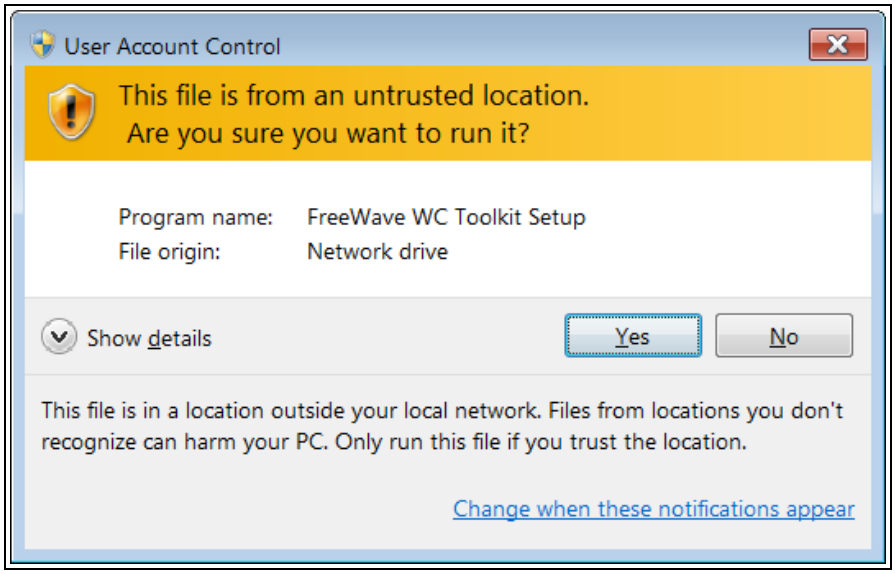


Figure 21: User Account Control dialog box

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)

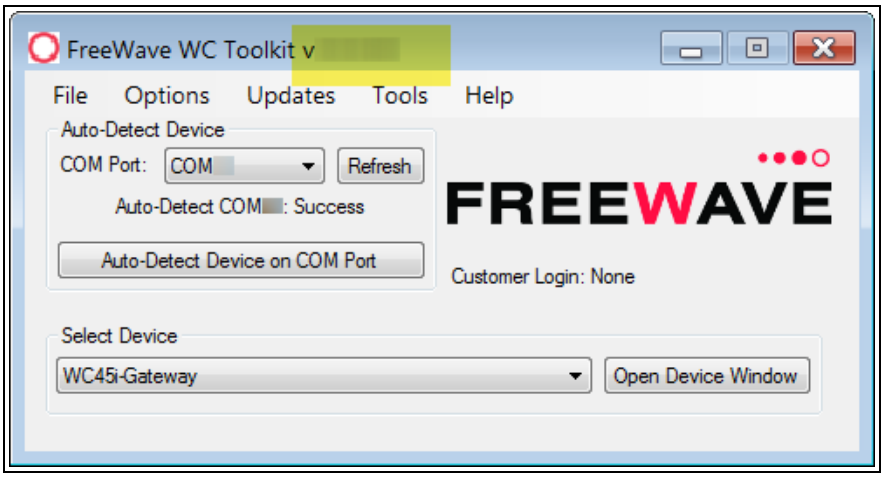


Figure 22: Select Device window

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

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

- 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.

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.
4. Open the **WC Toolkit** software.
   The **Select Device** window opens. (Figure 23)

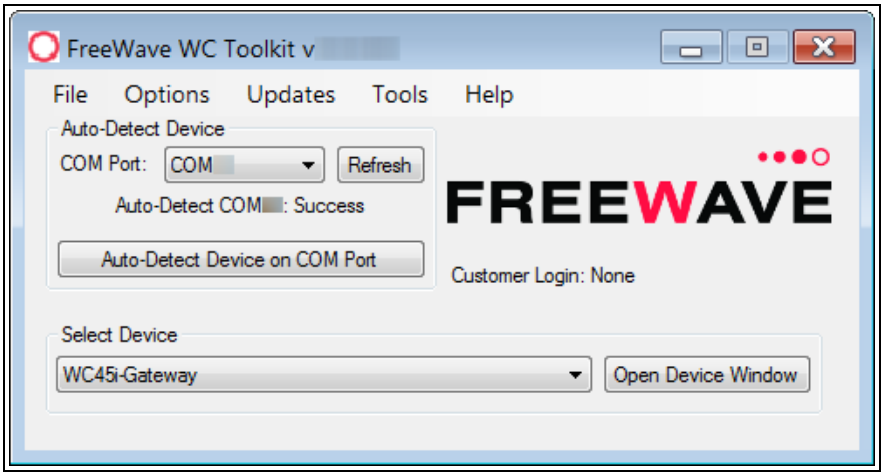


Figure 23: Select Device window

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).

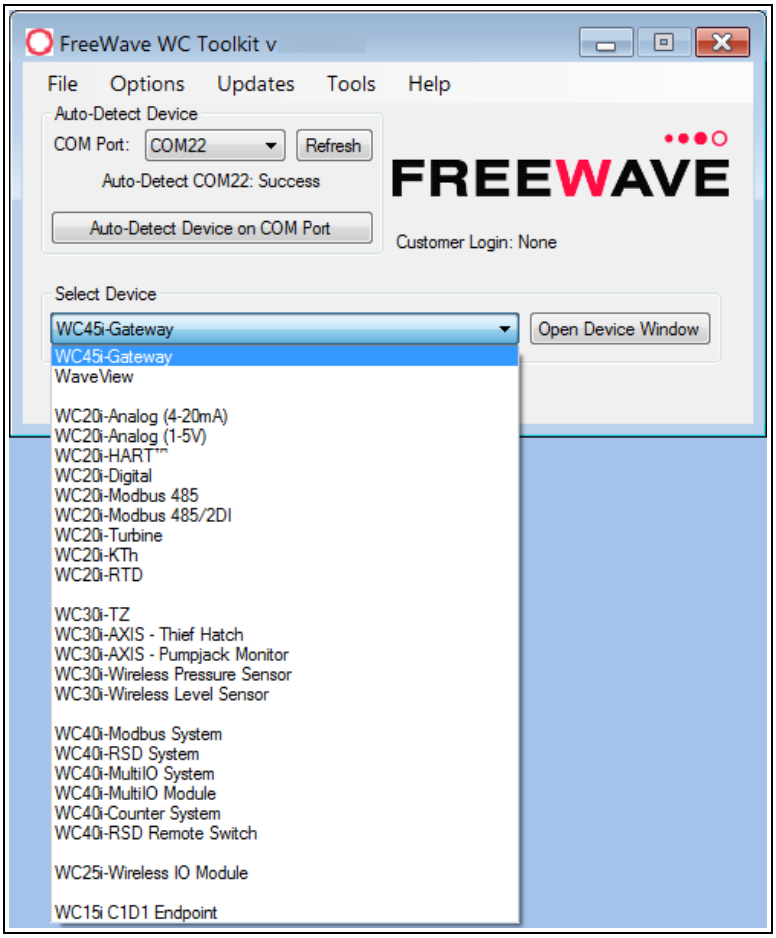


Figure 24: Select Device list box

The **Device Configuration** window opens for the selected device.

