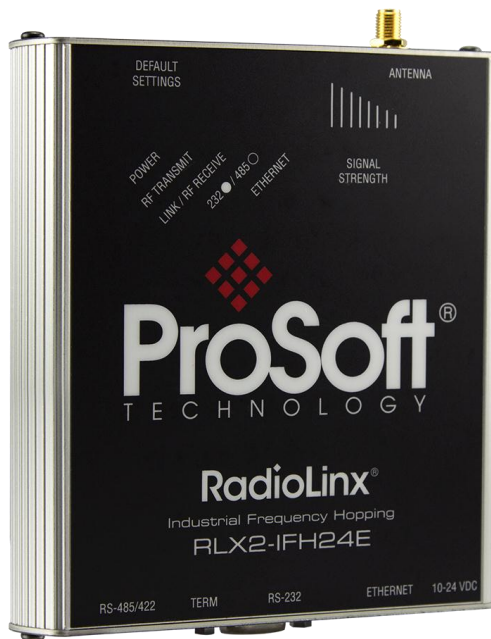




Where Automation Connects.



## RLX2-IFHxE

**Industrial Wireless**

Industrial Frequency Hopping  
Ethernet Radios

May 28, 2014

**USER MANUAL**

## Your Feedback Please

We always want you to feel that you made the right decision to use our products. If you have suggestions, comments, compliments or complaints about our products, documentation, or support, please write or call us.

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RLX2-IFHxE User Manual

May 28, 2014

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Printed documentation is available for purchase. Contact ProSoft Technology for pricing and availability.

## Important Safety Information

The following Information and warnings pertaining to the radio module must be heeded.

"This Equipment is suitable For Use in Class I, Division II, Groups A, B, C, D or Non-Hazardous Locations Only"

**"WARNING – EXPLOSION HAZARD – Substitution of any components may impair suitability for Class I, Division 2"**

**"WARNING - EXPLOSION HAZARD - Do not disconnect equipment unless power has been removed or the area is known to be non-hazardous".**

Device must be powered by a Class 2 Power Source.

Device is open-type and is to be installed in an enclosure suitable for the environment that utilizes a tool removable door/cover.

"THIS DEVICE CONTAINS A TRANSMITTER MODULE, FCC ID: . PLEASE SEE FCC ID LABEL ON BACK OF DEVICE."

"THIS DEVICE USES AN INTERNAL COMPACT FLASH RADIO MODULE AS THE PRIMARY RADIO COMPONENT. THE COMPACT FLASH RADIO MODULE DOES NOT HAVE AN FCC ID LABEL. THE COMPACT FLASH RADIO MODULE HAS NO USER SERVICEABLE PARTS."

"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 UNDESIRE OPERATION."

"CHANGES OR MODIFICATIONS NOT EXPRESSLY APPROVED BY THE PARTY RESPONSIBLE FOR COMPLIANCE COULD VOID THE USER'S AUTHORITY TO OPERATE THE EQUIPMENT."

## Industry Canada Requirements

"THIS DEVICE HAS BEEN DESIGNED TO OPERATE WITH AN ANTENNA HAVING A MAXIMUM GAIN OF 24 dB. AN ANTENNA HAVING A HIGHER GAIN IS STRICTLY PROHIBITED PER REGULATIONS OF INDUSTRY CANADA. THE REQUIRED ANTENNA IMPEDANCE IS 50 OHMS."

"TO REDUCE POTENTIAL RADIO INTERFERENCE TO OTHER USERS, THE ANTENNA TYPE AND ITS GAIN SHOULD BE CHOSEN SUCH THAT THE EQUIVALENT ISOTROPICALLY RADIATED POWER (EIRP) IS NOT MORE THAN THAT REQUIRED FOR SUCCESSFUL COMMUNICATION."

"THE INSTALLER OF THIS RADIO EQUIPMENT MUST INSURE THAT THE ANTENNA IS LOCATED OR POINTED SUCH THAT IT DOES NOT EMIT RF FIELD IN EXCESS OF HEALTH CANADA LIMITS FOR THE GENERAL POPULATION; CONSULT SAFETY CODE 6, OBTAINABLE FROM HEALTH CANADA."

---

ATEX; Zone 2

---

CE

---

cULus; Class 1, Div 2

---

CB Safety (IEC 60950-1)

---

FCC/IC

---

## FCC Part 15 & Industry Canada Rules

The statements contained in this "Regulatory Approvals" section are required. If the ProSoft Technology wireless device and switches are used as a component of any device, these statements must be a component of that device's product documentation.

## Compliance Statement

The ProSoft Technology radio devices comply with Part 15 of the FCC Rules as well as Industry Canada Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference, and,
- This device must accept any interference received, including interference that may cause undesired operation.

In Canada, this device is to be operated indoors only and away from windows to provide maximum shielding and to prevent radio interference to the Canadian licensed service. Equipment (or its transmit antenna) that is installed outdoors in Canada is subject to licensing.

**Note:** The ProSoft Technology radio device is labeled with an FCC ID number and a Canadian Certification Number. If this label is not visible when installed in an end-device, the outside of the device **MUST** also display a label referring to the enclosed radio. Use wording on the label similar to the following:

RLX2-IFH9E: "Transmitter Module FCC ID: NS908P25, Canada 3143A-O8P32"

RLX2-IFH24E: "Transmitter Module FCC ID: IC NS912P32, Canada 3143A-12P32"

OR

RLX2-IFH9E: "This device contains Transmitter Module FCC ID: NS908P25, Canada 3143A-O8P32"

RLX2-IFH24E: "This device contains Transmitter Module FCC ID: NS912P32, Canada 3143A-12P32"

**WARNING:** Changes or modifications to this radio module not expressly approved by its manufacturer, ProSoft Technology, may void the user's authority to operate the equipment.

## EU Requirements

1. For outdoor use, France has a frequency restriction of 2.4 GHz to 2.454 GHz for an output power greater than 10 mW and below 100 mW.
2. For outdoor use in France, the output power is restricted to 10 mW in the frequency range of 2.454 GHz to 2.4835 GHz.
3. 5.15 GHz to 5.35 GHz is restricted to 200 mW EIRP throughout the European Union.

## Recommended Antennas

Recommended Antennas

Part Number	Max Gain	Part Number	Max Gain	Part Number	Max Gain
A902S-OA	2 dBi	A2424NJ-DB	24 dBi	A2410NJ-DY	10 dBi
A907NJ-OC	7 dBi	A082503-80-OBH	3 dBi	A2415NJ-DY	15 dBi
A908NJ-DY	8 dBi	A911NJ-DY	11 dBi	A2402S-OS	2 dBi
A2402S-OSLP	2 dBi	A2403NBH-OC	3 dBi	A2404NBHW-OC	4 dBi
A2404NJ-OC	4 dBi	A2405S-OA	5 dBi	A2405S-OM	5 dBi
A2505S-OS	5 dBi	A2406NJ-OC	6 dBi	A2406NJ-OCD	6 dBi
A2408NJ-OC	8 dBi	A2409NJ-OCD	9 dBi	A2415NJ-OC	15 dBi
A902NJ-OC	2 dBi	A902S-OA	2 dBi	A903NBH-OC	3 dBi
A903S-OM	3 dBi	A905NJ-OC	5 dBi	A907NJ-OC	7 dBi
A2408NJ-DP	8 dBi	A2413NJ-DP	13 dBi	A2416NJ-DP	16 dBi
A2419NJ-DP	19 dBi	A912NJ-DP	12 dBi	A2419NJ-DB	19 dBi

## **Antenna spacing requirements for user safety**

It is important to keep the radio's antenna a safe distance from the user. To meet the requirements of FCC part 2.1091 for radio frequency radiation exposure, this radio must be used in such a way as to guarantee at least 20 cm between the antenna and users. Greater distances are required for high-gain antennas. The FCC requires a minimum distance of  $1 \text{ mW} \cdot \text{cm}^2$  power density from the user (or 20 cm, whichever is greater).

If a specific application requires proximity of less than 20 cm, the application must be approved through the FCC for compliance to part 2.1093.

## **Important Notice**

Due to the nature of wireless communications, data transmission and reception can never be guaranteed. Data may be delayed, corrupted (that is, it may have errors), or be totally lost. Significant delays or losses of data are rare when wireless devices such as ProSoft Technology Wireless products are used in a normal manner with a well-constructed network. Nevertheless, the RLX2-IFHxE should not be used in situations where failure to transmit or receive data could result in damage of any kind to the user or any other party, including but not limited to personal injury, death, or loss of property. ProSoft Technology accepts no responsibility for damages of any kind resulting from delays or errors in data transmitted or received using ProSoft Technology products, or for failure of the (RLX2-IFHxE) to transmit or receive such data.

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# 1 Start Here

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## 1.1 Specifications

### 1.1.1 **RLX2-IFH24E**

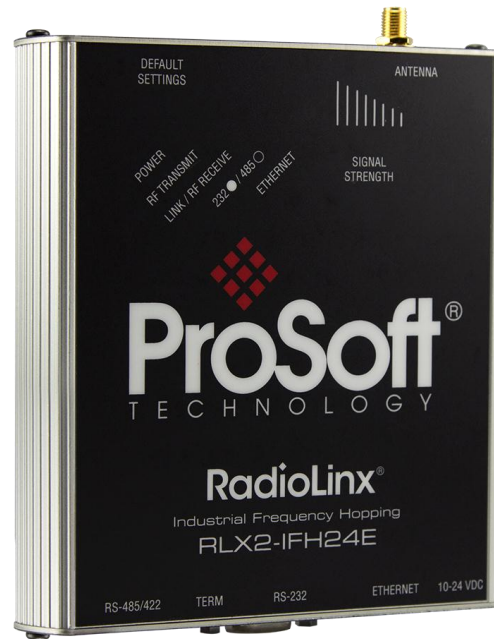
The RLX2-IFH24E Industrial Frequency Hopping 2.4 GHz series of radios provide powerful and secure wireless Ethernet and Serial communications. These radios are well suited for demanding, long-range (up to 15+ miles) SCADA and other Ethernet applications including those in harsh or hazardous environments.

Operating in the internationally license-free 2.4 GHz band, the RLX2-IFH24E provides an alternative when other wireless technologies cannot be used due to government regulations, band saturation, or customer preference. The RLX2-IFH24E is backwards compatible with ProSoft Technology's RLX-IFH24E.

You can configure the RLX2-IFH24E as a master, repeater, or remote radio. It provides virtual peer-to-peer packet switching and network optimization using advanced Smart Switch technology. Combined with an industry leading high-speed transmitter, the RLX2-IFH24E is ideal for applications that require fast and reliable communications at long distances.

The RLX2-IFH24E is quickly configured using the included graphical ControlScope software. An OPC server software is also included and allows you to monitor radio network health with any OPC client-based HMI software.

The RLX2-IFH24E employs proprietary frequency hopping algorithms and 128-bit AES encryption algorithm approved by most governments for critical networks.



Frequency	2.400 GHz to 2.4835 GHz
Protocols	All standard IEEE 802.3 protocols
Security	128 bit AES encryption
Network Topology	Point-to-point, point-to-multipoint, store and forward repeater. Smart Switch packet switching for virtual peer-to-peer communications
Error Detection	32 bit CRC, ARQ (Automatic Resend Query)
Radio Type	Frequency Hopping Spread Spectrum
Transmit Power	100 mW to 1 W (FCC - A model - Programmable) 10 mW to 100 mW (ETSI - E model - Programmable)
Channel data rates	1.1 Mbps or 345 kbps (Programmable)
Receiver Sensitivity (Typical)	1.1 Mbps: -97 dBm @ 10-6 BER 345 kbps: -104 dBm @ 10-6 BER
Outdoor Range	15+ miles pt-pt with high gain directional antennas and RF line-of-sight

#### Hardware Specifications

Enclosure	Extruded aluminum with DIN
Size	14.7 x 11.8 x 3.8 cm / 5.78 x 4.64 x 1.48 inches (W x H x D)
Ethernet Port	10/100 Base-T connector, shielded RJ45 IEEE 802.3, 802.3u, 802.3x
Serial Data Port	RS-232, DB9/ RS-422 and RS-485 300 bps to 230 kbps. Supports serial to serial tunneling and serial TCP/UDP encapsulation

---

Antenna Ports	(1) RP-SMA connector
Weight	13 oz. (369g)
Operating Temp	-40°F to 167°F (-40°C to +75°C)
Humidity	Up to 95% RH, with no condensation
Vibration	IEC 60068-2-6 (5g, @ 10 Hz to 150Hz)
Shock	IEC 60068-2-27; 20g @ 11ms, 3-Axis (Operational) IEC 60068-2-27; 30g @ 11ms, 3-Axis (Non-Operational)
External Power	9 to 24 VDC
Power Consumption	4.2 W maximum

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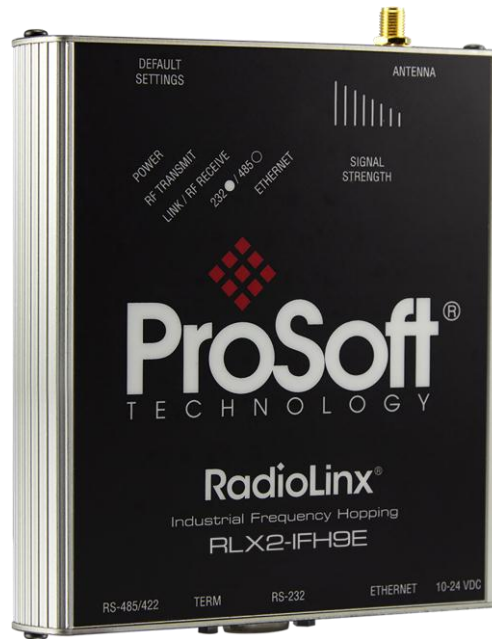
### **1.1.2 RLX2-IFH9E**

The ProSoft Technology Industrial Frequency Hopping 900 MHz series of radios provide powerful and secure wireless Ethernet and serial communications. They are well suited for demanding, long range (up to 30+ miles) SCADA and other Ethernet applications, including those in harsh or hazardous environments. The RLX2-IFH9E is backwards compatible with ProSoft Technology's RLX-IFH9E.

You can configure the RLX2-IFH9E as a master, repeater, and remote radio. It provides virtual peer-to-peer packet switching and network optimization using advanced Smart Switch technology. Combined with an industry leading high-speed transmitter, the RLX2-IFH9E is ideal for applications requiring fast and reliable communications at long distances.

The RLX2-IFH9E is quickly configured using the included graphical ControlScope software. An OPC server software is also included and allows users to monitor radio network health with any OPC client-based HMI software.

The RLX2-IFH9E employs proprietary frequency hopping algorithms and 128-bit AES encryption approved by most governments for critical networks.



Frequency	900 MHz to 928 MHz
Protocols	All standard IEEE 802.3 protocols
Security	128 bit AES encryption
Network Topology	Point-to-point, point-to-multipoint, store and forward repeater. Smart Switch packet switching for virtual peer-to-peer communications
Error Detection	32 bit CRC, ARQ (Automatic Resend Query)
Radio Type	Frequency Hopping Spread Spectrum
Transmit Power (Programmable)	100 mW to 1 W (Programmable) 20 dBm to 30 dBm (Programmable)
Channel data rates	1.1 Mbps or 345 kbps (Programmable)
Receiver Sensitivity (Typical)	1.1 Mbps: -97dBm @ 10-6 BER 345 kbps: -104 dBm @ 10-6 BER
Outdoor Range	30+ miles pt-pt with high gain directional antennas and RF line-of-sight

#### Hardware Specifications

Enclosure	Extruded aluminum with DIN
Size	14.7 x 11.8 x 3.8 cm / 5.78 x 4.64 x 1.48 inches (W x H x D)
Ethernet Port	10/100 Base-T connector, shielded RJ45 IEEE 802.3, 802.3u, 802.3x
Serial Data Port	RS-232, DB9 / RS-422 and RS-485 300 bps to 230 kbps. Supports serial to serial tunneling and serial TCP/UDP encapsulation

Antenna Ports	(1) RP-SMA connector
Weight	13 oz. (369g)
Operating Temp	-40°F to 167°F (-40°C to +75°C)
Humidity	Up to 95% RH, without condensation
Vibration	IEC 60068-2-6 (5g @ 10Hz to 150Hz)
Shock	IEC 60068-2-27 ; 20g @ 11ms, 3-Axis (operational) IEC 60068-2-27; 30g @ 11MS, 3-Axis (non-operational)
External Power	9 to 24 VDC
Power Consumption	4.2 W maximum

## 1.2 Package Contents

The following components are included with your RLX2-IFHxE radio, and are all required for installation and configuration.

