



# WIRELESS MODEM

## PULSE '2070' USER MANUAL

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### Warnings and Precautions

The following symbols indicate important safety warnings and precautions throughout this manual.

They are defined as follows:

	<b>WARNING</b> indicates that serious bodily harm or death may result from failure to adhere to the precautions.
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	<b>CAUTION</b> indicates that damage to equipment may result if the instructions are not followed.
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	<b>NOTE</b> suggests optimal conditions under which the equipment will operate effectively and safely.
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## Table of Contents

<b>Warnings and Precautions.....</b>	<b>2</b>
<b>Table of Contents.....</b>	<b>3</b>
<b>Introduction .....</b>	<b>5</b>
Overview .....	5
Product Description .....	5
Network Concepts.....	6
Mode of Operation .....	6
Supported Network Topologies .....	7
Upstream and Downstream.....	8
Hop Patterns .....	8
<b>Hardware .....</b>	<b>9</b>
Antenna Connection .....	9
Hardware Configuration .....	10
Controller Installation .....	11
Data Connection .....	12
COM1 .....	13
Supported Formats .....	13
RTS/CTS Operation.....	14
DCD Operation .....	14
COM2 .....	15
USB Connection .....	15
LED Indicators .....	16
Status Indicator .....	16
Serial Data Indicators.....	17
RSSI Indicators.....	17
<b>Software.....</b>	<b>18</b>

# WIRELESS MODEM

## PULSE '2070' USER MANUAL

---

Overview .....	18
Installation .....	19
Connecting the Modem to a Computer .....	19
Operation .....	19
<b>Troubleshooting .....</b>	<b>20</b>
General.....	20
New Deployments.....	21
Bench Test Your Radios.....	22
Bench Test Your Application .....	24
Install and Troubleshoot Your Radios .....	26
Connect Client Equipment .....	28
Existing Deployments.....	30
<b>Appendix A: RF Exposure.....</b>	<b>31</b>
FCC .....	31
Health Canada.....	31
<b>Appendix B: Declaration of Conformity.....</b>	<b>32</b>
FCC .....	32
Warning (Part 15.21).....	32
Industry Canada .....	32

## Introduction

### Overview

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This manual is a reference for the ENCOM PULSE '2070' Wireless Modem.

It contains instructions, suggestions, and information which will help you set up your equipment.

### Product Description

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ENCOM manufactures the PULSE family of Wireless Modems that are used to provide reliable wireless communications between serial devices.



The PULSE '2070' plugs directly into a 2070 Controller, which provides power and serial data through the edge connector. Data from your serial device is transparently sent to other ENCOM PULSE Wireless Modems using license free 900 MHz technology. LED indicators on the front panel provide serial and RF status information.

The USB connector on the front panel is reserved for our Windows based PULSE Link software application. ENCOM PULSE Link is used to configure the PULSE family of modems, and also allows you to optimize and diagnose PULSE deployments.

Typical applications for ENCOM PULSE Wireless Modems include:

- SCADA
- Remote Telemetry
- Surveillance
- Traffic Control
- Industrial Controls
- Remote Monitoring
- Security
- Display Signs
- Railway Signs

## Network Concepts

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### Mode of Operation

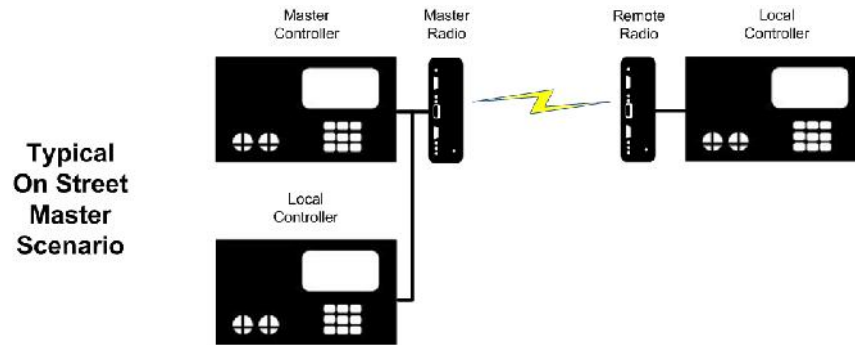
ENCOM supplies a PC based software application that you will use to define the mode of operation for each ENCOM PULSE modem. A PULSE modem can be configured as one of the following:

- Master
- Repeater
- Remote

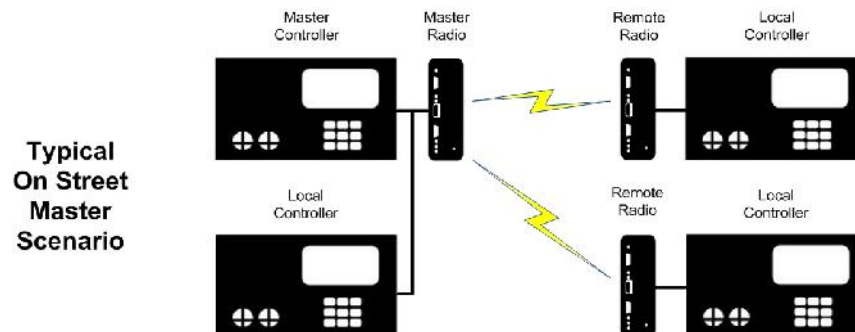
ENCOM PULSE modems are deployed in networks. Each network typically consists of one Master radio, and one or more Remote radios. Repeaters are optional, and when included in the network they are physically positioned between the Master and Remote radios. In effect, they are used to extend the network range.

### Supported Network Topologies

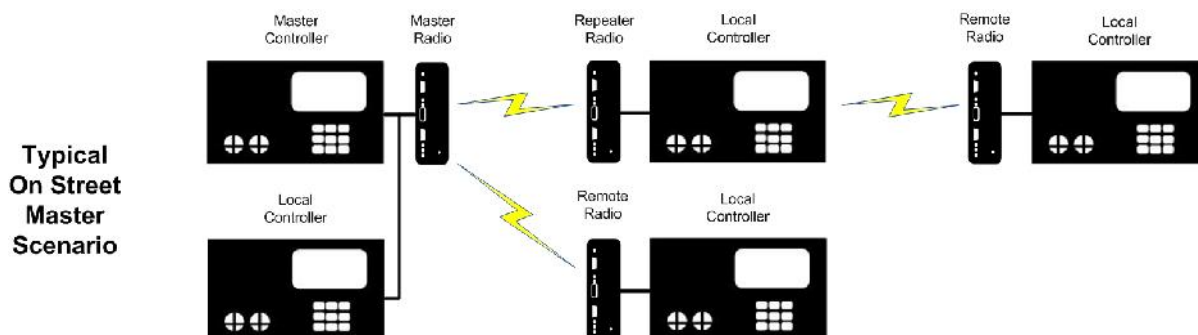
The simplest network consists of one Master and one Remote. This is referred to as a Point-to-Point deployment. The example below shows a Point-to-Point Traffic Control application.



It is possible to have a Master directly communicate with more than one Remote. This is referred to as a Point-to-Multipoint deployment.

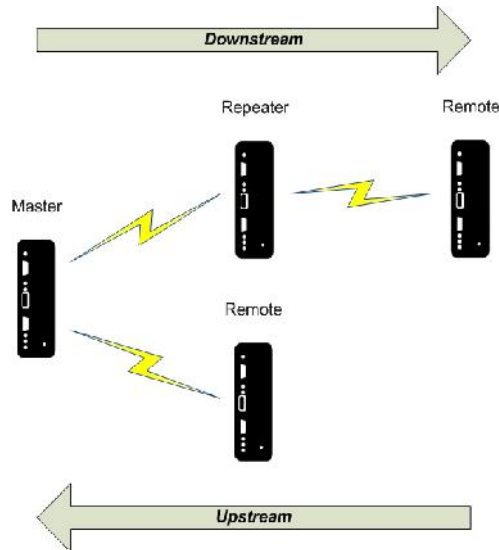


Repeaters can be included in a network and can be deployed as required. However, it is important to note that using Repeaters will increase your packet latency. ENCOM recommends that you determine whether Repeaters are suitable for your application during system design.