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

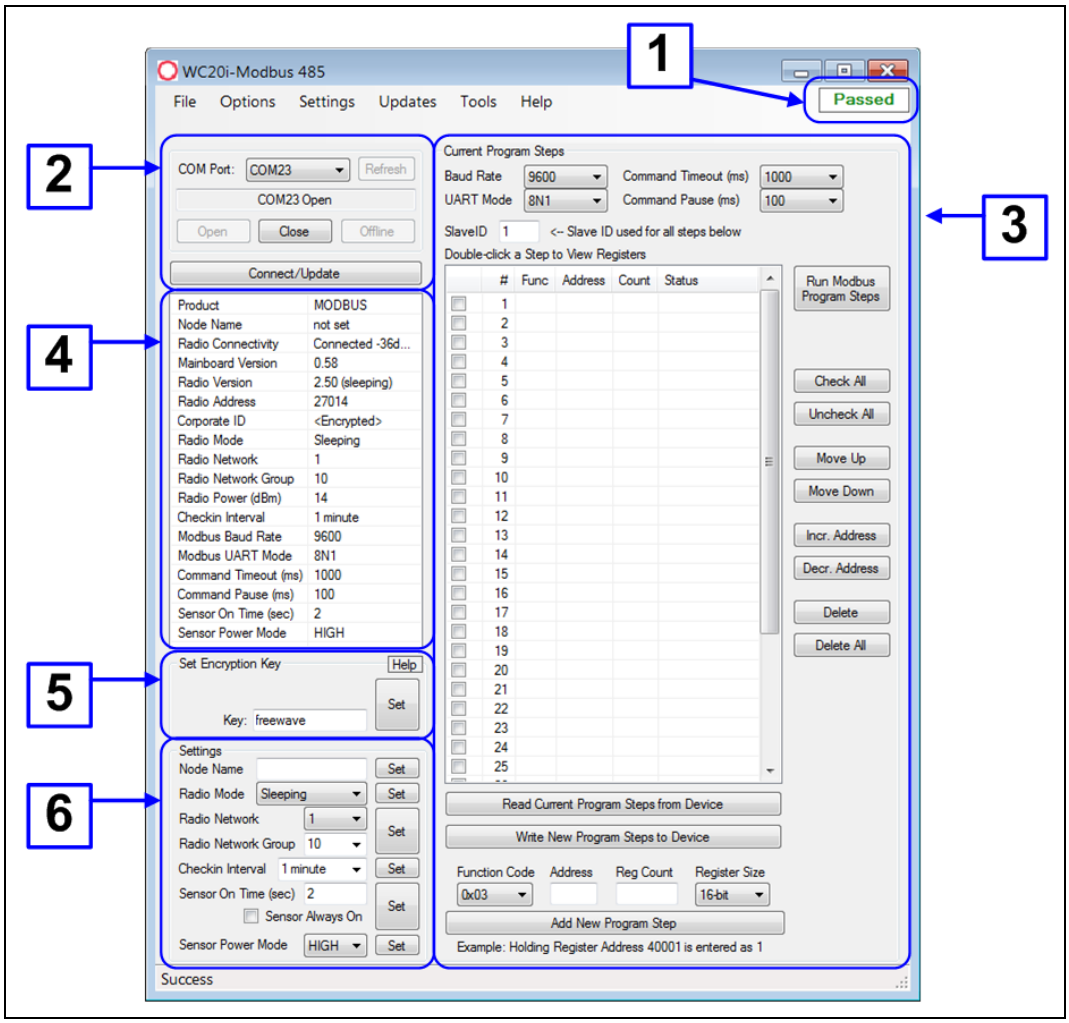


Figure 25: Device Configuration window: WC20i-485 or WC20i-485-S

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.

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.

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.

> **Caution**: Having the **Sensor Always On** selected is useful for rapid data collection on a sensor that has a long warm-up time.
> However, it will shorten the battery life **dramatically** unless a **Solar Powered WC20i** is used.

k. Click the **Set** button to save the information.

l. 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 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).

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)
- **0x03** for MODBUS_READ_HOLDING_REGISTERS
- **0x04** for MODBUS_READ_INPUT_REGISTERS
- **0x05** 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.

Procedure

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

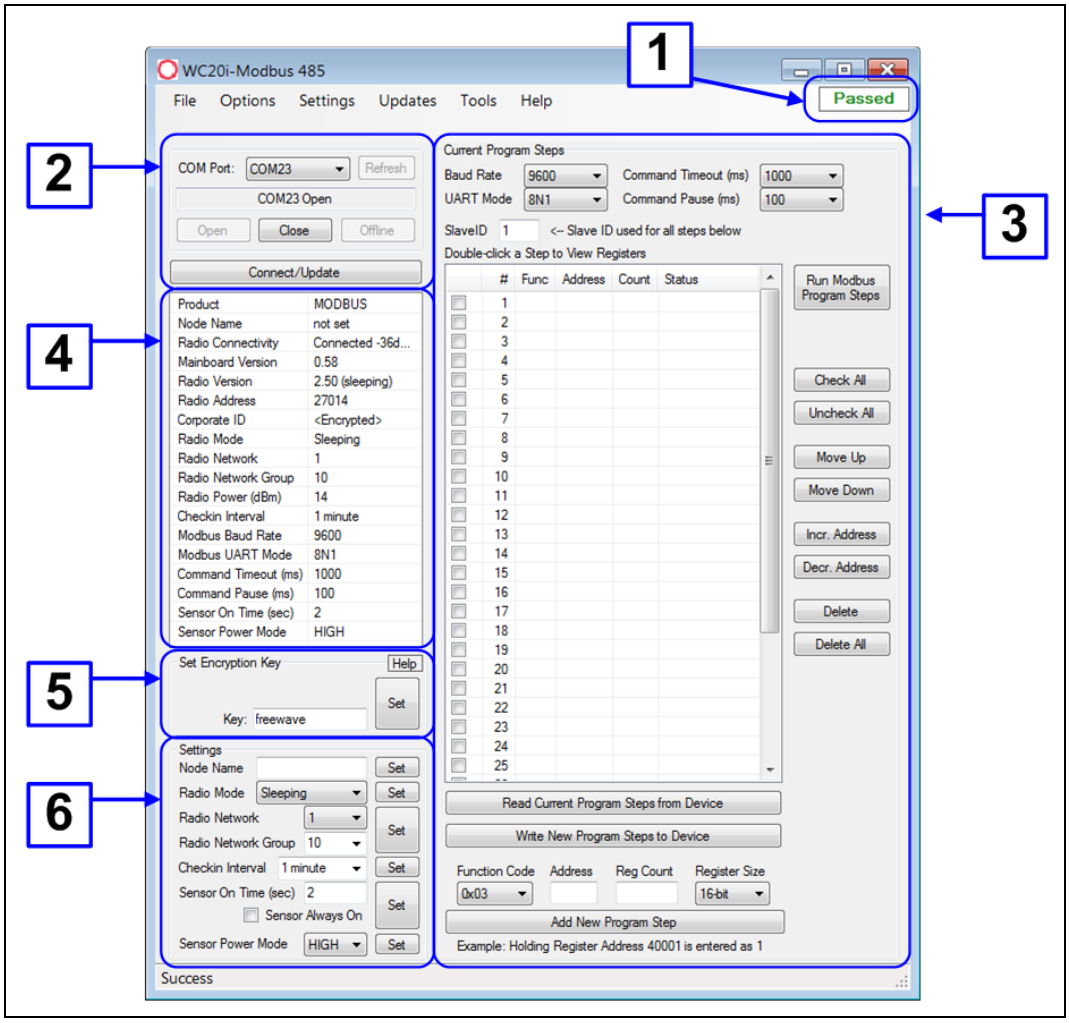


Figure 26: Device Configuration window: WC20i-485 or WC20i-485-S

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 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).

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.