**Important:** Before beginning the installation, please verify that all of the following items are present.

Qty.	Part Name	Part Number	Part Description
1	RLX2-IFHxE Radio	RLX2-IFHxE	Industrial Frequency Hopping Ethernet Radios
1	2-pin Power Plug	002-0116 RLX CONN	Mating connector used for attachment to customer's power supply
1	5-pin I/O Plug	002-0082 RLX CONN	I/O terminal
1	Header Operating Lever	357-0061	Tool used to assist in power connector wiring
1	Antenna	A2502S-OA A902S-OA	2dBi Omni Articulating Antenna (RLX2-IFH24E) 2dBi Omni Articulating Antenna (RLX2-IFH9E)
1	ProSoft Solutions DVD	DVD-001	Contains sample programs, utilities, and documentation for the RLX2-IFHxE module.

If any of these components are missing, please contact ProSoft Technology Support for replacement parts.

## 1.3 System Requirements

The following system requirements are the recommended minimum specifications to successfully install and run:

- Supported operating systems:
  - Microsoft Windows® Vista
  - Microsoft Windows XP Professional with Service Pack 1 or 2
  - Microsoft Windows 7 Professional (32-or 64-bit)
  - Microsoft Windows 2000 Professional with Service Pack 1, 2, or 3
  - Microsoft Windows Server 2003
- Pentium® II 450 MHz minimum. Pentium III 733 MHz (or better)
- 128 Mbytes of RAM minimum, 256 Mbytes of RAM recommended

- 100 Mbytes of free hard disk space (or more based on application requirements)
- 256-color VGA graphics adapter, 800 x 600 minimum resolution (True Color 1024 x 768 recommended)
- DVD drive
- Ethernet hub with standard RJ45 Ethernet cable  
*or*  
Ethernet port with RJ45 crossover cable for direct connection to module

In addition, you will need:

- A connection to an existing wired or wireless Ethernet network, with a Static or Dynamic IP address for your computer
- Static IP address, Subnet Mask and Gateway address for each device you plan to install. You can get this information from your system administrator.

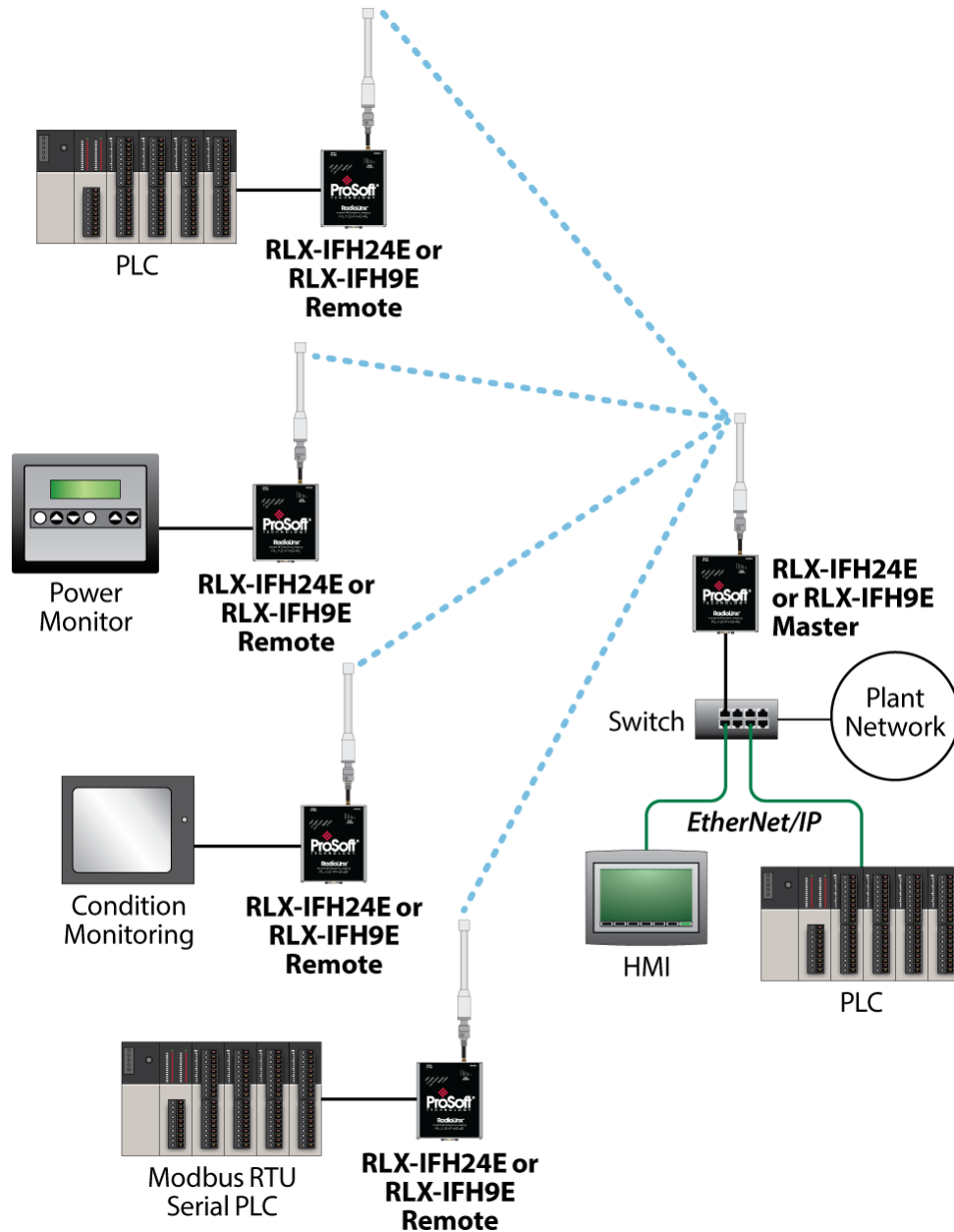
## 1.4 Installing ControlScape FH Configuration Software

- 1 Insert the ProSoft Solutions DVD in your optical disc drive. On most computers, a menu screen opens automatically. If you do not see a menu within a few seconds, follow these steps:
  - a) Click **Start**, and then choose **My Computer**.
  - b) Open the DVD drive by double-clicking on the drive's icon.
  - c) Run the program ProSoft\_DVD.exe by double-clicking the file.
- 2 Once the software loads, select Industrial Wireless from the Platform drop-down list box.
- 3 Select RLX2-IFH9E or RLX2-IFH24E from the Product drop-down list box. This starts the Installation Wizard.
- 4 Follow the installation wizard instructions to install the program with its default location and settings.
- 5 When the installation completes, Windows may prompt to restart the computer.

## 1.5 Planning the Network

Before you configure and install the network, you should create a plan for it. To begin, determine where you need radios and then choose locations for them accordingly. For example, you might decide to install your master radio near a PC in a central plant location. You can use the PC to configure the radios through ControlScape FH. If the plant is an oil refinery, for example, you might decide to install radios near the oil tanks.

The following illustration shows how a radio network of RLX2-IFH24E radios can be deployed to connect a variety of PLCs using a variety of industrial protocols. You could deploy a similar network of RLX2-IFH9E radios.



The next important issue is how to link the radios. Unless the radios are very close together, you must make sure that each pair of radio antennas in the network has a line of sight between them. In other words, you must be able to see from one antenna to another, either with the naked eye or binoculars.

If a line of sight does not exist between antennas, you must choose a site for installing a repeater radio, which creates a bridge between the radio antennas. As part of your planning, you may need to conduct a site survey. ProSoft Technology can perform this survey, you can do it yourself, or you can hire a surveyor.

The simplest way to design the physical network of radios, antennas, connectors, cables, amplifiers and other accessories, is to use ProSoft Wireless Designer. This application determines your hardware needs based on your answers to a few questions, and then generates a Bill of Materials specifying all the components you need for your installation.

Consider printing your network plan from ProSoft Wireless Designer for references as you configure your network in ControlScape FH.

Protect radios from direct exposure to weather, and provide an adequate, stable power source. Make sure that your plan complies with the radio's power requirements and cable specifications (page 42, page 25, page 13).

**Important:** Radios and antennas must be located at least 8 inches (20 cm) away from personnel.

### **1.5.1 Installation Questions**

You may consider the following questions to make your installation easier, and to familiarize yourself with your system and what you want to do.

- How many radios in your network?
- Is there a line of sight between the radios?
- Selected the appropriate antennas for your network?
- What type of network protocols do you need to support?
- What type of cable connections do your network devices require?
- Is the connection made to an existing wired or wireless Ethernet network?

### **1.5.2 ProSoft Wireless Designer**

*ProSoft Wireless Designer* simplifies the task of specifying a ProSoft Wireless installation, and provides a variety of views containing an accurate description of each site in a wireless network, including:

- Visual diagram of site layout
- Location (latitude and longitude, based on GPS coordinates)
- Radio type, frequency range, and country-specific channel and power requirements
- Length, type and estimated signal loss for cables
- Required accessories, including lightning protection, cable adaptors and antennas
- Complete parts list

Use *ProSoft Wireless Designer* when conducting a site audit, it provides a complete list of components and a detailed description for each site and link. You can use this information to understand and visualize a network, and provide necessary information for technical support and maintenance.



### System Requirements

ProSoft Wireless Discovery Tool is designed for computers running Microsoft Windows and Microsoft .NET Framework version 3.0 or newer.

Minimum hardware requirements are:

- 400 MHz or faster Pentium PC
- 128 MB RAM
- DVD drive
- 280 MB available hard drive space

The Microsoft .NET Framework version 3.0 is not supported on Windows 95, Windows NT 4, or Windows 3.x.

It is highly recommended for all platforms that you upgrade to the latest Windows Service Pack and install all critical updates available from Microsoft to ensure the best compatibility and security.

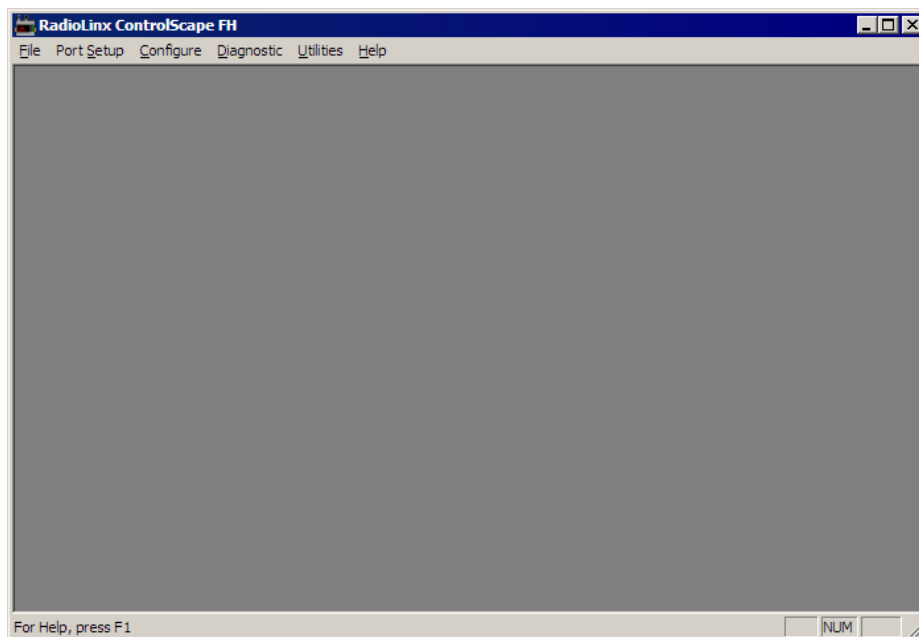
## 1.6 Configuring the Radios

### 1.6.1 Start ControlScape FH

Use the ControlScape FH software to configure the RLX2-IFHxE radios and the radio network.

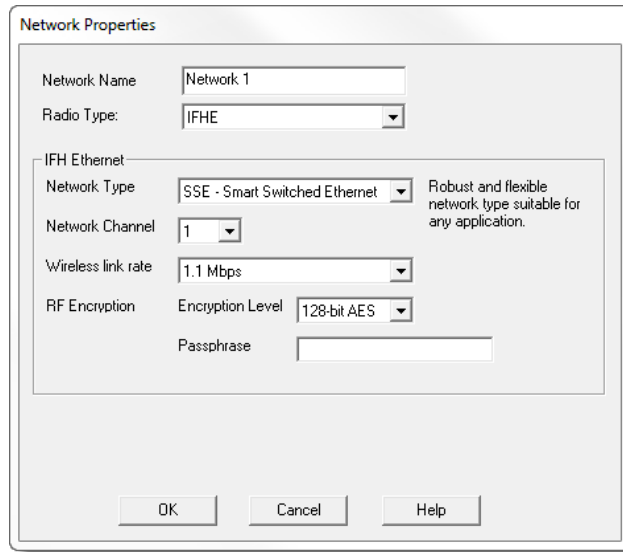
#### To start ControlScape

- 1 Click the Windows **Start**, and then choose Programs
- 2 In the Programs menu, navigate to the ProSoft Technology folder, and then choose RadioLinx ControlScape.
- 3 Allow a few moments for the program to load. When the program has finished loading, you see a screen like this:

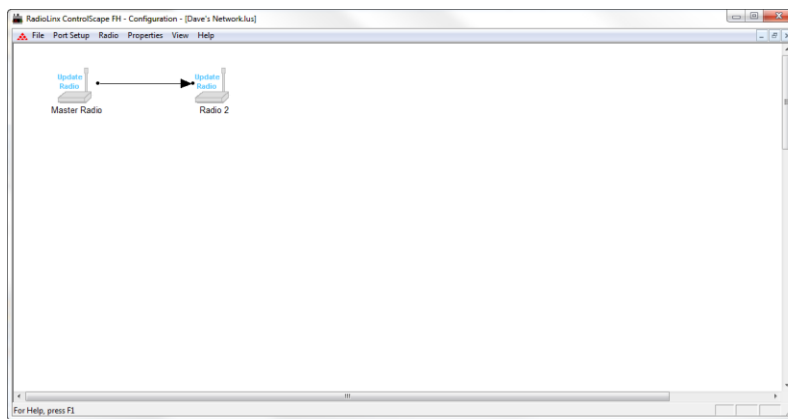


### 1.6.2 Set Up the Network

1. At the top of ControlScape FH window, click **Configure > New Network**.
2. The fields on this *Network Properties* dialog box depend on what type of radio you select. The following example shows a RLX2-IFHxE radio.



3. Select the parameters for your network. The **Passphrase** field requires a passphrase for the radio, which is similar to a password. This can be anything you want and can be up to 24 characters.
4. Click **OK**. The *Configuration Window* now shows a *Master* and *Remote* radio.



5. Choose **File > Save** to save this configuration and then proceed with the instructions in the next section.

### Network Types - IFHE Radios

**Note:** The available network types depend on the type of radio you are configuring. Not all network types are available on all radios. Only the SSE and PTP network types can be chosen for new networks. ControlScape FH still supports all of the legacy network types. The SSE type replaces those networks as it provides the flexibility of the E2E and P2P network types with the performance of the PMP network type or better.

#### **IFH Radios**

- Point-to-Point networks
- Smart Switched Ethernet

**Note:** There is only one Master radio for each network.

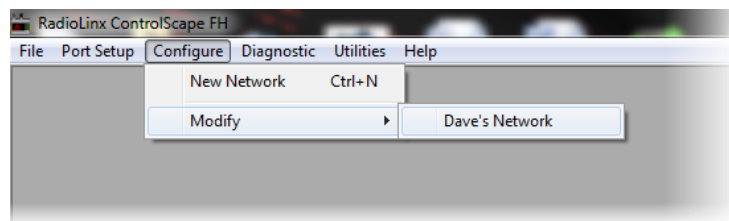
### **1.6.3 General Radio Configuration**

**Note:** If possible, configure all the radios side by side in an office setting and make sure they link before you install them in the field. If feasible, it would be even better if you could set up the entire system in the office and make sure your equipment communicates properly through the radio network.

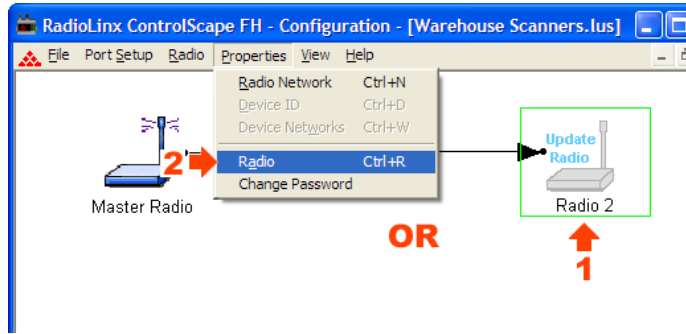
**Important:** If the radios are close enough to each other that their received signal strength is greater than -40dBm, performance may be degraded. Disconnect antennas from radios during bench testing, or move the radios further apart from each other.

Configure the radios themselves after the network is designed. Radios are configured one at a time, using the configuration PC.