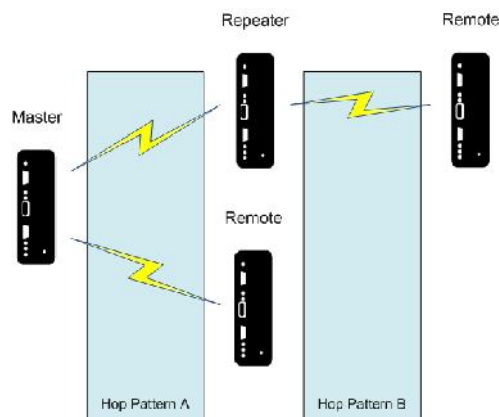
### Upstream and Downstream

This document uses the terms upstream and downstream when describing the relative orientation of Wireless Modems in a network. Data travelling from the Master towards the Remotes is said to be flowing **downstream**. Conversely, data travelling towards the Master from the Remotes is said to be flowing **upstream**.



### Hop Patterns

ENCOM radios communicate using Frequency Hopping Spread Spectrum (FHSS) technology. A predefined sequence of channel numbers is called a hop pattern. All radios that need to communicate directly with one another must share the same hop pattern. Accordingly, Repeaters must be configured to use two different hop patterns; one for communicating upstream and one for communicating downstream.





## Hardware


### Antenna Connection


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The ENCOM PULSE '2070' Wireless Modem is equipped with a Reverse Polarity TNC Female antenna connector.


Please note that an antenna is not supplied with this product. Refer to the instructions provided by the antenna manufacturer and comply with all installation instructions and recommendations.


The antenna and antenna cable should be installed before the Wireless Modem is powered on.

	Always ensure that the radio equipment is powered down when installing the antenna.
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	Never work on an antenna system when there is lightning in the area.
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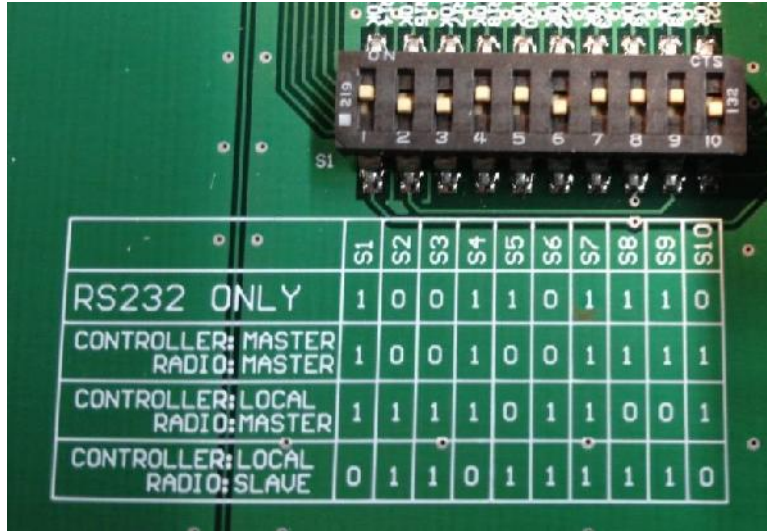
	The installation, removal or maintenance of all antenna components must be carried out by qualified and experienced personnel.
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	Direct human contact with the antenna is potentially unhealthy when the radio is generating RF energy.
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	Do not operate the Wireless Modem without an antenna connected, as this can damage the transmitter.
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### Hardware Configuration

There is a bank of DIP switches on the ENCOM PULSE '2070' Wireless Modem. These DIP switches must be set appropriately for your application, prior to installation.