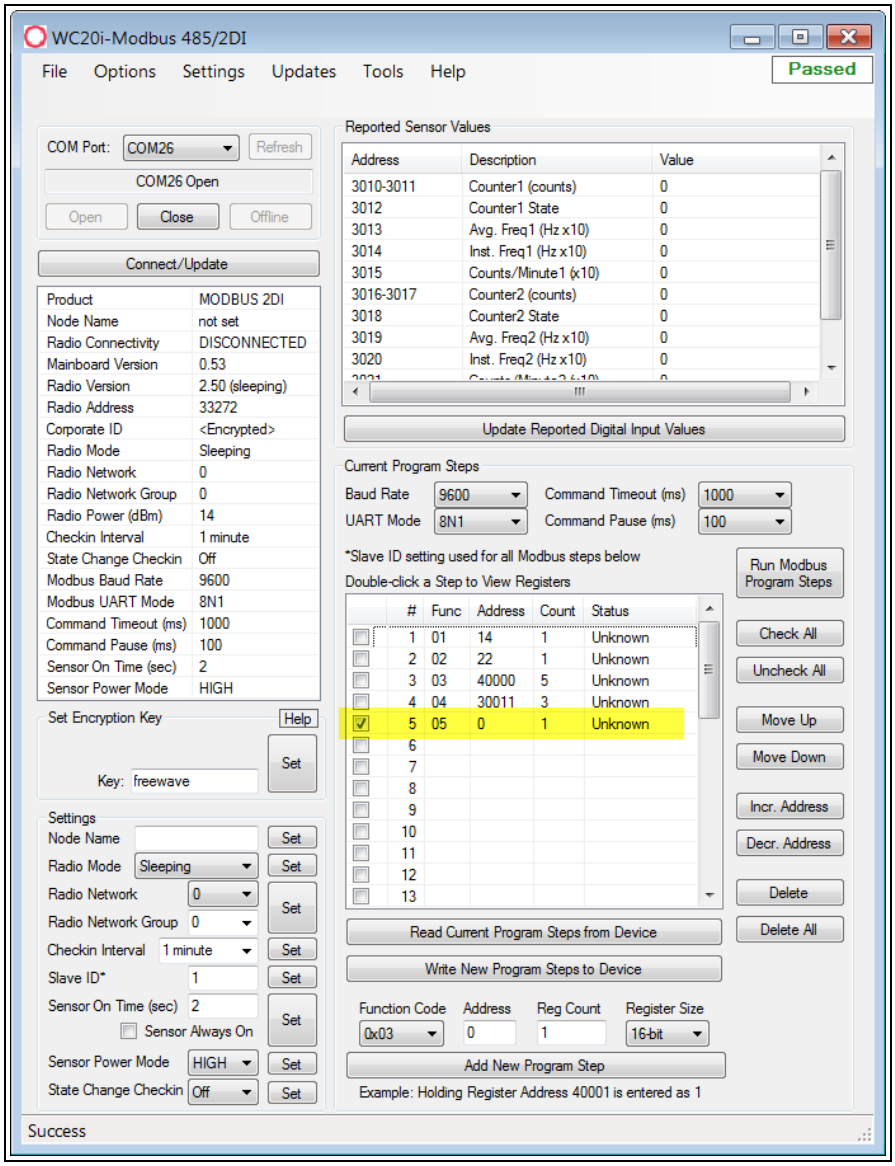


Figure 27: Selected Program Step in the WC20i-485-2DI Device Configuration window

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.

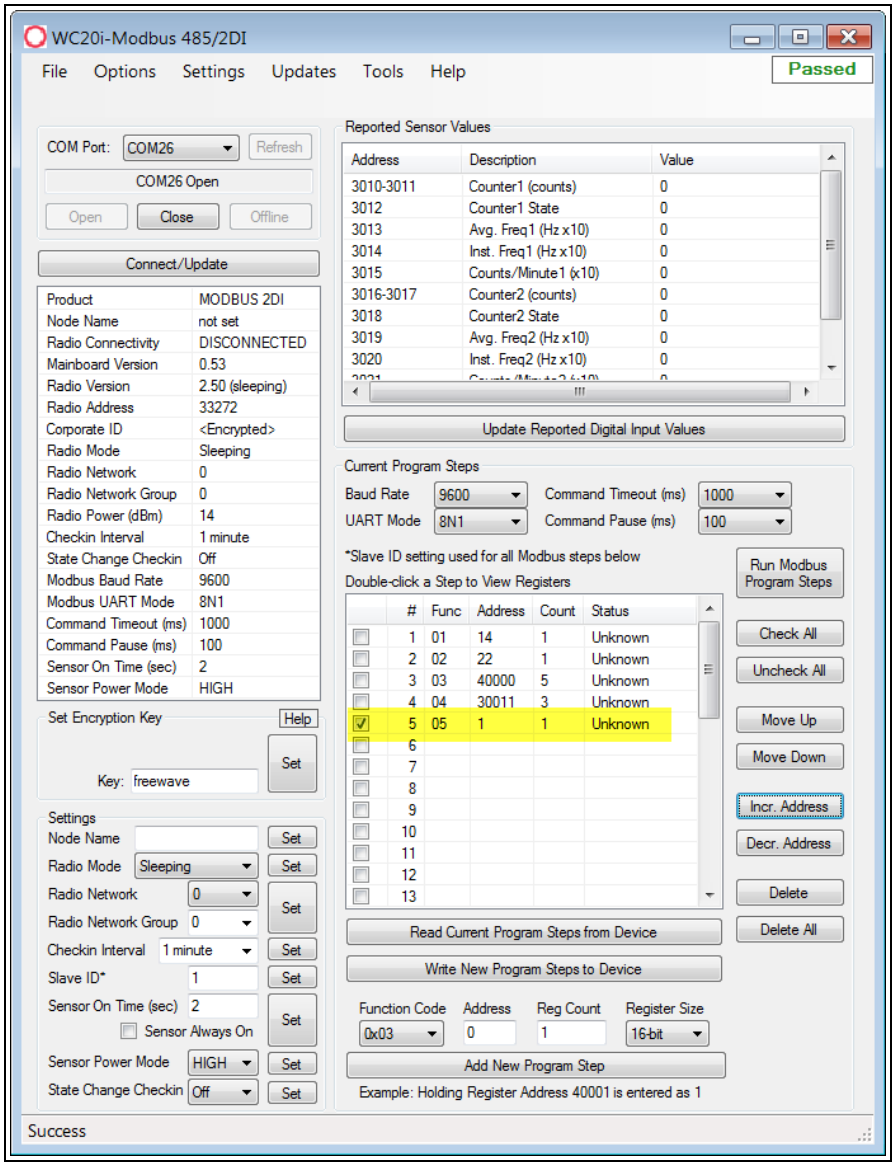


Figure 28: Selected Program Step with Increased Address Value

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 TX and ACT lights and a Red blinking light for RX.
> If the connection is NOT successful, a Green blinking 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.

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).

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.