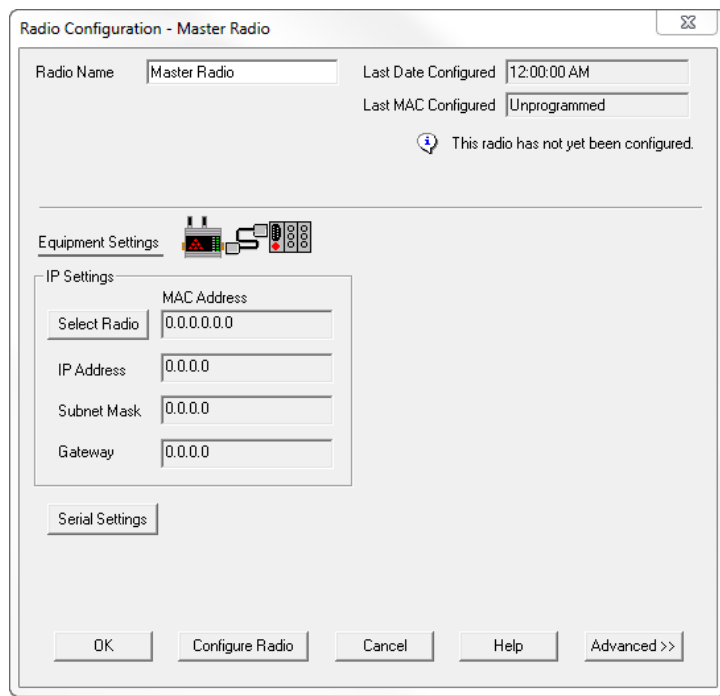
1. Connect the radio to an Ethernet switch or hub (straight-through cable) or directly to the Configuration PC's Ethernet port (crossover cable).
2. Access the *Radio Configuration* dialog box to set network-specific parameters for each individual radio. Starting from the ControlScape FH, choose **Configure > Modify > "name"**.



3. The *Radio Network Configuration* screen appears. There are two different ways to display the <name> dialog box from this screen:
  - Double-click the icon of the radio to be configured.
  - Select the icon of the radio to configure by clicking it, and then choose **Properties > Radio**.



4. The *Radio Configuration Dialog Box* appears. The image of the dialog box is different depending on the *Network Types - Radio* selection.



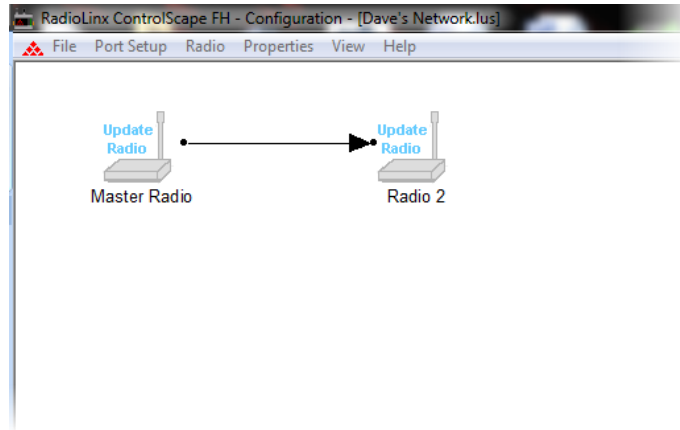
5. Continue to configure the radios depending on their network type.

**Note:** The network types available depend on the type of radio you select. Not all network types are supported on all radios. Refer to the user manual for your radio to determine which network types are available.

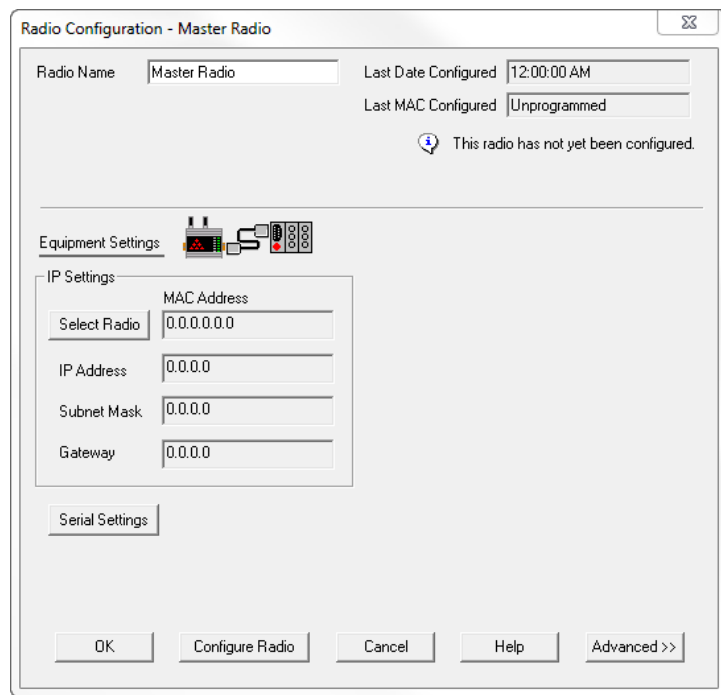
### 1.6.4 Set Up the Master Radio

RLX2-IFHxE radios are designed to act as a replacement for wired connections between a local device (for example, a PLC) with one or more remote devices (for example, another PLC, an HMI, or a field device such as a valve, meter, bar code scanner, or other measurement or control device).

Every radio network requires one Master radio, and one or more Remote radios. When you create a new network, ControlScope FH automatically populates the network with a pair of radios, as shown in the following illustration.



1. Double-click the *Master Radio* icon to open the *Master Radio* dialog box.

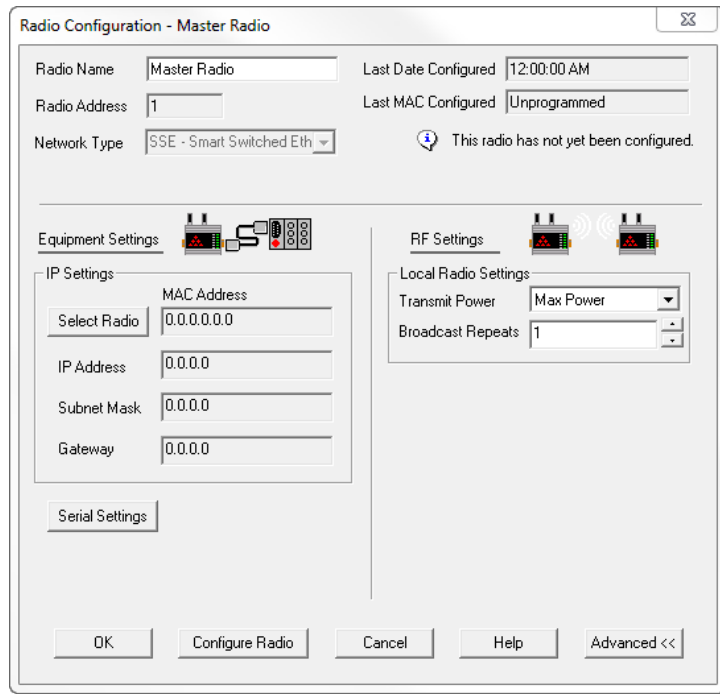


The default settings work with many devices without modification; however you need to assign an IP address, subnet mask and default gateway for each radio on the network. If you are using Serial Protocol Encapsulation to transmit serial data over the wireless network, you may also need to know the communication parameters to use if the wired device requires different settings. This information is normally available in the user manuals for the device.

**Note:** The PC or laptop you use to configure the radios must be on the same subnet as the radio. All ProSoft radios are shipped with a default IP address and Network Mask. The default IP address is 192.168.0.254 with a subnet mask of 255.255.255.0.

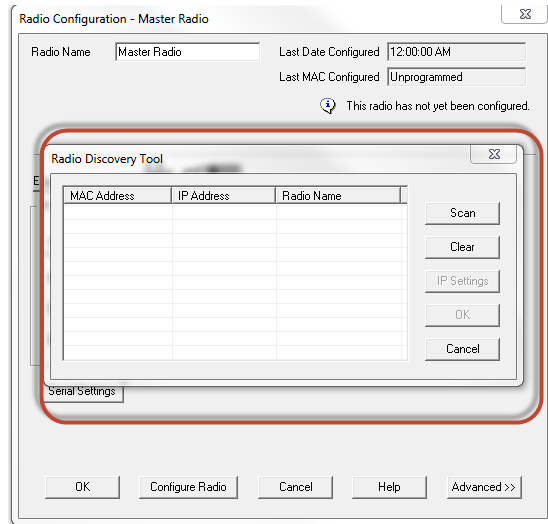
Certain devices may require additional configuration, if the default configuration is not adequate for reliable data transfer. For example, you may need to adjust transmit power to reduce interference with other devices transmitting on the same frequency, or to fine-tune the packet settings to accommodate timing and packet size requirements for an industrial protocol.

2. Click **Advanced** to show these additional options.

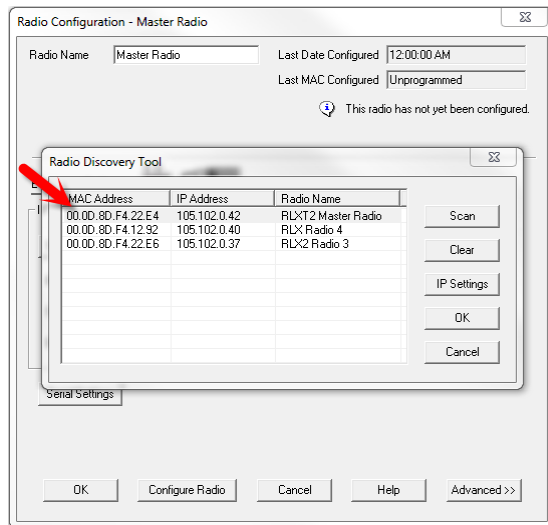


- 3 This will open the *Master Radio* configuration window.

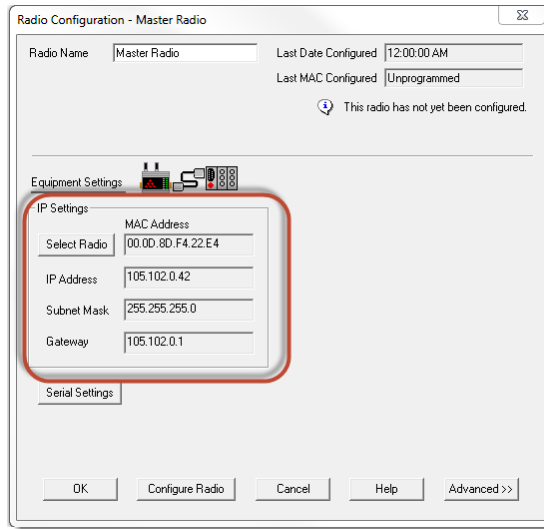
- 4 Click **Select Radio**. The *Radio Discovery Tool* appears.



- 5 Click **Scan** to display all radios discovered by the **Radio Discovery Tool**. If the IP address is configured properly, select the radio from the list of discovered radios and click **OK**.

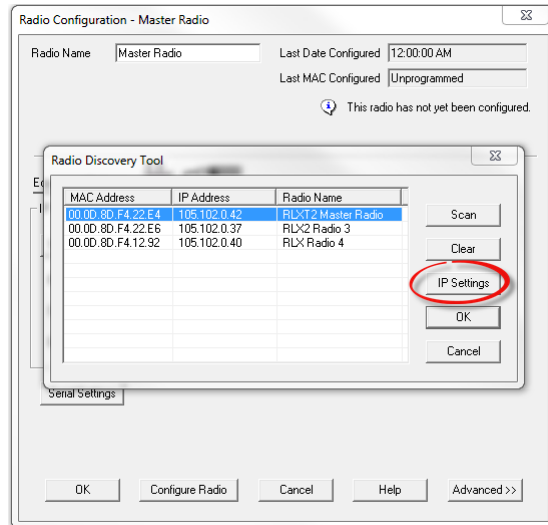


- 6 This displays the settings for the radio.



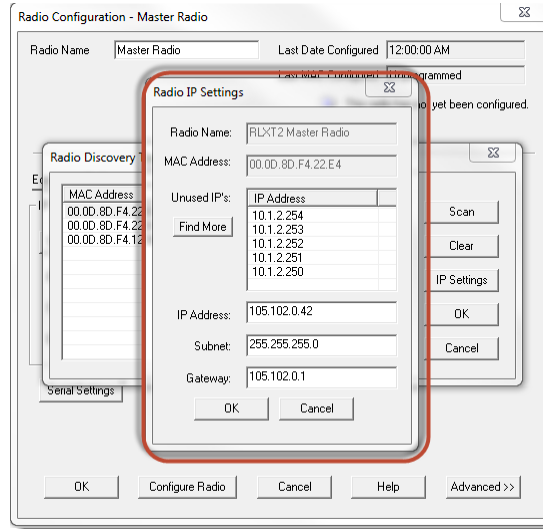
This enables ControlScape FH to communicate the new settings to the radio.

- 7 If the IP setting must be modified, click **IP Settings** after selecting the radio from the list.



- 8 Enter the new IP information. A list of suggested IPs are presented for selection. You can enter your own IP address manually as well. Click **OK**.





- 9 When you have finished making your selections, click **OK** to save the radio configuration.

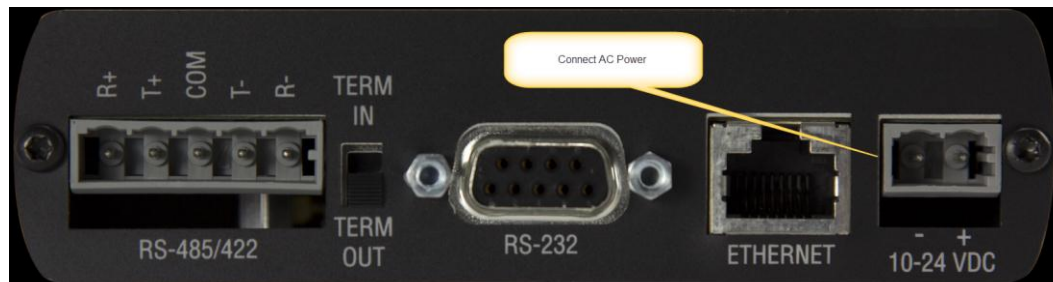
### Plug in the Cables

You must transfer these settings to the Master radio in order for these changes to take effect. ControlScape FH updates the radio's internal settings through the Ethernet connection between your computer and the radio.

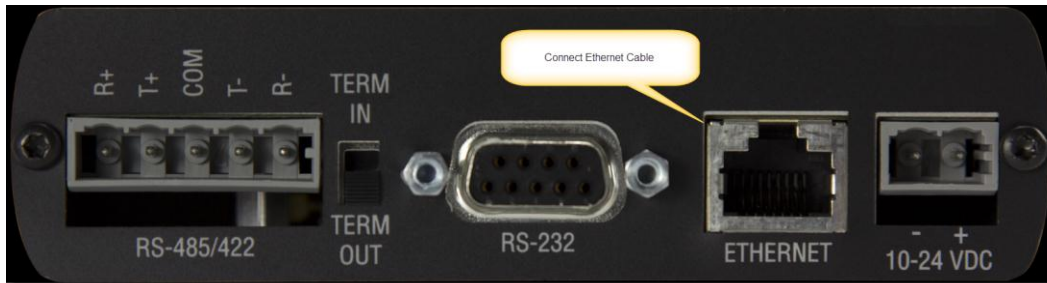
**Important:** The serial port on the bottom of the radio, labeled RS-232, is reserved for connections to external network devices, and cannot be used to configure the radio.

**Important:** Please allow sufficient time for the radio to power up and respond to discovery or configuration requests. In some instances, the radio may require up to 90 seconds to become responsive.

- 1 Connect the AC power adapter cord to the port labeled 10 - 24 VDC 6W on the bottom of the radio, and then plug the power adapter into an electrical outlet.



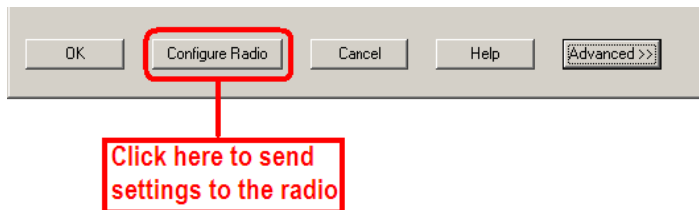
- 2 Connect an Ethernet cable to the ETHERNET port on the bottom of the radio.
  - If you are connecting through an Ethernet switch or hub to the radio, use a straight-through cable to connect the radio to the switch or hub.
  - If you are connecting directly from your PC to the radio, use a crossover cable to connect to the radio from the Ethernet port on your PC.



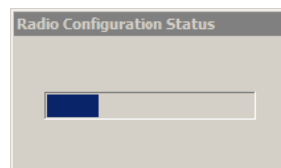
When the radio is powered up, it goes through a brief self-test during which the LED Indicators on the front of the radio illuminate. The Power/Status LED should be green, meaning that the radio has power.