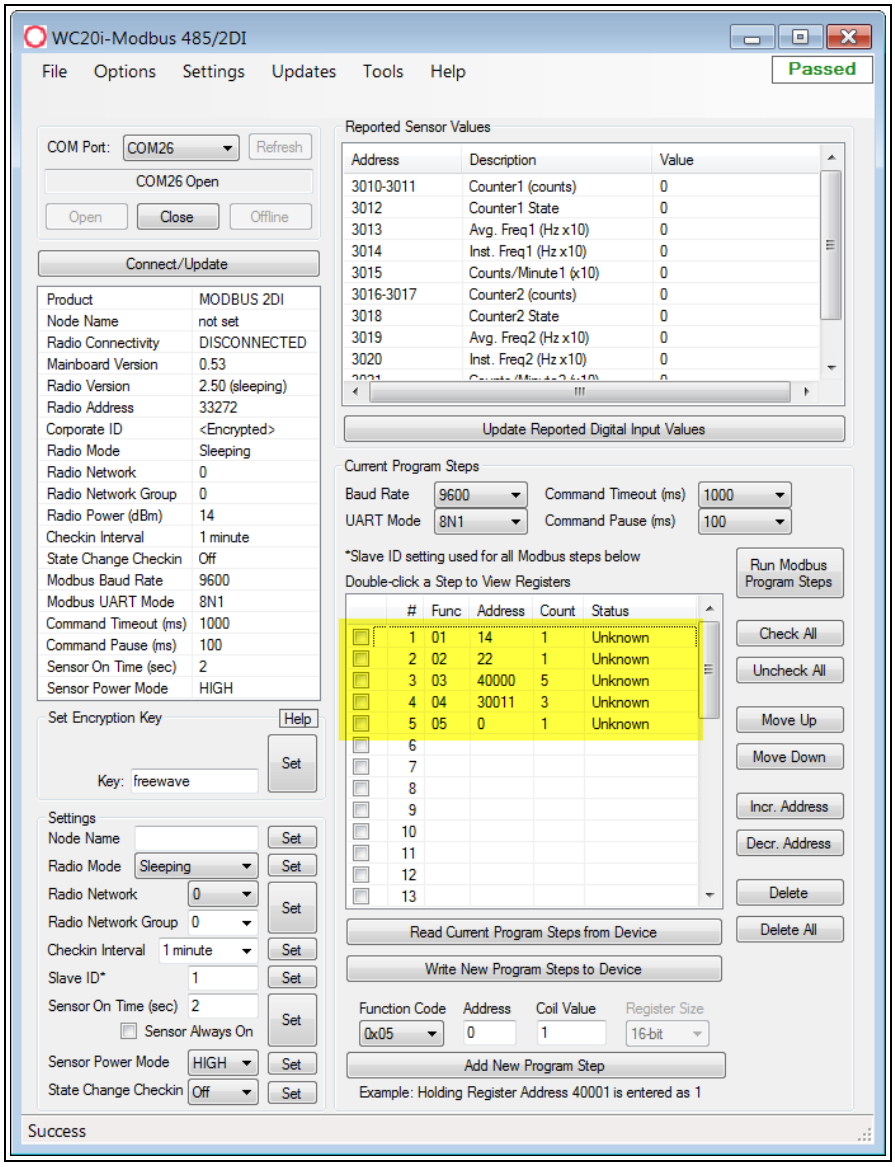


Figure 29: Example: WC20i-485-2DI Device Configuration window with Program Steps

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.

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 TX and ACT lights and a Red blinking light for RX.
   If the connection is NOT successful, a Green blinking 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.

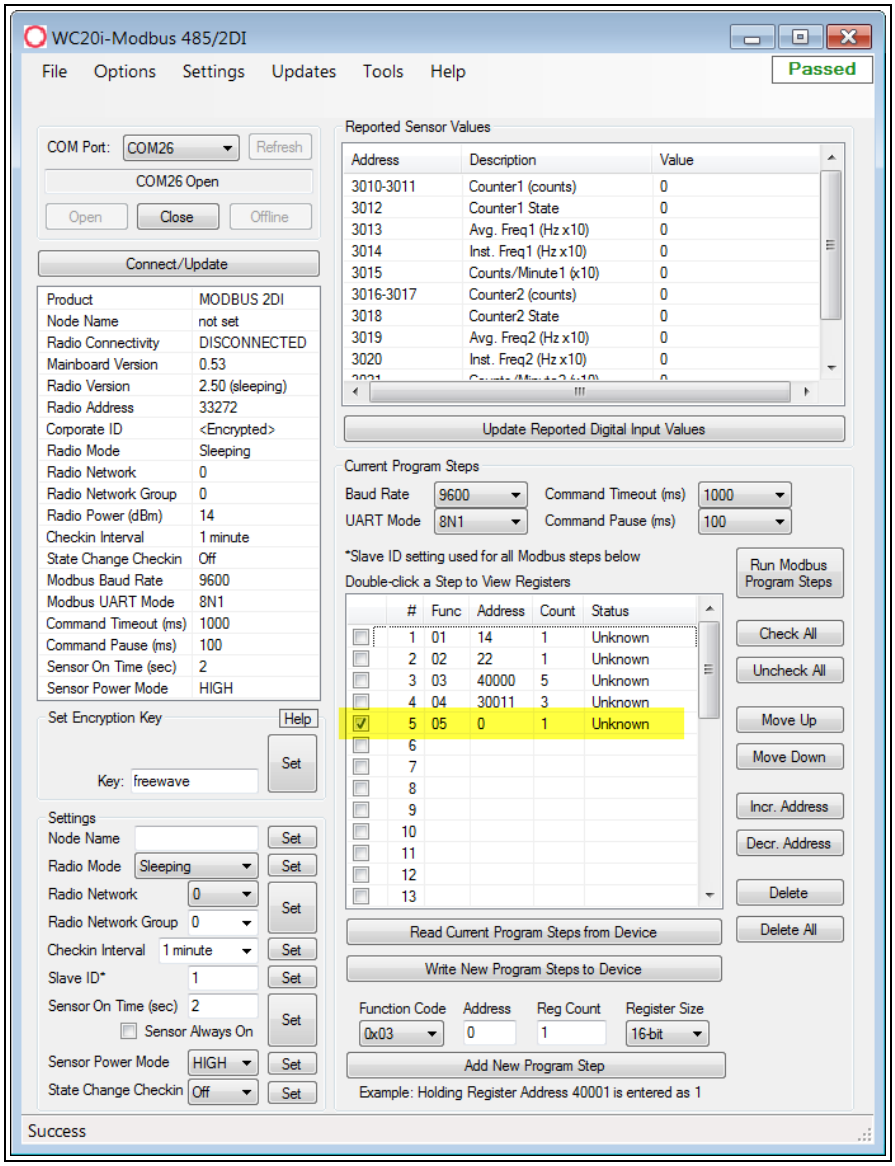


Figure 30: Selected Program Step in the WC20i-485-2DI Device Configuration window

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 TX and ACT lights and a Red blinking light for RX.
   If the connection is NOT successful, a Green blinking 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).

7.3.1. Delete All Program Steps

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

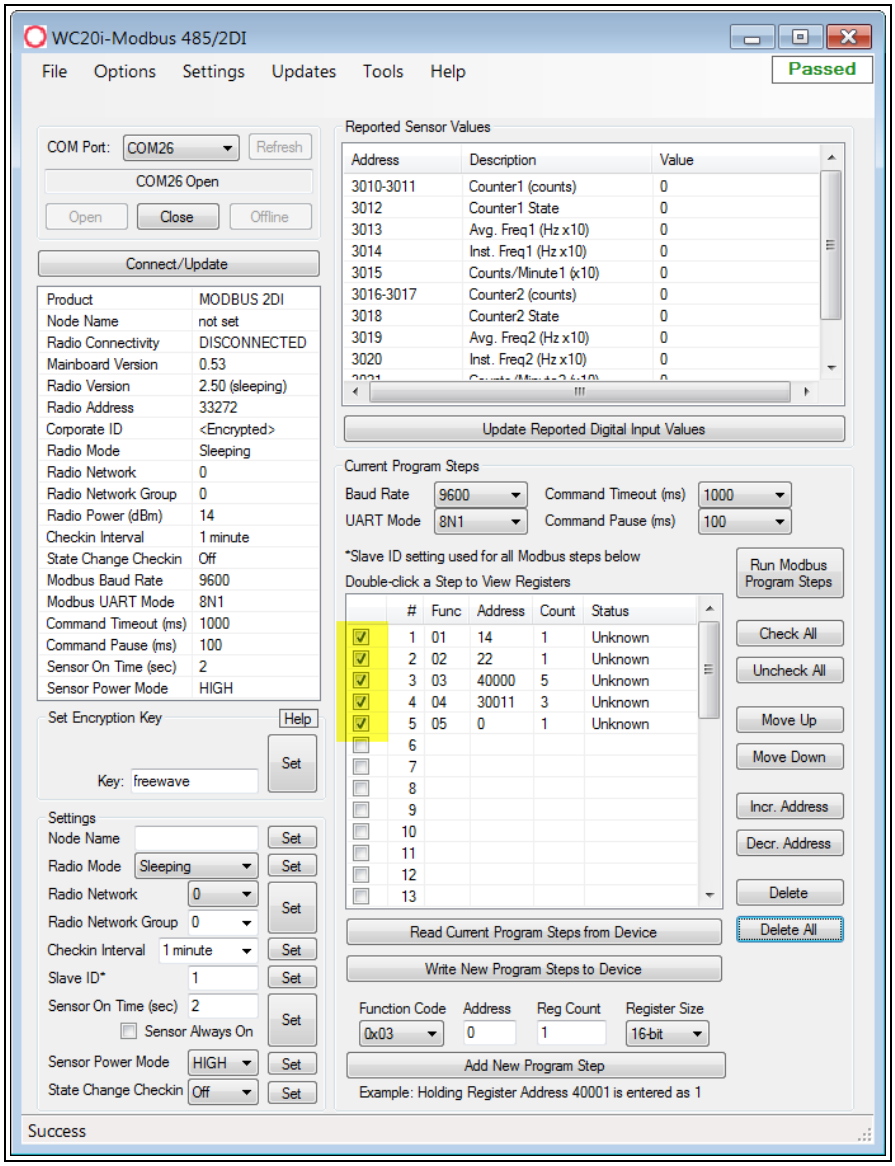


Figure 31: All Program Step Selected in the WC20i-485-2DI Device Configuration window

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.