Transferring the Configuration to the Master Radio

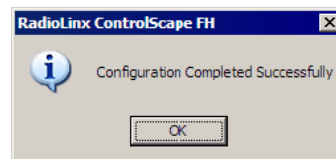
To send the new configuration settings to the Master radio, click **CONFIGURE RADIO** on the Radio Configuration dialog box.



ControlScope FH displays a progress indicator as it attempts to connect to the radio.



The following message appears when the configuration completes successfully.



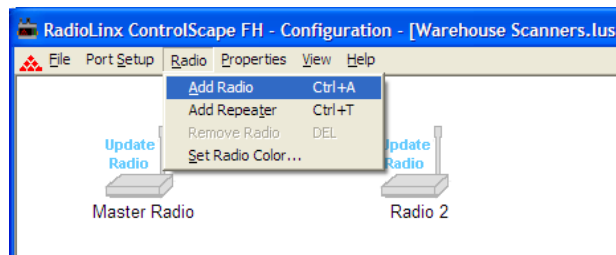
When the configuration transfers successfully, ControlScape FH updates the Radio Configuration dialog box with information retrieved from the radio, including the radio's Serial Number and Last Date Configured.

### 1.6.5 Adding Remote Radios

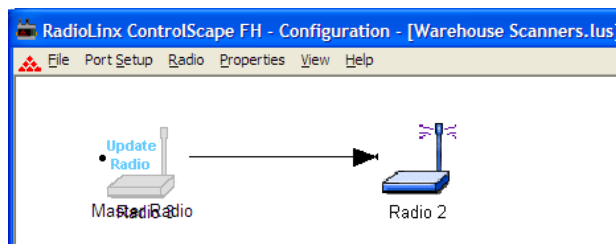
You can choose the color for the radios. The color of a radio does not affect the function of the network; however, there may be times when color-coded radios more clearly represent the application.

**Important:** When defining a color, the color must be defined before the radio is added.

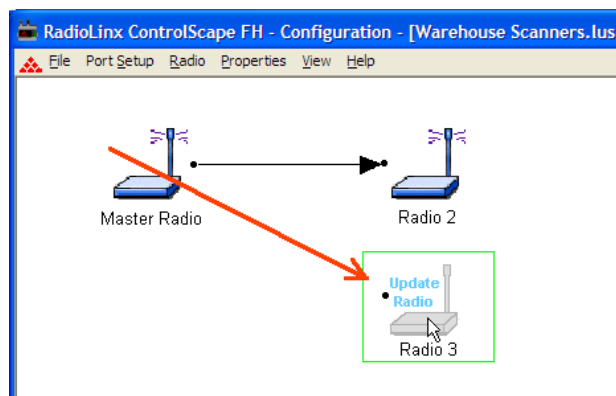
In ControlScape FH, choose **Radio > Add Radio**.



The new radio icon icon appears and is superimposed over the Master Radio icon.



Move (click and drag) the additional Remote radio icon off the Master Radio icon.

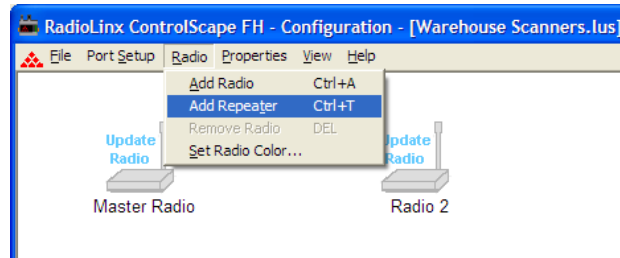


See Graphically Defining the RF Link (page 29) to define the communication links between radios.

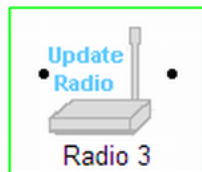
**Note:** See When to Re-Configure Radios (page 33) to ensure all radios are updated.

### 1.6.6 Add Repeaters

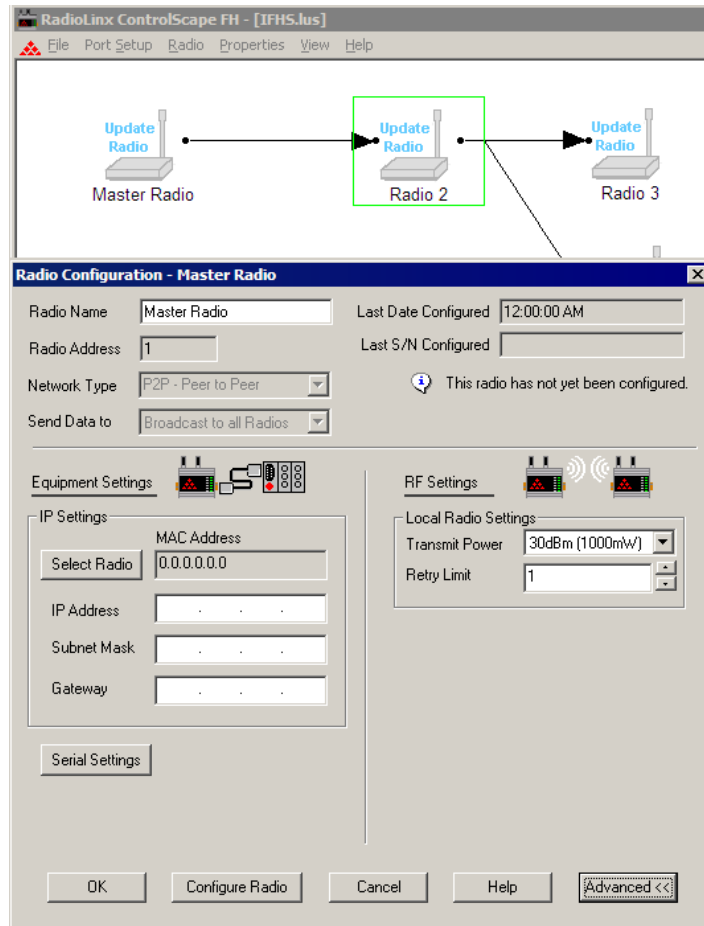
The following illustration shows how to add a repeater to the network. Select Menu > Add Repeater to add a repeater icon to the network.



The repeater radio icon has link points (black dots) on both sides of each repeater radio. The remote radio icon has only one link point located on the left side of the radio. As with all new radios, the radio displays that it needs to be updated.



Initially, a new network starts with a Master radio and a Remote radio connected by the RF link. To add a Repeater, the link between the Master and Remote radios needs to be deleted. After the Repeater is in place and you connect the RF links, you can adjust the the Repeater's settings.



**Important:** The parameters on this dialog box depend on the type of radio you select. Click **Help** or refer to the user manual of your radio for an explanation of each parameter.

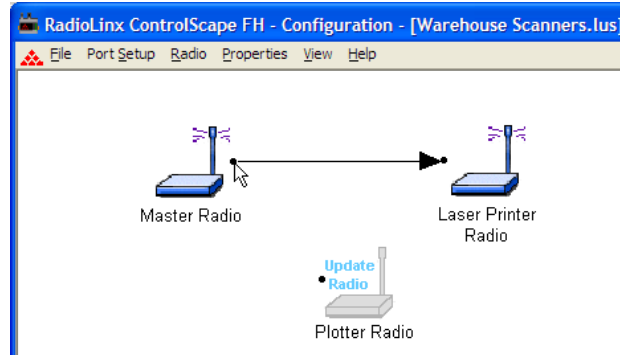
### 1.6.7 Graphically Defining the RF Link

You must define radio communication links between radios. ControlScope FH uses lines between radios to graphically define the RF communication links in a network.

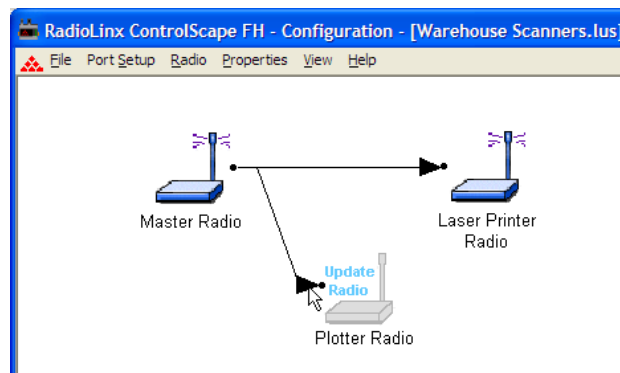
From the network's **Configuration Screen**:

- 1 Click the Master radio's link point (the black dot to the right of the Master radio icon).

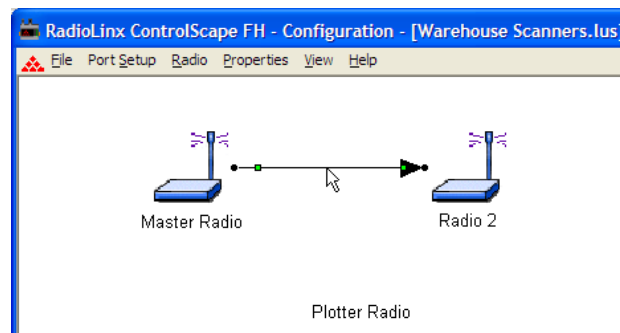
**Note:** Select the Master radio's link point (only) and not the Master radio icon itself. If you select the Master radio (surrounded by a colored box), click anywhere else on the screen to de-select the Master radio icon.



- 2 Click-and-drag the RF link to the Remote radio's link point (located to the left of the Remote radio). A line appears between the Master and Remote radios. This is the graphical representation of the RF communication link. When you release the mouse button, an arrowhead appears at the end of the line at the Remote radio's link point.



- 3 To remove a RF link between two radios, click the line between the radios.



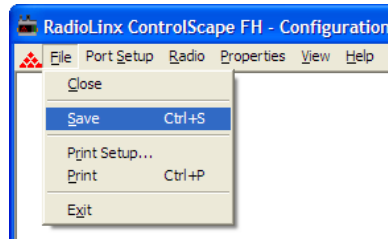
- 4 Press the **Delete** key to remove the line between the radios. Now you can add a repeater between the two radios, or you can connect the radios to other radios.

### 1.6.8 Saving the Network Configuration

Save the Network's definition if:

- A new network has been defined
- Changes have been made to the network's definition

- 1 Choose **FILE > SAVE**.

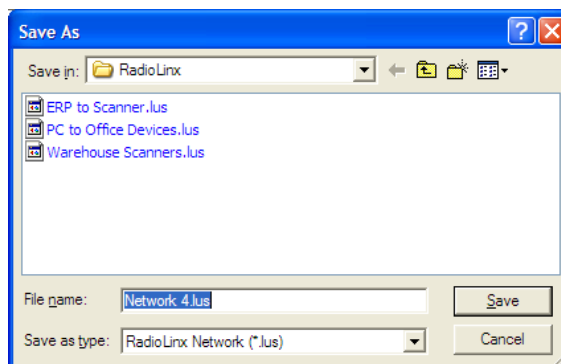


**Note:** This is the last time that you can change the network's name within ControlScope FH. If you need to rename a network you have already saved, you must rename the .LUS file in Windows Explorer.

- 2 Edit the network configuration file name if necessary.

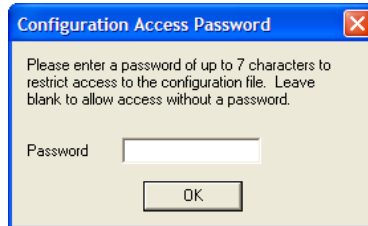
**Note:** Do not change the default directory. The ControlScope FH Setup/Diagnostic Application uses the default directory to maintain network-related data.

- 3 Click **Save**.



### 1.6.9 Print the Network Definition

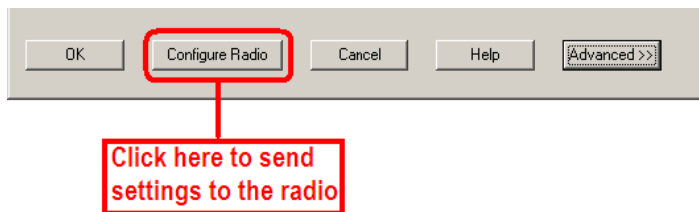
If this is the first time you are saving this network, the Password dialog box appears.



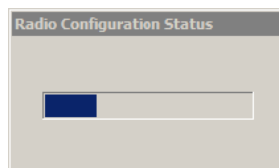
Enter the new password, or leave blank for no password protection and click **OK**.

### 1.6.10 Transfer the Configuration to the Remote Radios

To send the new configuration to the Remote radio(s), click **Configure Radio** on the Radio Configuration dialog box.



ControlScape FH displays a progress indicator as it attempts to connect to the radio.



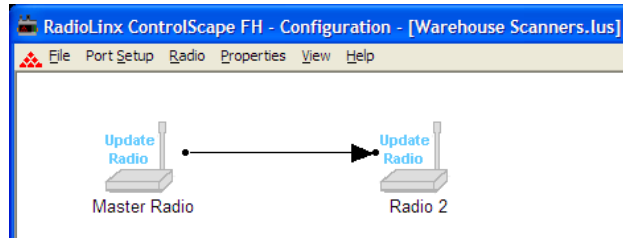
Repeat these steps for each Remote radio on your network.

When the configuration transfers successfully, ControlScape FH updates the Radio Configuration dialog box with information retrieved from the radio, including the radio's *Serial Number* and *Last Date Configured*.



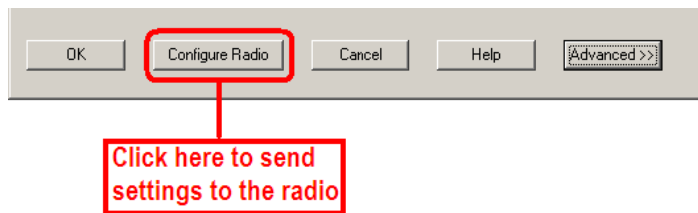
### When to Re-Configure Radios

All radios must be configured before being installed in a network. In general, after the radios are functioning in a network, they do not need to be re-configured if the network changes. The program alerts you when the radios need to be configured (radio type, IP address, etc), as illustrated below:



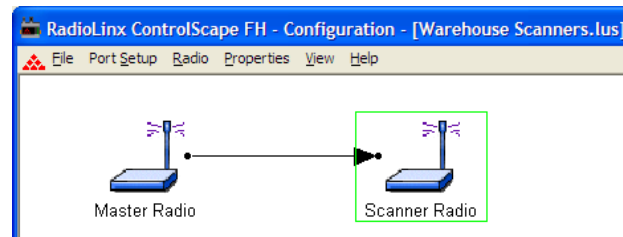
### Reconfiguring a Remote Radio

To reconfigure the Remote radio(s), click **Configure Radio** on the Radio Configuration dialog box.



Repeat these steps for each Remote radio on your network.

After you configure all the radios, the graphical layout appears as follows:



## 1.7 Planning the Physical Installation

A network's performance is affected by attributes specific to the installation site. Consider the following requirements, where possible, to optimize your network installation:

- Design the network to use less than 2048 radios (per network).

- Place radios within the specified 15 miles of each other.
- Add repeater to extend distance or where line of sight is limited.
- Radios or antennas CANNOT be placed within 8 inches (20 cm) of where people will be.

Though radio frequency communication is reliable, sometimes its performance can be affected by intangibles. A good network installation plan includes time and resources for performance testing and installation changes.

See Testing the Network Installation Plan (page 34) to verify your network before the network installation is complete.

## 1.8 Testing the Network Installation Plan

Test your installations before finalizing the installation.

After you have configured the network and the radios:

- Install the Master radio in its proposed permanent location.
- Cable the Configuration PC to the Master radio.
- Place the Remote radios in their proposed locations.
- Temporarily place each radio's antenna near its proposed mounting location. The temporary placement of the antenna can be by hand; however, with this testing method, one person must hold the antenna while another monitors the Remote radio's signal strength as displayed on the Configuration PC.

To improve the signal quality of each Remote's communication:

- Increase the height of the antenna's placement.
- Use higher-gain antennas.
- Increase the radio's transmission power by connecting the radio to the Configuration PC, and reconfiguring it.
- Select a new location for the Remote radio and/or its antenna.
- Decrease the length of the antenna cable.
- Determine and resolve sources of electrical noise which may be interfering with the radio transmission.
- Add a repeater between the radios that are not communicating, or reconfigure an existing radio as a repeater if line of sight is available.

**Note:** See When to Re-Configure Radios (page 33) to ensure all radios are updated.

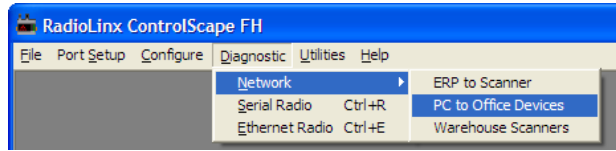
## 1.9 Verifying Communication

ControlScape FH provides several ways to verify that the radios are configured and communicating with each other.

### 1.9.1 Viewing Operating Network

To view a graphical representation of a network's communication links, connect a radio to the Configuration PC.

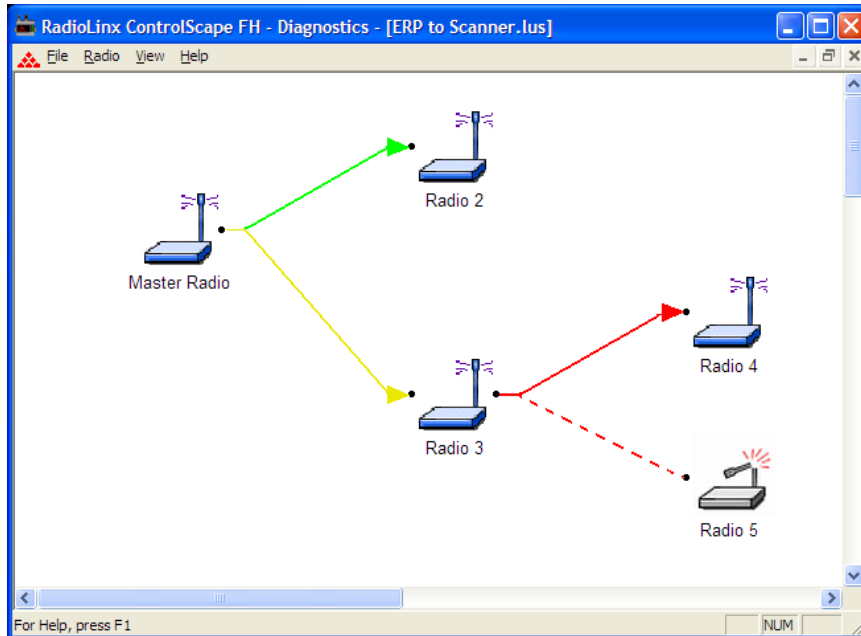
From the ControlScape FH, choose **Diagnostic > Network > network "name"**



The IP Address of the radio connected to the configuration PC is automatically displayed.

**Note:** Full network diagnostics are available only when you are connected to the Master radio. If you are connected to a Remote or a Repeater radio, you are only able to retrieve status information for the radio to which you are currently connected.

The following is the ControlScape FH's graphical representation of a network with intact communication links. The functioning RF communication links are represented as solid colored lines.

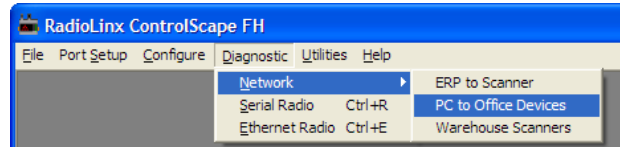


The colored lines indicate the signal strength of each radio. If any of the communication links show red dashed lines, then see Troubleshooting Missing Radios (page 55).

### 1.9.2 Viewing Signal Strength

After a network is configured, you can monitor the signal strength of the Remote radios.

1. From the ControlScape FH **Main Menu**, choose Diagnostic > Network > the network by name

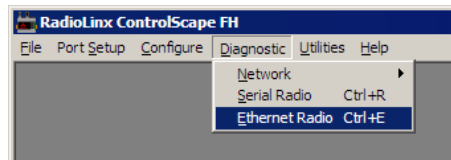


2. After the network is displayed, double click the **Remote radio** to open the *Radio Status* dialog box. This dialog box shows information about the radio, including serial number, hardware and firmware information, and signal strength. The appearance of this dialog box depends on the radio model and type.

### 1.9.3 Getting Radio Status

You can query a radio to view its settings on the Configuration PC. You can query Radios directly (through a cable connected to the Configuration PC) or remotely (through communication with the Master radio cabled to the Configuration PC).

To directly query a radio (either Master or Remote), connect an Ethernet cable from the radio to the PC, See Plug In the Cables (page 25). From the ControlScape FH Setup/Application choose **Diagnostic > Radio**.



The *Radio Parameters* dialog box appears. Click **Get Data** to receive data. The following illustration shows the *Ethernet Radio Parameters* dialog box before getting data from the radio.

Ethernet Radio Parameters

Ethernet Radio List - Select one to get data

MAC Address	IP Address	Radio Name

Refresh List

Get Data

Close

Ethernet Information

MAC Address

IP Address

Subnet Mask

Default Gateway

Serial Settings

Baud Rate

Data Bits

Parity

Stop Bits

Handshake

Encapsulation Settings

Protocol

Remote IP

Remote Port

Listen IP

Listen Port

General Information

Serial Number

Ethernet Version

Core Version

Network Type

Radio Settings

Channel Number

Transmit Power

Wireless Link Rate

IFH Radio Settings

Unit Address

Operating Mode

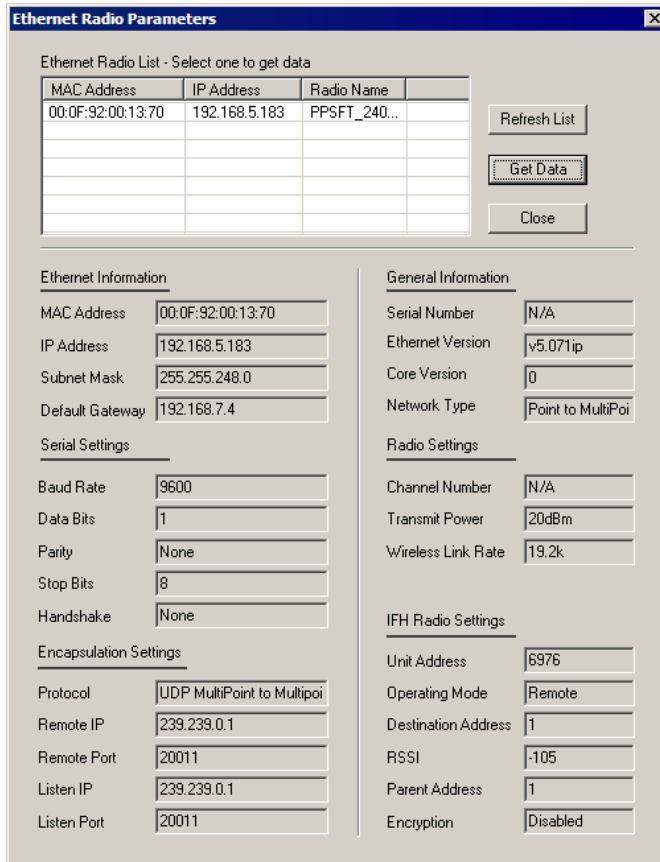
Destination Address

RSSI

Parent Address

Encryption

The following illustration shows the dialog after receiving data.



## 2 Installing the Radios

### *In This Chapter*

- ❖ Radio Hardware ..... 39
- ❖ Cable Connections ..... 41

**Important:** If the radios are close enough to each other that their received signal strength is greater than -40 dBm, performance may be degraded. Disconnect antennas from radios during bench testing, or move the radios further apart from each other.

**Tip:** To make it easier to physically identify the radios you are configuring, apply a label to each radio with the radio name.

After you have configured each radio using ControlScape FH, you can install the radios and test their performance. Install the radios in their proposed permanent locations, then temporarily place each radio's antenna near its proposed mounting location. The temporary placement of the antenna can be by hand; however, with this testing method, one person must hold the antenna while another monitors the radio's signal strength.

To see how a radio is linked in the network, connect the radio to your PC, and then choose your network in ControlScape FH.

The Diagnostic view shows a diagram of the network's wireless connections. Use this view to see whether all the radios are linked. Refer to Improving Signal Quality (page 41) for more information on overcoming poor connectivity.

### 2.1 Radio Hardware

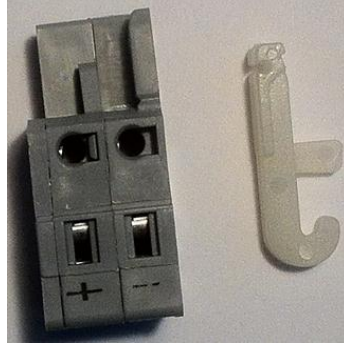
#### **2.1.1 Radio Power Requirements**

The RLX2 radios accept voltages between 9 and 24 VDC, with an average power draw of 6 watts or less. A detachable power connector comes with the radio, as shown below. The connector terminals are labeled + (positive DC connection) and - (DC ground connection).

You can use the AC-to-DC power supply adapter supplied with the optional RLX-IHBTK Bench Test Kit. DC power wires must be less than 6.5 feet (2 meters) in length to meet regulatory requirements.

**Important:** When wiring the power connector supplied with the radio, be sure to observe the proper polarity markings on the power connector. Improper connector wiring can cause serious damage to the radio which is not be covered under the ProSoft Warranty.

The power connector (ProSoft P/N 002-0116) and wire installation tool (ProSoft P/N 357-0061) are shown in the following graphic. The wire installation tool is helpful when installing wires into the spring-loaded contacts inside the power connector.



To use the wire installation tool, insert it into the connector as shown.



Press down on the installation tool to use it as a level to open the connector's contacts to insert a wire. A properly wired connector is shown below.





### 2.1.2 Connecting antennas

Each radio must have an antenna connected to the Main antenna port on the radio; without an antenna for each radio, the network will not function.

All antennas for radios that communicate directly with each other should be mounted so they have the same antenna polarity. Small antennas with a reverse-polarity SMA connector can be mounted directly on the radio. Screw the antenna onto the antenna port connector until it is snug.

Larger antennas and antennas that do not have a reverse-polarity SMA connector must be mounted separately and connected to the radio using a coaxial antenna cable. Because the antenna cable attenuates the RF signal, use the shortest required antenna cable to ensure optimum performance.

**Important:** If the radio is to be used in a hazardous location, the radio must be mounted in an enclosure approved for hazardous locations. The radio requires a separate cable connection to the SMA connector that leads to an internal antenna.

#### Improving Signal Quality

If you need to improve a radio's signal quality, try the following steps:

- Adjust the direction of the high-gain antennas.
- Increase the height of the antenna's placement.
- Use higher-gain antennas or external preamplifiers.
- Select a new location for the radio and/or its antenna.
- Decrease the length of the antenna cable.
- Determine and resolve sources of interfering electrical noise.
- Add a repeater between radios that are not communicating.

## 2.2 Cable Connections

The application ports on the RLX2-IFHxE module support Ethernet, RS-232, RS-422, and RS-485 interfaces.



The application ports are located on the bottom of the radio.

- The Ethernet port uses a standard RJ45 connector
- The RS-232 port uses a standard DB9 connector.
- The RS-485/RS-422 port uses a custom connector, supplied with the radio.

### 2.2.1 Ethernet Cable Specifications

The recommended cable is category 5 or better. A category 5 cable has four twisted pairs of wire that are color-coded and cannot be swapped. The module only uses two of the four pairs when running at 10 MBit or 100 MBit speeds. All eight wires are used when running at 1000 MBit speeds.

Category 5e or better cable is recommended for 1000 MBit speeds.

The Ethernet port on the radio is Auto-Sensing. You can use either a standard Ethernet straight-through cable or a crossover cable. The module detects the cable type and use the appropriate pins to send and receive Ethernet signals. You can connect the module to an Ethernet hub, a 10/100/1000 Base-T Ethernet switch, or directly to a PC.

Ethernet cabling is like U.S. telephone cables but have eight conductors. Some hubs have one input that can accept either a straight-through or crossover cable, depending on switch position. In this case, ensure that the switch position and cable type agree.

Refer to Ethernet Cable Configuration (page 42) for a diagram of how to configure Ethernet cable.

### 2.2.2 Ethernet Cable Configuration

**Note:** The standard connector view shown is color-coded for a straight-through cable.

Crossover cable		Pin #1	Straight-through cable	
RJ-45 PIN	RJ-45 PIN		RJ-45 PIN	RJ-45 PIN
1 Rx+	3 Tx+		1 Rx+	1 Tx+
2 Rx-	6 Tx-		2 Rx-	2 Tx-
3 Tx+	1 Rx+		3 Tx+	3 Rx+
6 Tx-	2 Rx-		6 Tx-	6 Rx-

### 2.2.3 Serial Port Basics

Two common serial interface standards are RS-232 and RS-485. The RS-232 protocol is an industry standard protocol while the RS-485 protocol is commonly used in the industrial automation market.

There are two types of devices to which a serial-cabled device can communicate:

- DCE (Data Communications Equipment): modem, plotter, "RLX2-IFHxE"
- DTE (Data Terminal Equipment): PC or terminal

Serial ports have two common connector styles:

- DB25 pin connector
- DB9 pin connector

To connect two DTE devices to each other, the easiest (and recommended) connection method is with a Null Modem cable (female connectors on each end).

**Note:** The RLX2-IFHxE is a DCE device.

The following table contains the pin functions for both the DB25 and the DB9 connectors:

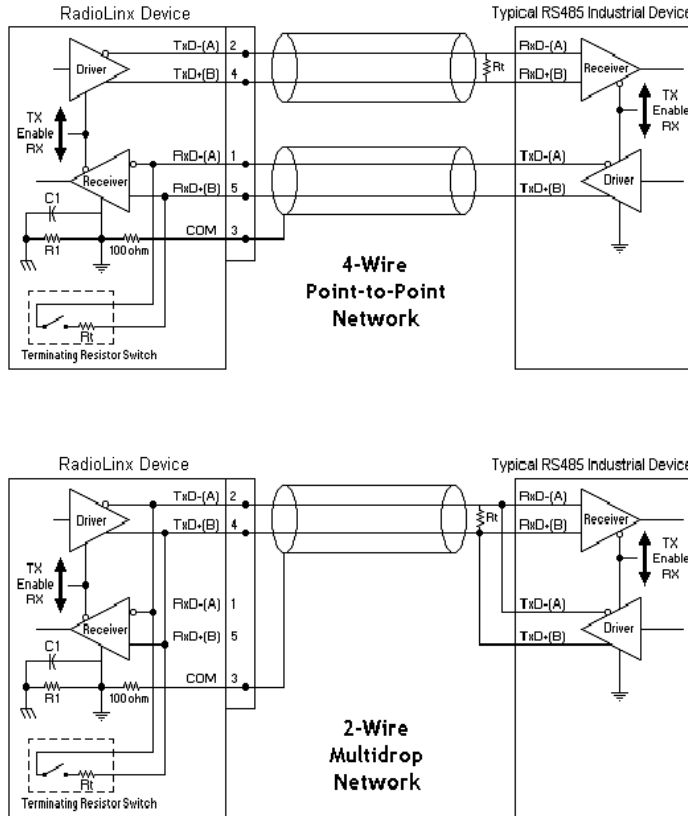
Pin Name	Pin Number DB9 / DB25	Function
Transmit Data (TXD)	Pin 3 / 2	Serial Data Output
Receive Data (RXD)	Pin 2 / 3	Serial Data Input
Clear-To-Send (CTS)	Pin 7 / 4	This line indicates that the modem is ready to exchange data.
Data-Carrier-Detect (DCD)	Pin 1 / 8	This line becomes active when the modem detects a carrier from the modem on the other end of the phone line.
Data-Set-Ready (DSR)	Pin 6 / 6	This tells the UART that the modem is ready to establish a link.
Data-Terminal-Ready (DTR)	Pin 4 / 20	This tells the modem that the UART is ready to exchange data.
Request -To -Send (RTS)	Pin 7 / 4	This line informs the modem that the UART is ready to exchange data.
Ring Indicator (RI)	Pin 9 / 22	Goes active when modem detects a ringing signal
Signal Ground (SG)	Pin 5 / 7	Signal ground

Communication signals diminish in strength as they travel through cable. The maximum cable lengths for RS-232 are less than RS-485 because the RS-232 interface is more susceptible to noise. The data performance of RS-232 and RS-485 is similar as long as the cable requirements are met. The following table gives an estimation of the cable length requirements for the two serial interface protocols:

Characteristic	RS-232	RS-485
Maximum cable length	100 feet	4000 feet
Maximum bits/sec.	20 kbps	100 Mbps

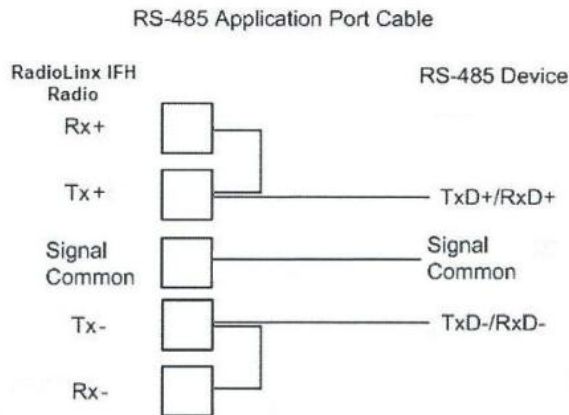
There are different ways to transfer data serially; simplex, half-duplex, and full-duplex. **Simplex** communication mode allows transmission of data in one direction only. In the **half-duplex** mode, data can be transferred in both directions, but not simultaneously. That means data can be transferred over a single pair of wires, but the data can only be transferred in one direction at a time. **Full-duplex** mode utilizes two pairs of wires and the data can be transferred in both directions simultaneously.