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 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).

7.4. Re-order Program Steps

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

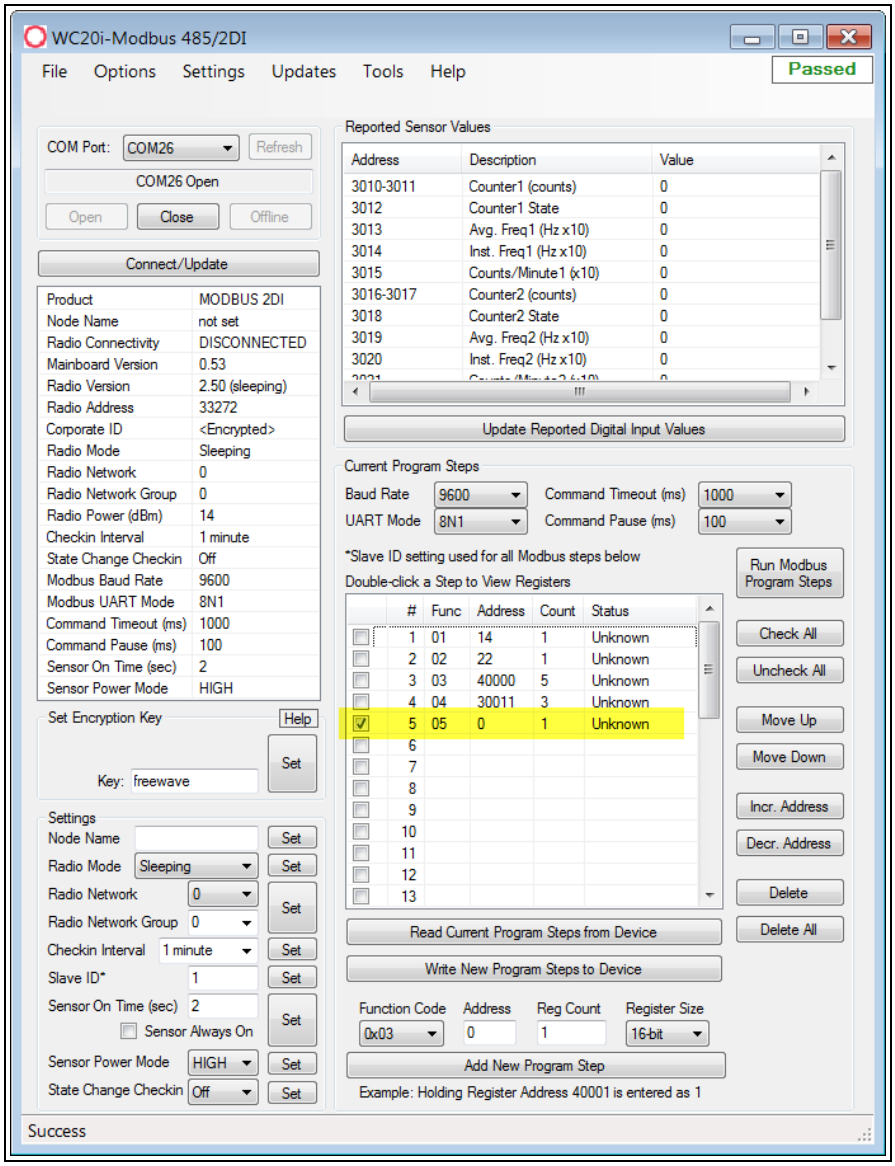


Figure 32: Selected Program Step in the WC20i-485-2DI Device Configuration window

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.

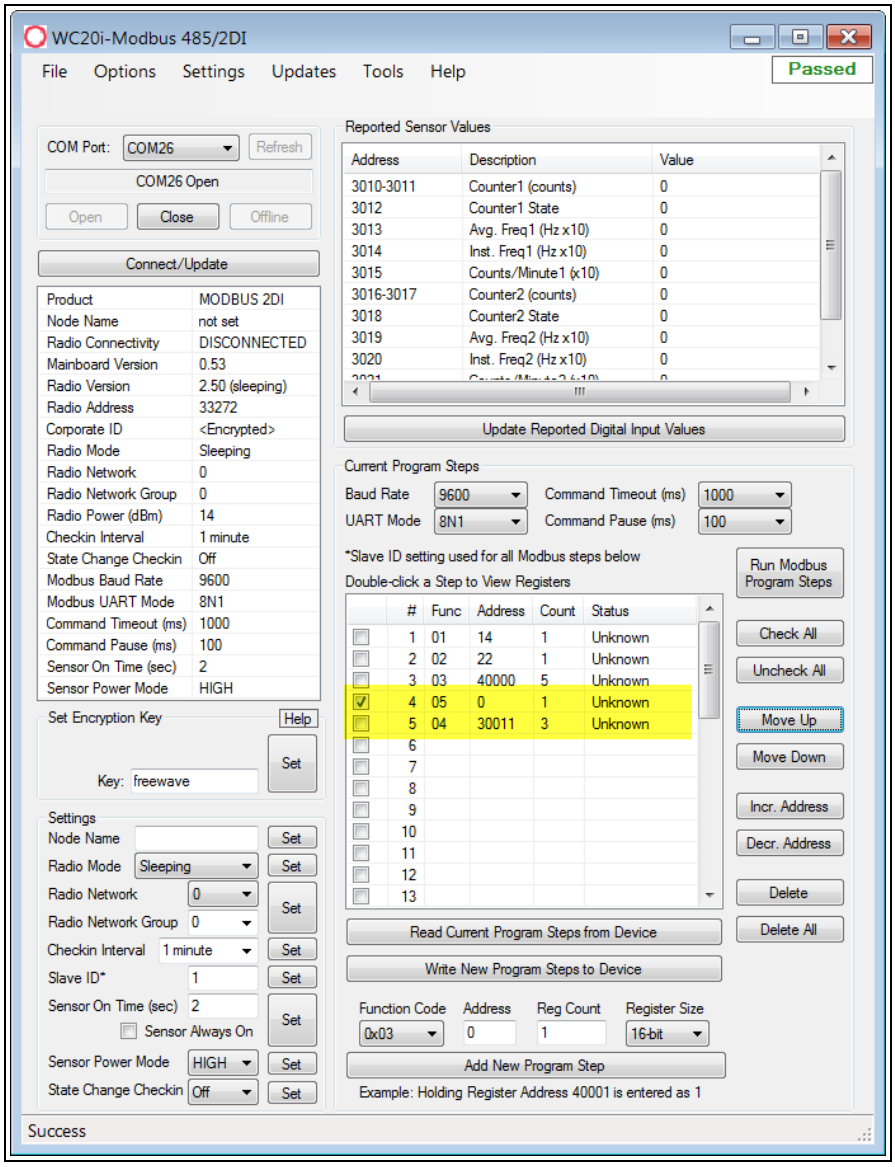


Figure 33: Selected Program Step Moved Up

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 TX and ACT lights and a Red blinking light for RX.
> If the connection is NOT successful, a Green blinking 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.

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).

8. Mounting, Battery Replacement, Cleaning

- The WC20i:
  - comes with a watertight ½" 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.

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.

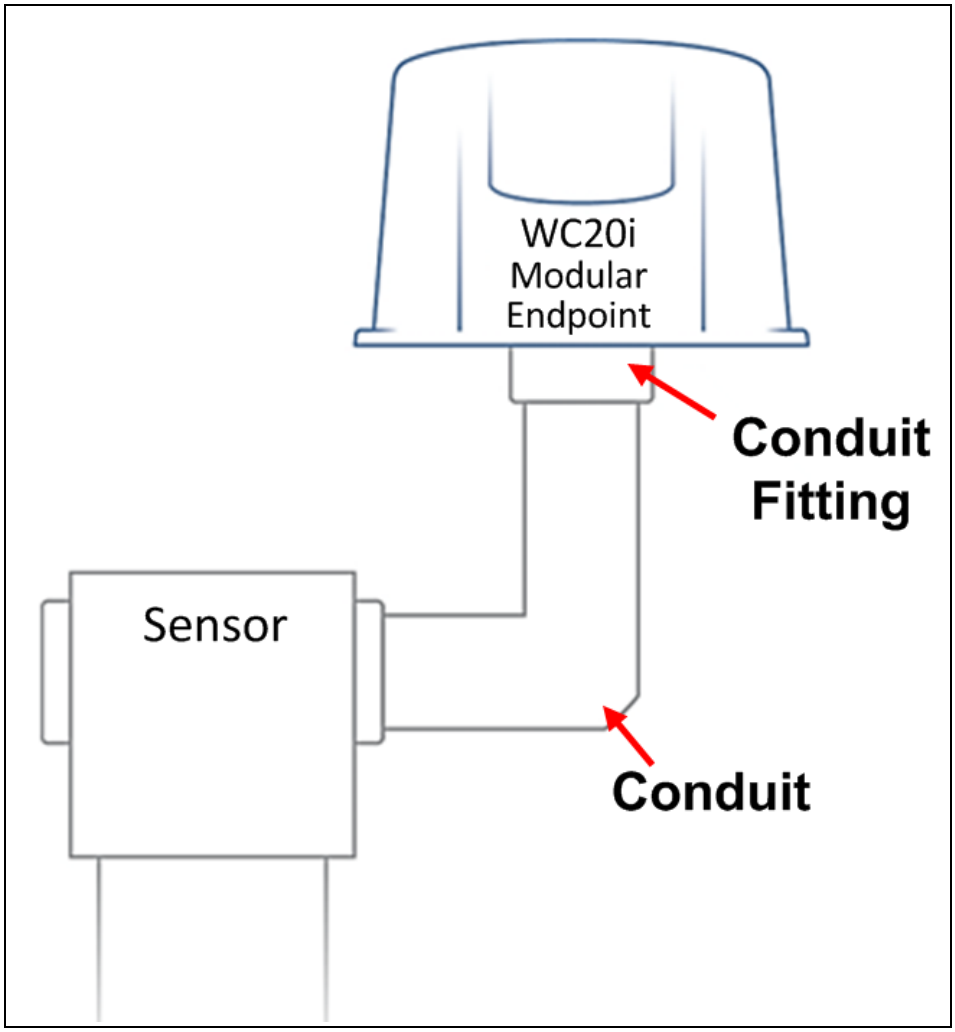


Figure 34: WC20i-485 or WC20i-485-S Modular Endpoint Direct Mount

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.

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.

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.

Modbus - WC20i-485 / WC20i-485-S Status Registers		
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

10. WC Toolkit Software Environment

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

- Device Configuration window (on page 57)

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.
4. Open the **WC Toolkit** software.
   The **Select Device** window opens. (Figure 35)

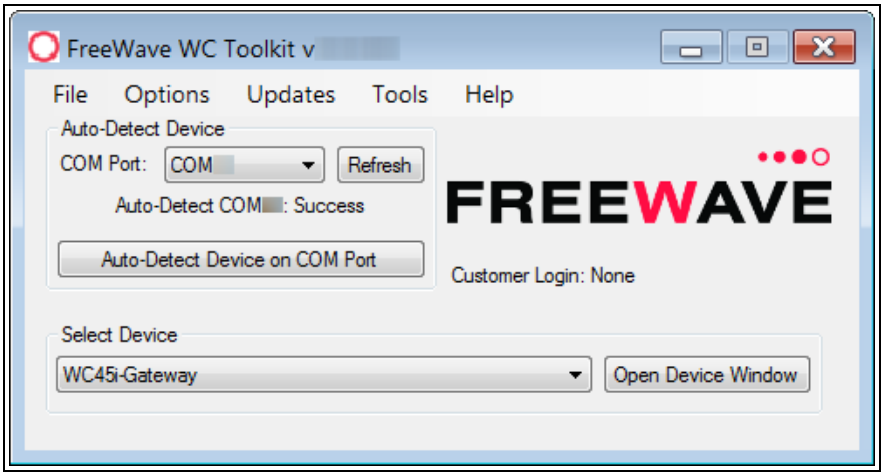


Figure 35: Select Device window

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.