### 2.2.4 Radio RS-485 Cable Specification



#### RS-485

The RS-485 interface requires a single two or three wire cable. The Common connection is optional and dependent on the RS-485 network. The cable required for this interface is shown below:



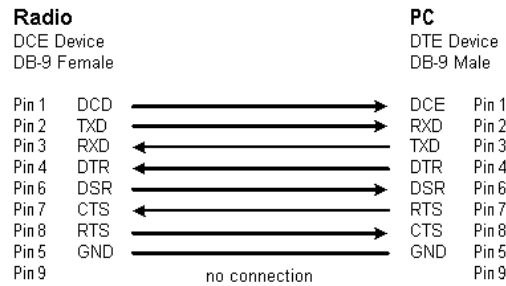
**Note:** A switch on the bottom of the RLX2-IFHxE radio allows you to specify whether the termination resistors are external or Internal in regards to the RS-485 connector. Terminating resistors are generally not required on the RS-485 network, unless you are experiencing communication problems that can be attributed to signal echoes or reflections. In this case, try changing the settings for termination. The switch positions are labeled "Term In" (internal) and "Term Out" (external).

### 2.2.5 Radio RS-232 Cable Specifications

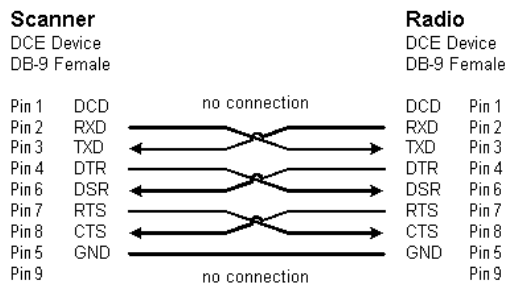
The following shows the wiring of the straight-through DB-9 serial cable used to connect:

- A radio to a PLC, PC, or other DTE device
- A radio to another DCE device

#### Straight-through Serial Cable

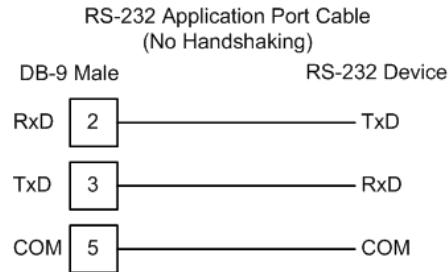


#### Null Modem Cable Wiring Diagram



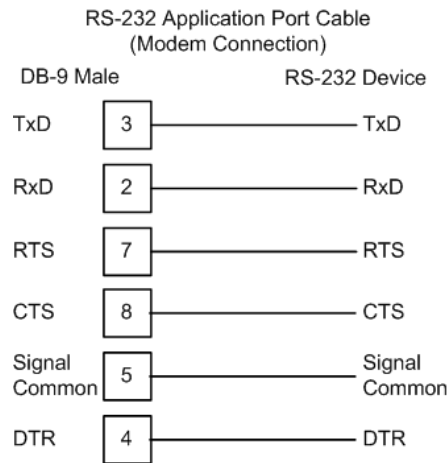
RS-232

When the RS-232 interface is selected, the use of hardware handshaking (control and monitoring of modem signal lines) depends on the requirements of the networked device. If no hardware handshaking will be used, the cable to connect to the port is as shown below:



RS-232 Modem Connection

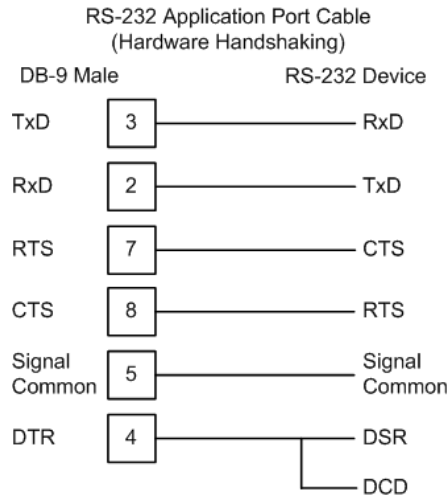
This type of connection is required between the radio and a modem or other communication device.



The "Use CTS Line" parameter for the serial device should be set to 'Yes' for most modem applications.

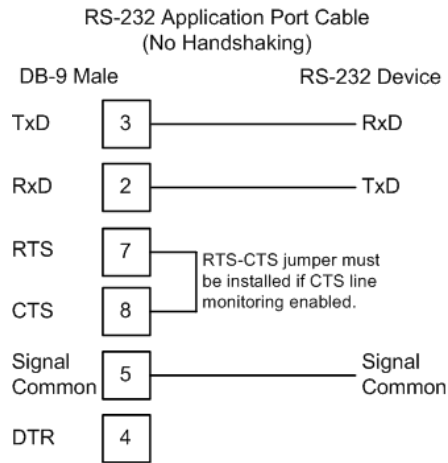
RS-232: Null Modem Connection (Hardware Handshaking)

This type of connection is used when the device connected to the radio requires hardware handshaking (control and monitoring of modem signal lines).



RS-232: Null Modem Connection (No Hardware Handshaking)

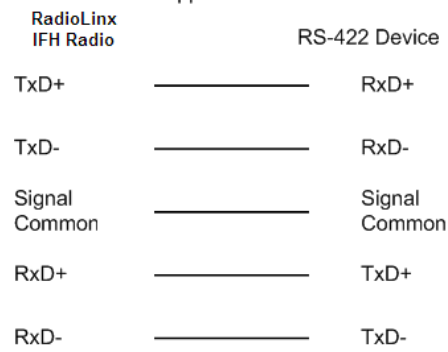
This type of connection can be used to connect the radio to a computer or field device communication port.



**Note:** If the serial device is configured with to use the CTS line, then a jumper is required between the RTS and the CTS line on the radio connection.

### 2.2.6 RS-422

RS-422 Application Port Cable





## 3 Diagnostics and Troubleshooting

### *In This Chapter*

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❖	Troubleshooting ControlScope FH Error Messages .....	53
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### 3.1 Diagnostics Overview

Use the Diagnostic function in ControlScope FH to:

- View a graphical representation of the overall function of a network.
- Query an individual radio and display its operating parameters.

You can use the information from the diagnostics function to:

- Optimize network function.
- Determine the source of failed communication.

### 3.2 LED Status Indicators

The RLX2-IFHxE front panel includes a set of LEDs that indicate the radio's status.

After you first plug in the power cable to the radio, the Power/Status LED should be green, meaning that the radio has power. The RF Transmit and RF Receive LEDs should blink.

LED	Description
Power	This LED indicates the power and boot status of the radio. Upon application of power to the radio, the LED lights for about 20 seconds and then begins to flash slowly for about 30 seconds. The slow flash indicates that the RLX2-IFHE is in its startup sequence. Once the LED stops flashing and remains lit, the RLX2-IFHE is ready for normal operation.
Ethernet	If this green LED is lit, the Ethernet cable is connected. If this LED is flashing, an Ethernet packet is being transmitted or received.
RF Transmit	This yellow LED indicates RF transmission.
Link/RF Receive	This green LED indicates RF reception.
232 / 485	On (lit) for RS-232, Off for RS-485/422

LED	Description
Signal Strength	<p>If only one of these three LEDs is lit, then the radio is linked. If two LEDs are lit, the radio's signal strength is fair. If all three LEDs are lit, the signal strength is good.</p> <p>When a repeater or remote is not linked, the LEDs light one at a time in a cycle from top to bottom. When the repeater or remote is linked, the LEDs light from bottom to top, with a blinking LED meaning a median signal strength between the lower LED and the blinking LED.</p>

### 3.3 Sources of Interference

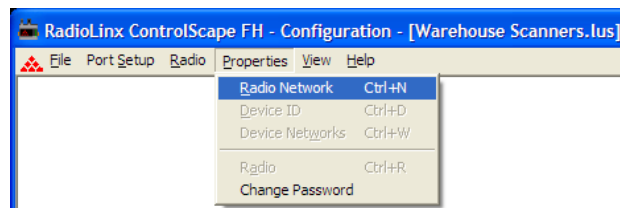
The RLX2-IFHxE operates more reliably than a radio using conventional technology due to the frequency hopping spread spectrum technique. While RLX2-IFHxE radios are less susceptible to interference due to this technique, interference (radio noise) may still occur. Radios are designed to detect specific radio frequencies. Interference is an unwanted signal that has been transmitted at the same frequency that the radio was designed to detect.

There are many man-made and natural sources of electromagnetic interference (lightning, power lines, switching power supplies, fluorescent lighting, microwave ovens, cordless phones, and so on). To decrease the effects of interference on network function:

- Use a directional (high gain) antenna at the Remote radio locations, if possible.
- Verify that each network operating in close proximity to each other has been assigned to a different channel.
- Install networks in rural areas (if at all possible) where they will likely encounter less man-made noise than in urban or suburban areas.
- Enable encryption.
- Change a radio's network output power (refer to the Radio Configuration screens for each radio of the network):
  - Increase power to "drown out" competing noise.
  - Decrease power of the radios on the network if they are interfering with another network in the vicinity.

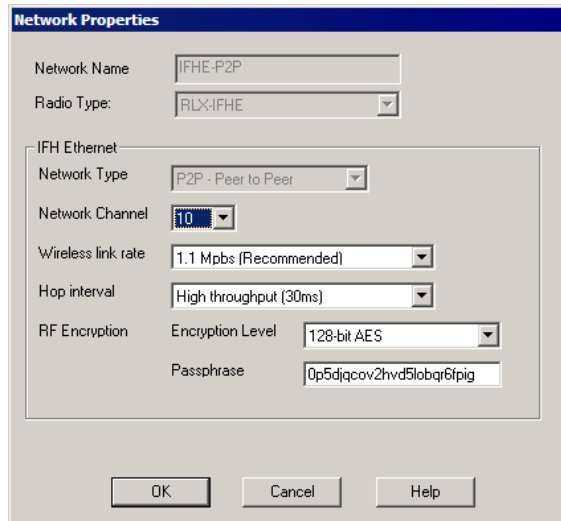
#### 3.3.1 Changing a Network's Channel

1. To modify the Network Channel an existing network, choose **Properties > Radio Network**:



2. The Networks Properties dialog box appears.

**Important:** The items in this dialog box depend on the type of radio you select. Click **Help** or refer to the user manual of your radio for an explanation of each parameter.



3. Select an unused Network Channel from the drop-down list.

**Note:** Some fields are unavailable in this dialog box because you cannot change these parameters here.

**Note:** See When to Re-Configure Radios (page 33) to ensure all radios are updated.

### 3.3.2 Monitoring Radio Channel Noise Level

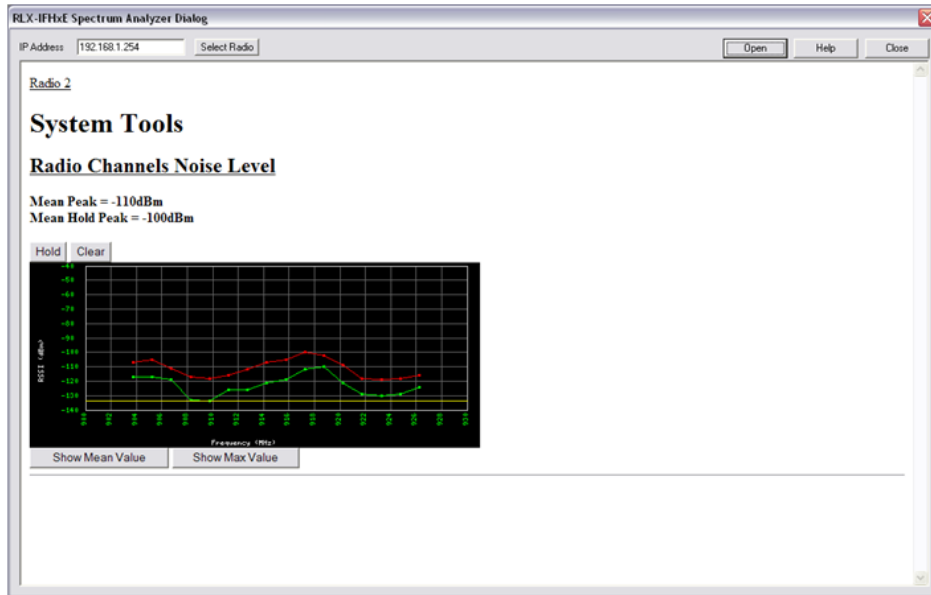
All radio networks experience background noise, known as Electromagnetic Interference (EMI), that consists of stray signals from other radios on the same frequency, or random interference generated by non-radio devices that leak or emanate EMI as a side effect of their operation. There are also natural sources of EMI, including atmospheric disturbances and sunspots. The snow on an unused or distant television channel, or static on a car radio when passing under high voltage power lines, are two common examples of background noise.

Unwanted noise, or EMI, on a data network can cause data transmission errors, or stop a radio network from functioning at all. Most modern devices, including RLX2-IFHxE radios, are designed to prevent unwanted emanation of EMI from the device. Radios are also typically designed to tolerate a certain amount of interference from other devices; however when the amount of noise reaches a certain threshold, typically within 10dB of a link's RSSI, the radio may be unable to distinguish between wanted and unwanted signals.

ControlScape FH can help you diagnose transmission problems with a graphical representation of radio channel noise. You can use this diagnostic information during a site survey to check for RF signals already present in an area, or to detect network issues caused by RF interference.

To detect the radio channel noise level for a particular radio:

1. Open the **UTILITIES** menu, and then choose **IFHE SPECTRUM ANALYZER**.
2. Select the radio by **IP ADDRESS**, and then click **OPEN**.



3. ControlScape FH then scans within the radio, and measures the noise within the frequency band. This data can help determine if there is a signal that is interfering with radio communications. The radio continues to periodically scan its frequency band until you click **CLOSE**, or you select a different radio to scan.

**Note:** The information in this dialog box is valid only for radios accessed through a wired Ethernet network. Scans for radios only over the RF network may not be accurate.

**Note:** Radio network communications are interrupted while the Spectrum Analyzer is active. Normal communication resume when you close the dialog box.

### 3.3.3 RLX2-IFHE Spectrum Analyzer Dialog Box

The Spectrum Analyzer Dialog Box opens when you choose Utilities > IFHE Spectrum Analyzer. Use this dialog box to help diagnose network issues.

**Note:** The information in this dialog box is valid only for radios accessed through a wired Ethernet network. Scans for radios only over the RF network may not be accurate.

**Note:** Radio network communications are interrupted while the Spectrum Analyzer is active. Normal communication resumes when you close the dialog box.

The fields in the dialog box are:

- **IP Address:** The IP address for the radio to test. Enter an IP address directly, or click *Select Radio* to choose a radio.

- **Select Radio:** Opens the *Radio Discovery Tool* dialog box . Choose a radio from the list, and then click **OK** to select the radio.
- **Open:** Click to begin testing the radio.
- **Close:** Click to quit testing the radio and close the dialog box.
- **Noise Level graphs:** The green plot represents the current spectrum values. The red plot represents the maximum value of the green plot over time. The yellow line represents the lowest current value or the current noise floor. Each point represents one of the available frequencies on which the radio could hop.
- **Hold:** Click to freeze the peak value graph.
- **Clear:** Click to reset the peak value graph.
- **Show Mean Value:** Displays the average value of the multiple measurements taken on each channel during a scan period.
- **Show Max Value:** Displays the maximum value of the multiple measurements taken on each channel during a scan period.

### 3.4 Troubleshooting ControlScape FH Error Messages

ControlScape FH displays informative error messages for many types of communication problems. The following topics describe how to interpret these messages.

#### 3.4.1 Radio Configuration Status Dialog Box

The *Radio Configuration Status* dialog box opens when you attempt to communicate with a radio network in *Diagnostic* mode, and ControlScape FH is not able to connect with any radios on the network.

- Click **Retry** to attempt an automatic baud rate detection sequence.
- Click **Cancel** to stop attempting to connect to a radio.

#### 3.4.2 Invalid Password Dialog Box

The Invalid Password dialog box opens when you enter the network password incorrectly. Check the status of the **Caps Lock** key on your keyboard, and then try entering the password again.

- **OK:** Click **OK** to save your selection and close the dialog box.
- **Help:** Click **Help** to read the online help for ControlScape FH.

#### 3.4.3 Check the Ethernet cable

If you connect a radio to a PC or network using an Ethernet cable and the Ethernet LED does not light on the radio, you may have used the wrong cable type. In other words, you may have used a crossover cable when you should have used a straight-through cable, or vice versa.

- Use a straight-through cable when connecting the radio to an Ethernet hub or a 10/100 Base-T Ethernet switch. Straight-through cables are used in most cases.

- Use a crossover cable when connecting the Ethernet radio directly to any device that is NOT a switch or a hub (for example, a direct connection to a PC, PLC, or printer).

### 3.4.4 Connection Errors

If ControlScope FH is not able to communicate with a radio, it opens a message box describing the problem.



To troubleshoot communication problems, follow these steps:

- Verify that you can communicate with the Master radio through an Ethernet cable. See Ethernet Cable Configuration (page 42).
- Verify that the Master radio and Remote radios are powered up.
- Verify that the Remote radios are connected to antennas. See Connecting Antennas (page 41). See Improving Signal Quality (page 41) to receive signals from the Master radio.
- Verify that the computer's IP address and the IP addresses of the radios are on the same network.
- Check for noise. See Eliminate Sources of Interference (page 50).

If you are still unable to connect to a radio, see Contacting Technical Support (page 77) for assistance.

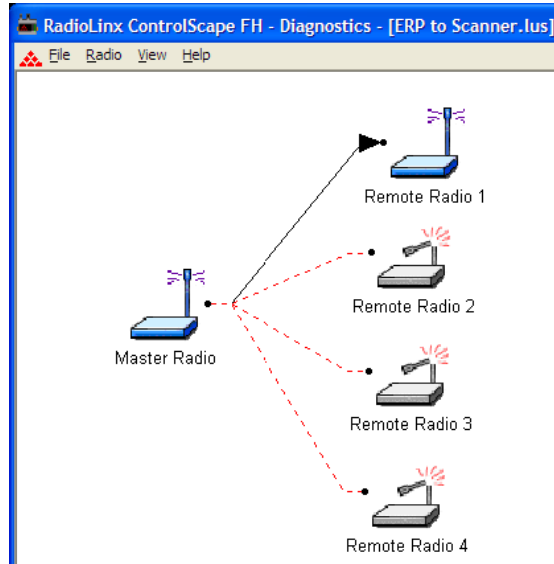
### 3.4.5 Resetting the Radio

When the radio is fully booted (LED not flashing about 1 minute after power is applied), depress and hold **Default Settings** for about 10 seconds until all the LEDs go out, and then release the button. The radio reboots with the default settings.

**Note:** Do not continue to hold **Default Settings** after the LEDs go out.

### 3.5 Troubleshooting Missing Radios

To view the communication links, you can connect any radio to the Configuration PC for network diagnostics.



One of the most common reasons radios do not communicate is an incorrect setting in the *Send Data To* field in the *Radio Configuration* dialog box.

Verify that the radio is sending to and receiving from the correct radio ID. If radios do not communicate, investigate electromagnetic interference. See Sources of Interference (page 50).

### 3.6 RadioLinx OPC Server

The RadioLinx OPC Server seamlessly links customer applications to RLX2-IFHxE radios. Any application that can act as an OPC Client, such as an HMI, can interact with any type of ProSoft Technology radios. It allows the applications to get the signal strength, serial number, and throughput information, as well as other useful statistics.

The RadioLinx OPC Server operates in the background on any PC that is connected to any radio. It independently manages all requests from OPC Clients for information on RLX2-IFHxE radios. The OPC Clients are typically HMI programs, but information from the OPC Server can also be easily monitored by Microsoft Excel. The clients can be programs running either on the same PC as the OPC Server or on a separate PC on the same network.

You can install the RLX OPC Server from the ProSoft Solutions DVD, included with your RLX2-IFHxE radio.

### **3.6.1 System Requirements**

The following system requirements are the recommended minimum specifications to successfully install and run RadioLinx OPC Driver.

- Microsoft Windows compatible PC
- Windows XP Professional with Service Pack 2 or higher, Windows VISTA, or Windows 2003
- Microsoft .NET Framework version 3.0 or higher
- 300 mHz Pentium processor (or equivalent)
- 128 megabytes of RAM
- 300 megabytes of available disk space



## 4 Antenna Reference

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### 4.1 Antennas

This section covers the important considerations for selecting, locating, and using antennas with radio modules.

You must also consider three important electrical characteristics when selecting antennas:

- Antenna location, spacing, and mounting (page 57)
- Antenna Pattern (page 58)
- Antenna Gain (page 58)
- Antenna Polarity (page 59)

When you are ready to connect an antennas to the radio, see Connecting antennas (page 41).

#### **4.1.1 Antenna location, spacing, and mounting**

Consider the following points regarding antenna location, spacing, and mounting:

- When placing antennas, ensure a clear line of sight between the master radio's antenna and all of the other radio antennas.
- If the site contains obstructing terrain or structures, mount the antenna on a tower or rooftop to provide a line-of-sight path between radios. The line-of-sight consideration becomes more important as the transmission path becomes longer.
- Mount the antennas as high off the ground as is practical. The higher an antenna is above the ground, the greater its range.
- Mount the antennas away from massive structures. Radio signals bounce off metal walls, for example, which can compromise a clear signal.
- Mount antennas to minimize the amount of nearby metal structures in the antenna pattern.
- Mount the antennas and install the radios away from sources of RF interference.
- Use the shortest possible antenna cable length. Signals lose power traveling through cables.
- Choose antennas that are appropriate for the network's intended function.

- If radio antennas are on the same network, mount them so they have the same polarity. If the antennas are on separate networks, mount them so they have a different antenna polarity—for example, mount transmitting and receiving antennas for one network vertically, and those for the other network horizontally.
- Space radios at least three feet (one meter) apart so they do not overload each other. If antennas must be near each other:
  - Mount omnidirectional antennas directly above each other.
  - Position directional antennas so they do not point at nearby antennas. Place antennas side by side if they point in the same direction. Place antennas back to back if they point in opposite directions.

### **4.1.2 Antenna Pattern**

Information between two wireless devices is transferred by electromagnetic energy radiated by one antenna and received by another. The radiated power of most antennas is not uniform in all directions and has varying intensities. The radiated power in various directions is called the pattern of the antenna. Mount each antenna so that its direction of strongest radiation intensity points toward the other antenna or antennas with which it will exchange signals.

Complete antenna patterns are three-dimensional, although often only a two-dimensional slice of the pattern is shown when all the antennas of interest are located in roughly the same horizontal plane, along the ground rather than above or below one another.

A slice taken in a horizontal plane through the center (or looking down on the pattern) is called the azimuth pattern. A view from the side reveals a vertical plane slice called the elevation pattern.

An antenna pattern with equal or nearly equal intensity in all directions is omnidirectional. In two dimensions, an omnidirectional pattern appears as a circle (in three dimensions, an omnidirectional antenna pattern would be a sphere, but no antenna has a true omnidirectional pattern in three dimensions). An antenna is considered omnidirectional if one of its two dimensional patterns, either azimuth or elevation pattern, is omnidirectional.

Beamwidth is an angular measurement of how strongly the power is concentrated in a particular direction. Beamwidth is a three dimensional quantity but can be broken into two-dimensional slices just like the antenna pattern. The beamwidth of an omnidirectional pattern is 360 degrees because the power is equal in all directions.

### **4.1.3 Antenna Gain**

Antenna gain is a measure of how strongly an antenna radiates in its direction of maximum radiation intensity compared to how strong the radiation would be if the same power were applied to an antenna that radiated all of its power equally in all directions. Using the antenna pattern, the gain is the distance to the furthest point on the pattern from the origin. For an omnidirectional pattern, the gain is 1, or equivalently 0 dB. The higher the antenna gain, the narrower the beamwidth, and vice versa.

The amount of power received by the receiving antenna is proportional to the transmitter power multiplied by the transmit antenna gain, multiplied by the receiving antenna gain. Therefore, there is a trade-off between the antenna gains and the transmitting power. For example, doubling one antenna gain has the same effect as doubling the transmitting power. Doubling both antenna gains has the same effect as quadrupling the transmitting power.

#### **4.1.4 Antenna Polarity**

Antenna polarization refers to the direction in which the electromagnetic field lines point as energy radiates away from the antenna. In general, the polarization is elliptical. The simplest and most common form of this elliptical polarization is a straight line, or linear polarization. Of the transmitted power that reaches the receiving antenna, only the portion that has the same polarization as the receiving antenna polarization is actually received. For example, if the transmitting antenna polarization is pointed in the vertical direction (vertical polarization, for short), and the receiving antenna also has vertical polarization, the maximum amount of power possible will be received. On the other hand, if the transmit antenna has vertical polarization and the receiving antenna has horizontal polarization, no power should be received. If the two antennas have linear polarizations oriented at 45° to each other, half of the possible maximum power will be received.

#### **4.1.5 Whip antennas**

You can use a 1/2 wave straight whip or 1/2 wave articulating whip (2 dBi) antenna with RLX2-IFHxE radios. These antennas are the most common type in use today. Such antennas are approximately 5 inches long, and are likely to be connected to a client radio (connected directly to the radio enclosure). These antennas do not require a ground plane. Articulating antennas and non-articulating antennas work in the same way. An articulating antenna bends at the connection.



#### **4.1.6 Collinear array antennas**



A collinear array antenna is typically composed of several linear antennas stacked on top of each other. The more stacked elements it has, the longer it is, and the more gain it has.

The antenna pattern is toroidal. Its azimuthal beamwidth is 360° (omnidirectional). Its vertical beamwidth depends on the number of elements/length, where more elements equal narrower beamwidth. The antenna gain also depends on the number of elements/length, where more elements produce higher gain. Typical gain is 5 to 10 dBi.

The antenna polarity is linear, or parallel to the length of the antenna.

#### **4.1.7 Yagi Array Antenna**

A yagi antenna is composed of an array of linear elements, each parallel to one another and attached perpendicular to and along the length of a metal boom. The feed is attached to only one of the elements. Elements on one side of the fed element are longer and act as reflectors; elements on the other side are shorter and act as directors. This causes the antenna to radiate in a beam out of the end with the shorter elements. The pattern depends on the overall geometry, including the number of elements, element spacing, element length, and so on. Sometimes the antenna is enclosed in a protective tube hiding the actual antenna geometry.

The Antenna Pattern (page 58) is a beam pointed along the boom toward the end with the shorter elements. The beamwidth varies with antenna geometry but generally is proportional to the length (where longer length produces a narrower beam).

The Antenna Gain (page 58) varies with antenna geometry but generally is proportional to the length (where longer length produces higher gain). Typical values are 6 to 15dBi.

The antenna polarity is Linear (parallel to the elements, perpendicular to the boom).



#### **4.1.8 Parabolic reflector antennas**

A parabolic reflector antenna consists of a parabolic shaped dish and a feed antenna located in front of the dish. Power is radiated from the feed antenna toward the reflector. Due to the parabolic shape, the reflector concentrates the radiation into a narrow pattern, resulting in a high-gain beam.

The antenna pattern is a beam pointed away from the concave side of the dish. Beamwidth and antenna gain vary with the size of the reflector and the antenna construction. Typical gain values are 15 to 30 dBi.

The antenna polarity depends on the feed antenna polarization.





## 5 Glossary of Terms

### Symbols & Numeric

#### 802.11

A group of wireless specifications developed by the IEEE. It details a wireless interface between devices to manage packet traffic.

#### 802.11a

Operates in the 5 GHz frequency range with a maximum 54 Mbit/sec signaling rate.

#### 802.11b

Operates in the 2.4 GHz Industrial, Scientific, and Measurement (ISM) band. Provides signaling rates of up to 11 Mbit/sec and is the most commonly used frequency.

#### 802.11g

Similar to 802.11b but supports signaling rates of up to 54 Mbit/sec. Operates in the heavily used 2.4 GHz ISM band but uses a different radio technology to boost throughput.

#### 802.11i

Sometimes Wi-Fi Protected Access 2 (WPA 2). WPA 2 supports the 128-bit and above advanced encryption standard, along with 802.1x authentication and key management features.

#### 802.11n

Designed to raise effective WLAN throughput to more than 100 Mbit/sec.

#### 802.11s

Deals with mesh networking.

### A

#### Access Point

A generic term for an 802.11 radio that "attaches" other 802.11 radios (clients) to a wired network. APs can also bridge to one another.

#### Ad hoc Mode

Wireless network framework in which devices can communicate directly with one another without using an AP or a connection to a regular network.

#### AES

Advanced Encryption Standard. New standard for encryption adopted by the U.S. government for secure communications.

**Amplifier**

A device connected to an antenna used to increase the signal strength and amplify weak incoming signals.

**Antenna**

A device connected to a wireless transceiver that concentrates transmitted and received radio waves to increase signal strength and thus the effective range of a wireless network.

**ASCII**

American Standard Code for Information Interchange. A communication mode in which each eight-bit byte in a message contains one ASCII character code. ASCII characters (or hexadecimal characters) are sometimes used as a key to encrypt data and ensure its secure transmission.

**Association**

Process whereby two 802.11 radios establish communications with each other. Requirements for communication include common SSID (network names) and encryption settings.

**Authenticate**

The process of confirming the identity of someone connecting to a network.

**Authentication Server**

A back-end database server that confirms the identity of a supplicant to an authenticator in an 802.1x-authenticated network.

**B**

**Band**

Another term for spectrum used to indicate a particular set of frequencies. Wireless networking protocols work in either the 2.4 GHz or the 5 GHz bands.

**Bandwidth**

(See Throughput)

**Base Station**

See Wireless Gateway

**Baud Rate**

The speed of communication between devices on the network. All devices must communicate at the same rate.

**bps**

Bits per Second. A measure of data transmission speed across a network or communications channel; bps is the number of bits that can be sent or received per second.



## C

### **Channel**

One portion of the available radio spectrum that all devices on a wireless network use to communicate. Changing the channel on the access point/router can help reduce interference.

### **Client**

A client is a software program, or the device on which that program runs, that makes requests for information from a software program, or the device on which that program runs, in a client-server relationship.

A Client on an Ethernet network is equivalent to a Master on a serial network.

### **Configuration PC**

A computer that contains the configuration tools for the RLX2-IFHxE.

## D

### **dBi**

Decibels referenced to an "ideal" isotropic radiator in free space; frequently used to express antenna gain

### **dBm**

Decibels referenced to one milliwatt (mW); an "absolute" unit used to measure signal power (transmit power output or received signal strength)

### **DCE**

Data communications equipment. A modem, for example.

### **Decibel (dB)**

A measure of the ratio between two signal levels; used to express gain (or loss) in a system.

### **Default Gateway**

The IP address of a network router where data is sent if the destination IP address is outside the local subnet. The gateway is the device that routes the traffic from the local area network to other networks such as the Internet.

### **Device-to-Device Network**

Two or more devices that connect using wireless network devices without the use of a centralized wireless access point. Also known as a peer-to-peer network.

### **DHCP**

The dynamic host configuration protocol is an Internet protocol, similar to BootP, for automating the configuration of computers that use TCP/IP. DHCP can be used to automatically assign IP addresses, to deliver IP stack configuration parameters, such as the subnet mask and default router, and to provide other configuration information, such as the addresses for printer, time, and news servers.

### **Direct Sequence Spread Spectrum**

One of two approaches (with frequency hopping spread spectrum) for sorting out overlapping data signals transmitted via radio waves. 802.11b uses DSSS.

### **Directional Antenna**

Transmits and receives radio waves in a certain direction(s) for greater performance.

### **Diversity Antenna**

An antenna system that uses multiple antennas to reduce interference and maximize reception and transmission quality.

### **DTE**

Data Terminal Equipment, for example, a computer or terminal.

### **Dual Band**

A device that is capable of operating in two frequencies. On a wireless network, dual-band devices are capable of operating in both the 2.4 GHz (802.11b/g) and 5 GHz (802.11a) bands.

## **E**

### **EAP**

Extensible Authentication Protocol. A protocol that provides an authentication framework for both wireless and wired Ethernet enterprise networks.

### **EIRP**

Equivalent isotropically radiated power (EIRP) is the amount of power that would have to be emitted by an isotropic antenna (that evenly distributes power in all directions and is a theoretical construct) to produce the peak power density observed in the direction of maximum antenna gain.

### **Encryption**

Method of scrambling data so that only the intended viewers can decipher and understand it.

### **ESD**

Electrostatic Discharge. Can cause internal circuit damage to the coprocessor.

### **ESSID**

Extended Service Set Identifier. A name used to identify a wireless network.

## F

### **Firmware**

Firmware is the embedded software code that runs in the module to direct module function (similar to the BIOS in a personal computer). This is distinguished from the Setup/Diagnostic Application software that is installed on the Configuration PC.

### **Frequency Hopping**

A radio that rapidly changes its operating frequency several times per second following a pre-determined sequence of frequencies. The transmitting and receiving radios are programmed to follow the same frequency hopping sequence.

### **Frequency Hopping Spread Spectrum**

Changes or hops frequencies in pattern known to both sender and receiver. FHSS is little influenced by radio stations, reflections, or other environmental factors. However, it is much slower than DSSS.

### **Fresnel Zone**

An elliptical area on either side of the straight line of sight that must also be clear for a long-range wireless network to work.