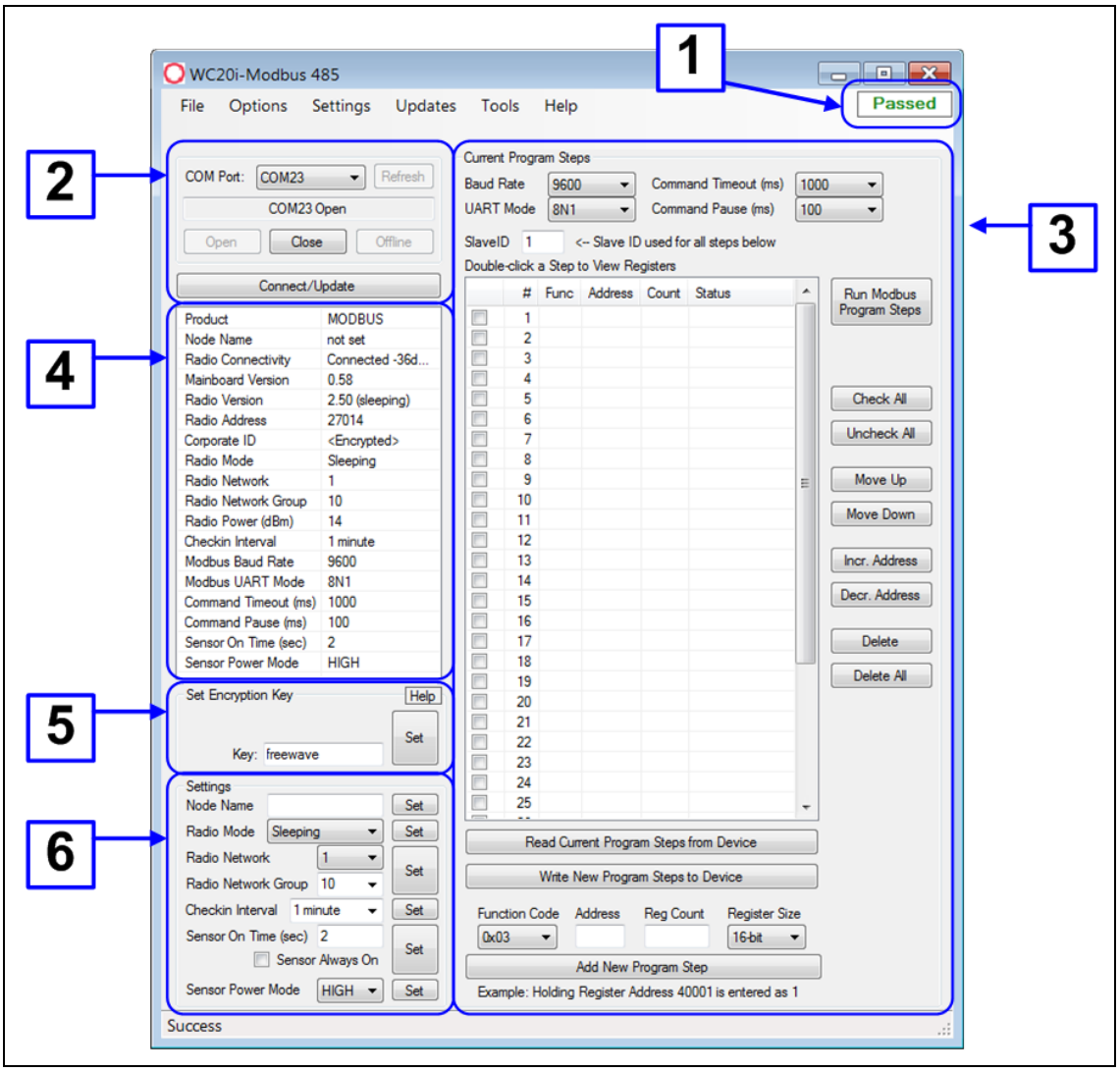


Figure 36: Device Configuration window: WC20i-485 or WC20i-485-S

Device Configuration window: WC20i-485 or WC20i-485-S		
Control Area	**Control Title**	**Control Description**
1 - **Status of Last Operation** text box		The **Status of Last Operation** text box indicates whether the last command from the WC Toolkit to the connected device is **Active** or has **Passed**. **Note**: A **Firmware Update Available** 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.

Device Configuration window: WC20i-485 or WC20i-485-S		
Control Area	**Control Title**	**Control Description**
2 - **Serial Port Settings** area		The **Serial Port Settings** 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 **COM Port** 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 **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.
2 - **Serial Port Settings** area	**COM** text box	The **COM** 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 **Open** button to re-connect the WAVECONTACT device to the COM port.
2 - **Serial Port Settings** area	**Close** button	Click the **Close** button to disconnect the WAVECONTACT device from the COM port.
2 - **Serial Port Settings** area	**Offline** button	Click the **Offline** 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 **Connect / Update** button to re-connect to the COM port of the WAVECONTACT device. **Note**: 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 - **Reported Values** area		The **Reported Values** area shows the reported data values from the attached sensor. **Note**: This information is read-only.
3 - **Current Program Steps**		The **Current Program Steps** area is used to define the Modbus operation codes for each poll check-in. **Note**: See the Current Program Steps area (on page 63) for detailed information about the settings.

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 - **Set Encryption Key** area		The **Set Encryption Key** area is used to activate and define the encryption key for the WAVECONTACT device.
5 - **Set Encryption Key** area	**Help** button	Click to open the Encryption **Help** message.
5 - **Set Encryption Key** area	**Key** text box	In the **Key** 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 are configured with the same **Key**.
5 - **Set Encryption Key** area	**Set** button	Click the **Set** button to save the information.
6 - **Settings** area		The **Settings** 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 **Node Name** text box, enter a name for the Endpoint using a maximum of 10 characters.

Device Configuration window: Settings area	
Control Title	**Control Description**
Radio Mode list box	Click the **Radio Mode** list box arrow and select either **Sleeping** or **Non-Sleeping**. • **Sleeping**: Select **Sleeping** to reduce power consumption and to use the designated **Checkin Interval** list box to connect with the Gateway. • **Non-Sleeping**: Select **Non-Sleeping** to always be in communication with the Gateway. • **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 **Radio Network** 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 **Radio Network Group** 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.

Device Configuration 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 • 1 minute • 2 minutes • 4.5 minutes • 10 minutes • 15 minutes • 30 minutes • 60 minutes **Note**: The default value is 5 seconds.
Sensor On Time (sec) text box	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. Contact the sensor manufacturer for details.
Sensor Always On check box	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. **Note**: Having the **Sensor Always On** selected is useful for rapid data collection on a sensor that has a long warm-up time. However, it will shorten the battery life **dramatically** unless a **Solar Powered WC20i** is used.
Sensor Power Mode list box	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.

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 **Current Program Steps** area is used to define the Modbus operation codes for each poll check-in.
3 - **Current Program Steps**	**Baud Rate** list box	Click the **Baud Rate** list box arrow and select the baud rate for the RS485 Modbus port.
3 - **Current Program Steps**	**UART Mode** list box	Click the **UART Mode** 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 **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. The options are: • 500 • 1000 • 1500 • 2000 • 2500 • 3000
3 - **Current Program Steps**	**Command Pause (ms)** list box	Click the **Command Pause (ms)** list box arrow and select the number of mS the device pauses between each Modbus transaction. The options are: • 50 • 100 • 150 • 200 • 250 • 500 • 1000 • 1500 • 2000
3 - **Current Program Steps**	**Slave ID** text box	In the **Slave ID** 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 **Registers** table shows the available Program Steps of the connected Modbus device.
3 - **Current Program Steps**	**Run Modbus Program Steps** button	Click the **Run Modbus Program Steps** button to run the Program Steps to poll the Modbus device on each check-in.

Device Configuration window: Current Program Steps area		
Control Area	**Control Title**	**Control Description**
3 - **Current Program Steps**	**Check All** button	Click the **Check All** button to select all the current Program Steps in the table.
3 - **Current Program Steps**	**Uncheck All** button	Click the **Uncheck All** button to clear all of the selected Program Steps in the table.
3 - **Current Program Steps**	**Move Up** button	Click the **Move Up** button to move a selected Program Step up in the program to its new location.
3 - **Current Program Steps**	**Move Down** button	Click the **Move Down** button to move a selected Program Step down in the program to its new location.
3 - **Current Program Steps**	**Incr. Address** button	Click the **Incr. Address** button to increase the address value of the selected Program Step.
3 - **Current Program Steps**	**Decr. Address** button	Click the **Decr. Address** button to decrease the address value of the selected Program Step.
3 - **Current Program Steps**	**Delete** button	Click the **Delete** button to IMMEDIATELY remove the selected Program Step from the table.
3 - **Current Program Steps**	**Delete All** button	Click the **Delete All** button to IMMEDIATELY remove all selected Program Steps from the table.
3 - **Current Program Steps**	**Read Current Program Steps from Device** button	Click the **Read Current Program Steps from Device** button to view the current Program Steps in the table.
3 - **Current Program Steps**	**Write New Program Steps to Device** button	Click the **Write New Program Steps to Device** 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 **Address** 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.

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 **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.
3 - **Current Program Steps**	**Coil Value** text 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.
3 - **Current Program Steps**	**Register Size** list box	Click the **Register Size** list box arrow and select the designated register size in bits. The default value is 16-bit. **Note**: The **Register Size** list box is only available if **0x03** or **0x04** is selected in the **Function Code** list box.
3 - **Current Program Steps**	**Add New Program Step** button	Click the **Add New Program Step** button to add a new Program Step to the table.

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)

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

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

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

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

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 • 5 seconds to 1 hour, typical
Networks	Maximum of 65,520 separate networks
Receiver	

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 **Note**: C1D1 certified when used with FreeWave system. Replacement can be performed safely in hazardous locations. Optional: C1D1 solar / battery module **Note**: 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

Appendix B: Control Drawing: 960-0027-02

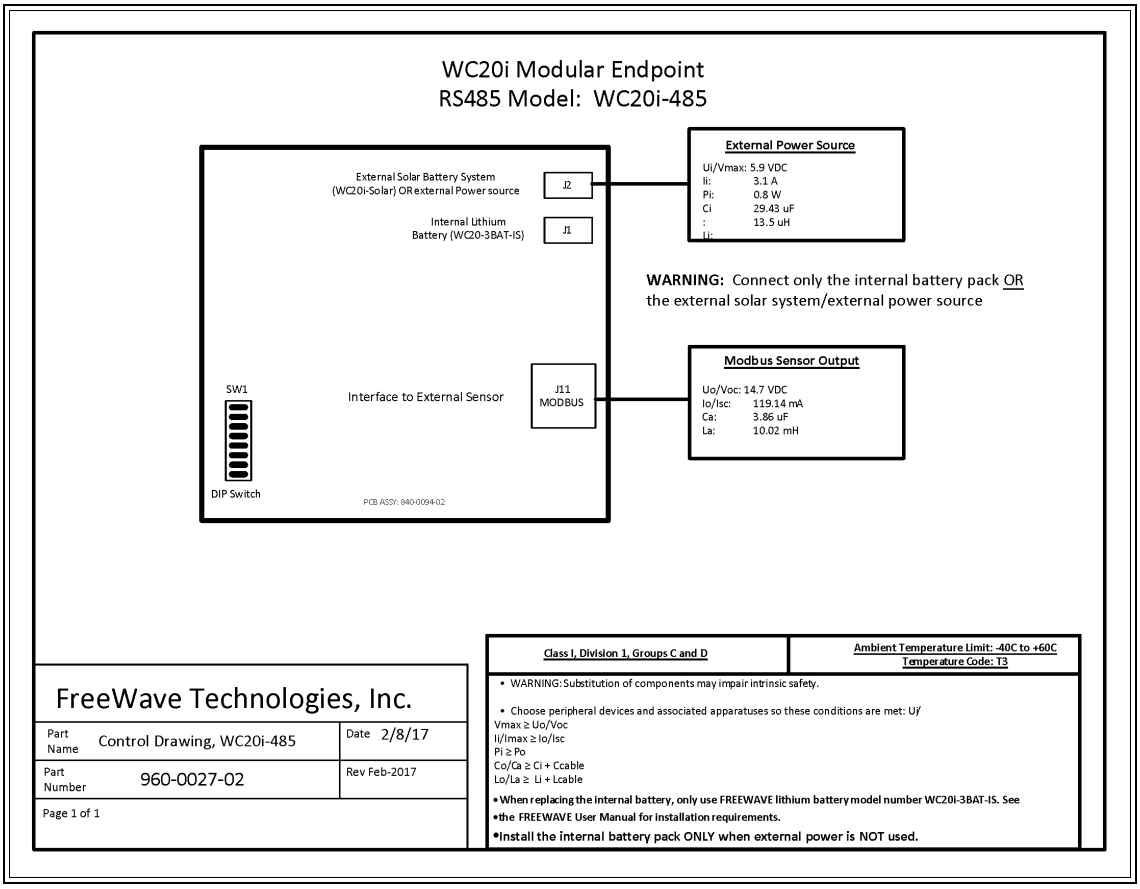


Figure 37: Control Drawing: WC20i-485 / WC20i-485-S

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.

Appendix D: LEDs

These are the WC20i LEDs available for field diagnostics.

WC20i LEDs	
Radio LEDs	**Description**
	• The Radio TX LED Flashes green each time a radio packet is sent. • This LED is rapidly Green blinking while searching for the radio network. • The Radio RX LED is Red blinking for each received radio packet.
Status LEDs	
	• The ERROR LED Red blinking to indicate an error condition.
Check-in button	
	• 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.

Appendix E: Available Accessories

These accessories are available from FreeWave for the WAVECONTACT products.

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. **Caution**: 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 **Note**: This does NOT include the WC20i Endpoint. It is only the Solar Panel with its accompanying equipment.

Available Accessories	
FreeWave Part #	**Description**
Tank Level Solar Panel Mounting Kits **Note**: These mounting kits fit all FreeWave**WC20i-Solar** 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

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

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

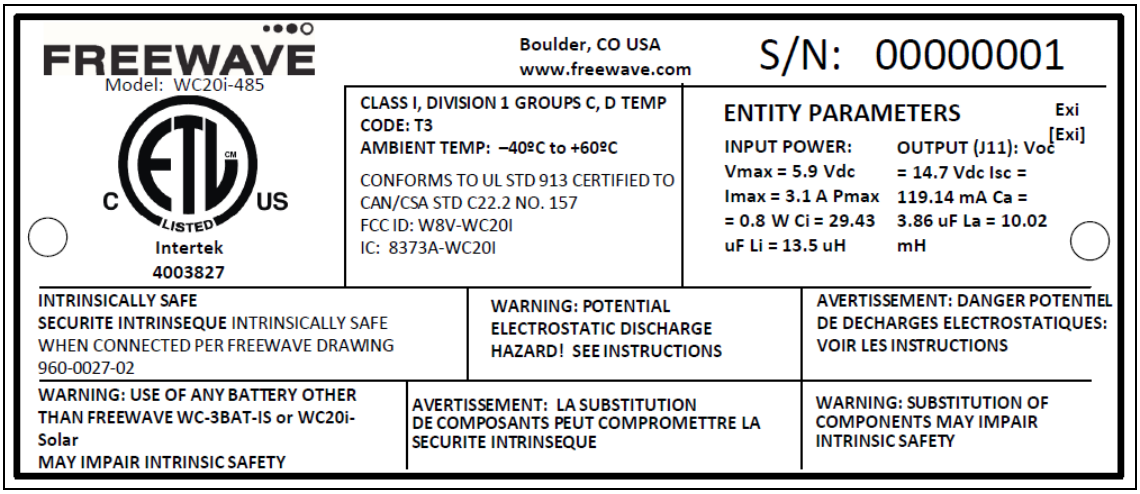
Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a maximum (or lesser) gain approved for this transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically 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.

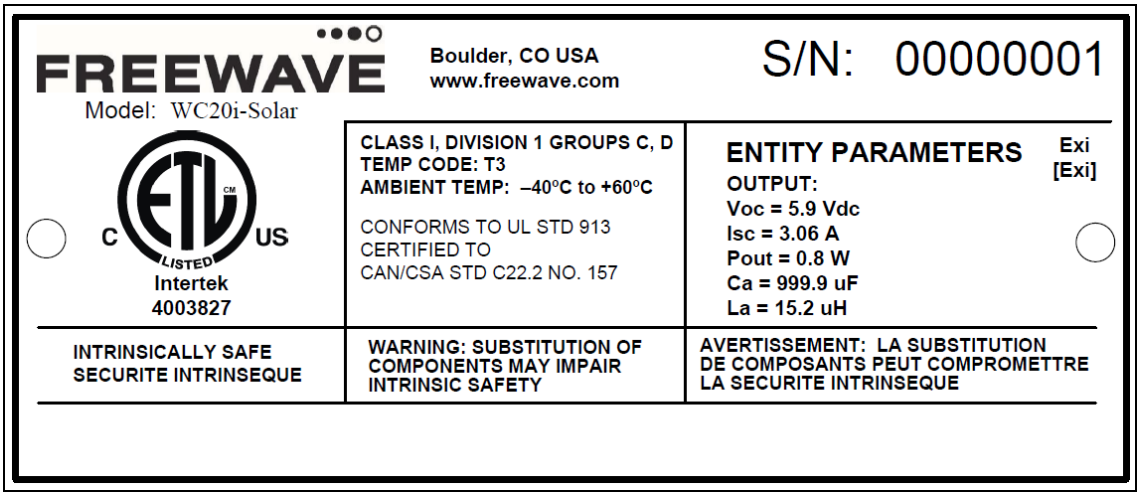
Ce dispositif est conforme aux normes permis-exemptes du Canada RSS d'industrie. L'opération est sujette aux deux conditions suivantes : (1) ce dispositif peut ne pas causer l'interférence, et (2) ce dispositif doit accepter n'importe quelle interférence, y compris l'interférence qui peut causer le fonctionnement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

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



WC20i-485-ETL C1D1

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



WC20i-Solar ETL C1D1 Label

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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.

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.

FREEWAVE