### **Full-Duplex**

A communications circuit or system designed to simultaneously transmit and receive two different streams of data. Telephones are an example of a full-duplex communication system. Both parties on a telephone conversation can talk and listen at the same time. If both talk at the same time, their two signals are not corrupted.

## G

### **Gain**

The amount by which an antenna concentrates signal strength in a wireless network.

### **Gateway**

In wireless terms, a gateway is an access point with additional software capabilities such as providing NAT and DHCP.

## H

### **Half-Duplex**

A communications circuit or system designed to transmit and receive data, but not both simultaneously. Citizens' Band (CB) or walkie-talkie radios are an example of a half-duplex communication system. Either party to a radio conversation may talk or listen; but both cannot talk at the same time without corrupting each other's signal. If one operator is talking, the other must be listening to have successful communication.

## **Hz**

Hertz. The international unit for measuring frequency equivalent to the older unit of cycles per second. One megahertz (MHz) is one million hertz. One gigahertz (GHz) is one billion hertz. The standard US electrical power frequency is 60 Hz. 802.11a devices operate in the 5 GHz band; 802.11b and g devices operate in the 2.4 GHz band.

## **I**

### **IEEE**

Institute of Electrical and Electronics Engineers, Inc. IEEE is a professional organization with members in over 175 countries and is an authority in technical areas such as computer engineering and telecommunications. IEEE developed the 802.11 specifications.

### **IP Address**

A 32-bit identification number for each node on an Internet Protocol network. These addresses are represented as four sets of 8-bit numbers (numbers from 0 to 255), separated by periods ("dots").

Networks using the TCP/IP Protocol route messages based on the IP address of the destination. Each number can be 0 to 255. For example, 192.168.0.100 could be an IP address. Each node on the network must have a unique IP address.

## **K**

### **Key**

A set of information (often 40 to as much as 256 bits) that is used as a seed to an encryption algorithm to encrypt (scramble) data. Ideally, the key must also be known by the receiver to decrypt the data.

## **L**

### **LAN**

A system of connecting PCs and other devices within the same physical proximity for sharing resources such as internet connections, printers, files, and drives. When Wi-Fi is used to connect the devices, the system is known as a wireless LAN or WLAN.

### **LED**

Light-emitting diode.

### **Line of Sight (LoS)**

A clear line from one antenna to another in a long-range wireless network.

### **Link point**

The graphical point next to a radio icon in the ControlScope FH software that represents the connection point for RF communications between radios. An RF connection between two radios is called an RF link and is represented as a graphical black line between the radio's link points.

---

## M

### **MAC ID**

Media Access Control address. Every 802.11 device has its own MAC address. This is a unique identifier used to provide security for wireless networks. When a network uses a MAC table, only the 802.11 radios that have had their MAC addresses added to the network's MAC table are able to get on the network.

### **Master device**

Device that is connected to the Master radio.

### **Mbps**

Megabits per second, or millions of bits per second. A measure of bandwidth.

### **Megahertz**

A measure of electromagnetic wave frequency equal to one million hertz. Often abbreviated as MHz and used to specify the radio frequency used by wireless devices.

### **Mesh Networking**

Features free-standing, non-wired network nodes that communicate among one another and form self-configuring networks, with only one node required to hook into a wired LAN. The other nodes are simply plugged into an electrical outlet, so cabling is much less of an issue.

### **MIC**

Message Integrity Check. One of the elements added to the TKIP standard. A "signature" is added by each radio on each packet it transmits. The signature is based on the data in the packet, a 64-bit value (key) and the MAC address of the sender. The MIC allows the receiving radio to verify (check) that the data is not forged.

### **MIMO**

Multiple Input Multiple Output refers to using multiple antennas in a Wi-Fi device to improve performance and throughput. MIMO technology takes advantage of a characteristic called multipath, which occurs when a radio transmission starts out at Point A and the reflects off or passes through surfaces or objects before arriving, via multiple paths, at Point B. MIMO technology uses multiple antennas to collect and organize signals arriving via these paths.

### **Modbus**

The Modbus protocol provides the internal standard that the MODICON<sup>®</sup> controllers use for parsing messages. During communications on a Modbus network, the protocol determines how each controller will know its device address, recognize a message addressed to it, determine the kind of action to be taken, and extract any data or other information contained in the message. If a reply is required, the controller constructs the reply message and sends it using Modbus protocol.

### **Modem**

Stands for MODulator-DEModulator, a device that converts digital signals to analog signals and vice-versa. Analog signals can be transmitted over communications links such as telephone lines.

## **N**

### **Network**

A series of stations or nodes connected by some type of communication medium. A network may consist of a single link or multiple links.

### **Node**

An address or software location on the network.

### **Null Modem Cable**

A specialty cross-communication cable with female connectors on each end used for direct connection between devices when no modems are present. Commonly used as a quick and inexpensive way to transfer files between two PCs without installing a dedicated network card in each PC.

## **P**

### **Panel Antenna**

An antenna type that radiates in only a specific direction. Panel antennas are commonly used for point-to-point situations. Sometimes called Patch antennas.

### **Parabolic Antenna**

An antenna type that radiates a very narrow beam in a specific direction. Parabolic antennas offer the highest gain for long-range point-to-point situations.

### **Peer-to-Peer Network**

Each radio in a Peer-to-Peer network has the ability to receive data from - and transmit data to - any other radio in the network.

### **Point-Multipoint (Broadcast) Network**

A network type where a single master radio sends data to every remote radio in the network. This is done repeatedly until every remote radio individually receives and acknowledges the data. Each remote radio sends pending data to the master radio that receives and acknowledges data sent from each remote. In this configuration, there are multiple remote radios referenced to a single master radio.

### **Point-Multipoint (Modbus) Network**

A network with a single Master radio and multiple Remote radios. The devices cabled to the radios communicate through the Modbus standard protocol. The Master radio sends data to a Remote radio based on the Modbus address of the Modbus device. The data is only sent to the single Remote device based on its address. Each Remote radio sends its data only to the Master radio. The Master and Remote radios acknowledge that data was received correctly.

### **Point-to-Multipoint**

A wireless network in which one point (the access point) serves multiple other points around it. Indoor wireless networks are all point-to-multipoint, and long-range wireless networks that serve multiple clients usually employ either a single omnidirectional antenna or multiple sector antennas.

### **Point-to-Point Network**

A network consisting of a single Master radio and a single Remote radio. All data from the Master is received and acknowledged by one Remote. All data from the single Remote is received and acknowledged by the Master radio.

### **Poll**

A method of electronic communication between devices involving a query and response of data.

### **Power Supply**

Device that supplies electrical power to the I/O chassis containing the processor, coprocessor, or other modules.

### **Protocol**

The language or packaging of information that is transmitted between nodes on a network.

## **Q**

### **QoS**

Quality of Service. Required to support wireless multimedia applications and advanced traffic management. QoS enables Wi-Fi access points to prioritize traffic and optimize the way shared network resources are allocated among different applications.

## **R**

### **RADIUS**

Remote Access Dial-In Service. This describes a general method for allowing remote users access to a network. It authenticates the user, specifies passwords and access rights to network resources. It also keeps track of accounting for when and how long the user is logged onto the network. It was originally used for dial-in users, accessing corporate networks via modems. It is now being specified as part of the 802.11i standard to control access of users to wireless networks. Any of several protocols can be used by the wireless client to communicate with the RADIUS server to gain access to the network resources. These protocols include EAP-TLS (Windows), LEAP (Cisco) and EAP-TTLS.

### **Range**

The distance covered by a wireless network radio device. Depending on the environment and the type of antenna used, Wi-Fi signals can have a range of up to a mile.

**Remote Access Point**

One of a number of secondary access points in a wireless network that uses WDS to extend its range. Remote access points (sometimes called relay access points) connect to a master access point.

**Remote device**

Devices connected remote radios

**Repeater**

A Repeater is a device used to extend the range of a Wi-Fi signal. Placed at the edge of signal reception, a repeater simply receives and re-transmits the signal.

**RS-232**

Recommended Standard 232; the standard for serial binary signals between DTE and DCE devices.

**RTU (Remote Terminal Unit)**

Modbus transmission mode where each eight-bit byte in a message contains two four-bit hexadecimal characters. There are two transmission modes (ASCII or RTU). The main advantage of the RTU mode is that its greater character density allows better data throughput than ASCII mode for the same baud rate; each message is transmitted in a continuous stream (See also ASCII, above).

**S****Sector Antenna**

An antenna type that radiates in only a specific direction. Multiple sector antennas are commonly used in point-to-multipoint situations.

**Signal Diversity**

A process by which two small dipole antennas are used to send and receive, combining their results for better effect.

**Signal Loss**

The amount of signal strength that is lost in antenna cable, connectors, and free space. Signal loss is measured in decibels. Also referred to as gain loss.

**Signal Strength**

The strength of the radio waves in a wireless network.

**Simplex**

A communications circuit or system designed to either transmit data or receive data, but not both. Broadcast television is an example of simplex communication system. A television station sends a TV signal but cannot receive responses back from the television sets to which it is transmitting. The TV sets can receive the signal from the TV station but cannot transmit back to the station.



### **Site Survey**

A comprehensive facility study performed by network managers to ensure that planned service levels will be met when a new wireless LAN, or additional WLAN segments to an existing network are deployed. Site survey's are usually performed by a radio frequency engineer and used by systems integrators to identify the optimum placement of access points to ensure that planned levels of service are met. Site surveys are sometimes conducted following the deployment to ensure that the WLAN is achieving the necessary level of coverage. Site surveys can also be used to detect rogue access points (unauthorized access point to the network).

### **Smart-Switched Ethernet Network**

Smart Switched Ethernet (SSE) network is suitable for any communication pattern between the radios. It efficiently determines whether to broadcast to all radios or direct to a single radio on a packet by packet basis.

### **Spectrum**

A range of electromagnetic frequencies.

### **Spread Spectrum**

A form of wireless communication in which a signal's frequency is deliberately varied. This increases bandwidth and lessens the chances of interruption or interception of the transmitted signal.

### **SSI**

Service Set Identifier is a sequence of characters unique to a specific network or network segment that's used by the network and all attached devices to identify themselves and allow devices to connect to the correct network when one or more than one independent network is operating in nearby areas.

### **Subnet Mask**

A mask used to determine what subnet an IP address belongs to. An IP address has two components: the network address, and the host (node or device) address. For example, consider the IP address 150.215.017.009. Assuming this is part of a Class B network (with a subnet mask of 255.255.0.0), the first two numbers (150.215) represent the Class B network address, and the second two numbers (017.009) identify a particular host on this network.

## T

### **TKIP**

Temporal Key Integrity Protocol. The wireless security encryption mechanism in Wi-Fi Protected Access. TKIP uses a key hierarchy and key management methodology that removes the predictability that intruders relied upon to exploit the WEP key. It increases the size of the key from 40 to 128 bits and replaces WEP's single static key with keys that are dynamically generated and distributed by an authentication server, providing some 500 trillion possible keys that can be used on a given data packet. It also includes a Message Integrity Check (MIC), designed to prevent the attacker from capturing data packets, altering them, and resending them. By greatly expanding the size of keys, the number of keys in use, and by creating an integrity checking mechanism, TKIP magnifies the complexity and difficulty involved in decoding data on a Wi-Fi network. TKIP greatly increases the strength and complexity of wireless encryption, making it far more difficult (if not impossible) for a would-be intruder to break into a Wi-Fi network.

## U

### **UART**

Universal Asynchronous Receiver/Transmitter

## W

### **WAP**

Wireless Application Protocol. A set of standards to enable wireless devices to access internet services, such as the World Wide Web and email.

### **WDS**

Wireless Distribution System. Enables access points to communicate with one another in order to extend the range of a wireless networks. Used in 802.11g based access points.

### **WEP**

Wired-Equivalent Privacy protocol was specified in the IEEE 802.11 standard to provide a WLAN with a minimal level of security and privacy comparable to a typical wired LAN, using data encryption.

### **Wi-Fi**

A certification mark managed by a trade group called the Wi-Fi Alliance. Wi-Fi certification encompasses numerous standards including 802.11a, 802.11b, 802.11g, WPA, and more. Equipment must pass compatibility testing to receive the Wi-Fi mark.

### **Wi-Fi CERTIFIED™**

The certification standard designating IEEE 802.11-based wireless local area network (WLAN) products that have passed interoperability testing requirements developed and governed by the Wi-Fi alliance.

### **Wi-Fi Interoperability Certificate**

A statement that a product has passed interoperability testing and will work with other Wi-Fi CERTIFIED products.

### **Wi-Fi Protected Setup**

Wi-Fi Protected Setup™ (previously called Wi-Fi Simple Config) is an optional certification program developed by the Wi-Fi alliance designed to ease set up of security enabled Wi-Fi networks in the home and small office environment. Wi-Fi Protected Setup supports methods (pushing a button or entering a PIN into a wizard-type application) that are familiar to most consumers to configure a network and enable security.

### **Wireless Gateway**

Term used to differentiate between an access point and a more-capable device that can share an internet connection, serve DHCP, and bridge between wired and wireless networks.

### **Wireless Network**

Devices connected to a network using a centralized wireless access point.

### **WLAN**

Wireless Local Area Network. A type of local area network in which data is sent and received via high-frequency radio waves rather than cables or wires.

### **WPA**

Wi-Fi Protected Access is a data encryption specification for 802.11 wireless networks that replaces the weaker WEP. It improves on WEP by using dynamic keys, Extensible Authentication Protocol to secure network access, and an encryption method called Temporal Key Integrity Protocol (TKIP) to secure data transmissions.

### **WPA2**

An enhanced version of WPA. It is the official 802.11i standard. It uses Advanced Encryption Standard instead of TKIP. AES supports 128-bit, 192-bit, and 256-bit encryption keys.

## **Y**

### **Yagi Antenna**

An antenna type that radiates in only a specific direction. Yagi antennas are used in point-to-point situations.



## 6 Support, Service & Warranty

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### 6.1 Contacting Technical Support

ProSoft Technology, Inc. is committed to providing the most efficient and effective support possible. Before calling, please gather the following information to assist in expediting this process:

- 1 Product Version Number
- 2 System architecture
- 3 Network details

If the issue is hardware related, we will also need information regarding:

- 1 Module configuration and associated ladder files, if any
- 2 Module operation and any unusual behavior
- 3 Configuration/Debug status information
- 4 LED patterns
- 5 Details about the serial, Ethernet or Fieldbus devices interfaced to the module, if any.

**Note:** For technical support calls within the United States, an emergency after-hours answering system allows 24-hour/7-days-a-week pager access to one of our qualified Technical and/or Application Support Engineers. Detailed contact information for all our worldwide locations is available on the following page.

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<b>Asia Pacific</b> (location in Malaysia)	Tel: +603.7724.2080 E-mail: <a href="mailto:asiapc@prosoft-technology.com">asiapc@prosoft-technology.com</a> Languages spoken include: Chinese, English
<b>Asia Pacific</b> (location in China)	Tel: +86.21.5187.7337 x888 E-mail: <a href="mailto:asiapc@prosoft-technology.com">asiapc@prosoft-technology.com</a> Languages spoken include: Chinese, English
<b>Europe</b> (location in Toulouse, France)	Tel: +33 (0) 5.34.36.87.20 E-mail: <a href="mailto:support.EMEA@prosoft-technology.com">support.EMEA@prosoft-technology.com</a> Languages spoken include: French, English
<b>Europe</b> (location in Dubai, UAE)	Tel: +971-4-214-6911 E-mail: <a href="mailto:mea@prosoft-technology.com">mea@prosoft-technology.com</a> Languages spoken include: English, Hindi
<b>North America</b> (location in California)	Tel: +1.661.716.5100 E-mail: <a href="mailto:support@prosoft-technology.com">support@prosoft-technology.com</a> Languages spoken include: English, Spanish
<b>Latin America</b> (Oficina Regional)	Tel: +1-281-2989109 E-Mail: <a href="mailto:latinam@prosoft-technology.com">latinam@prosoft-technology.com</a> Languages spoken include: Spanish, English
<b>Latin America</b> (location in Puebla, Mexico)	Tel: +52-222-3-99-6565 E-mail: <a href="mailto:soporte@prosoft-technology.com">soporte@prosoft-technology.com</a> Languages spoken include: Spanish
<b>Brasil</b> (location in Sao Paulo)	Tel: +55-11-5083-3776 E-mail: <a href="mailto:brasil@prosoft-technology.com">brasil@prosoft-technology.com</a> Languages spoken include: Portuguese, English

## 6.2 LIMITED WARRANTY

For complete details regarding ProSoft Technology's TERMS & CONDITIONS OF SALE, WARRANTY, SUPPORT, SERVICE, and RETURN MATERIAL AUTHORIZATION INSTRUCTIONS, please see the documents on the Product DVD or go to [www.prosoft-technology.com/warranty](http://www.prosoft-technology.com/warranty).

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