The legend on the Wireless Modem indicates there are four valid switch combinations:

Legend	Description
RS232 Only	This is the required setting for most deployments
Controller: Master Radio: Master	These settings are only appropriate when FSK is used for communications, and the Wireless Modem needs to be connected to an external analog modem
Controller: Local Radio: Master	
Controller: Local Radio: Slave	

# WIRELESS MODEM

## PULSE '2070' USER MANUAL

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### Controller Installation

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The ENCOM PULSE '2070' Wireless Modem always plugs into slot A2 (second from the left) of the 2070 Controller.



The Controller can be powered ON when the PULSE Modem is plugged in. Site specific regulations and/or practices may not allow equipment to be connected or disconnected when power is applied. If these regulations are in effect, ensure the 2070 Controller is powered down prior to installation.

Insert the PULSE Modem into the 2070 Controller and tighten the thumbscrews to ensure it is fully inserted and secured. Conversely, to remove the Wireless Modem, ensure the thumbscrews are completely released before attempting to pull it out of the 2070 Controller.

### Data Connection

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The ENCOM PULSE '2070' Wireless Modem uses Circuit #1 and Circuit #2 of the 2070 chassis backplane, as per the 2070 specification. Please ensure that your Controller application is configured appropriately.

The Wireless Modem has two DB9 female data ports on the front panel, labeled COM1 and COM2. The intended use of these data ports is described below.



### COM1

The COM1 data port follows the RS232 DCE convention, although some pins are unused.

Pin	Description	Direction
1	DCD Data Carrier Detect	Output
2	RXD Receive Data	Output
3	TXD Transmit Data	Input
5	GND Signal Ground	
7	RTS Ready to Send	Input
8	CTS Clear to Send	Output

When the Wireless Modem is installed in a Master 2070 Controller (On Street Master), COM1 can be used to:

- Connect the Wireless Modem to a 2070-7 module in a co-located Local 2070 Controller, or
- Connect the Wireless Modem to external equipment, such as an analog modem

When the Wireless Modem is installed in a Local 2070 Controller, COM1 can be used to:

- Connect the Wireless Modem to external equipment, such as an analog modem

### Supported Formats

Baud Rates: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200

Data Bits: 7, 8

Parity: None, Odd, Even

Stop Bits: 1, 2

### **RTS/CTS Operation**

The RTS/CTS control lines can be configured so they are:

- Disabled
- Used for conventional flow control
- Used to frame data sent from your serial device to the Wireless Modem

### **DCD Operation**

The DCD control line can be configured so it is:

- Always ON
- Only ON when the RF radio is synchronized
- Used to frame data sent from the Wireless Modem to your serial device

### COM2

The COM2 data port follows the RS232 DTE convention, although some pins are unused.

Pin	Description	Direction
1	DCD Data Carrier Detect	Input
2	RXD Receive Data	Input
3	TXD Transmit Data	Output
4	DTR Data Terminal Ready	Output
5	GND Signal Ground	
7	RTS Ready to Send	Output
8	CTS Clear to Send	Input

Data port COM2 provides a passthrough connection to the Controller's C20 port. This is typically used for direct PC connections.

### USB Connection

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The USB connector on the front panel accepts a Mini B cable.

ENCOM can provide a standard cable to connect the PULSE Wireless Modem to a PC.

### LED Indicators

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There are several LEDs present on the face plate of the Wireless Modem.

- Status indicator
- Serial data indicators
- RSSI indicators



Each of these is described below.

#### Status Indicator

When this LED is ON, it indicates that the Wireless Modem has power and is operational.



### Serial Data Indicators

There are two LEDs, one labelled TX and one labelled RX. The behaviour of these LEDs depends on the radio mode, as described in the following table.

Radio Mode	LED	Description
Master, or	TX	<ul style="list-style-type: none"><li>Blinks when the radio is transmitting data</li></ul>
Remote	RX	<ul style="list-style-type: none"><li>Blinks when the radio is receiving data</li></ul>
Repeater	TX	<ul style="list-style-type: none"><li>Blinks when the radio is transmitting data from an attached serial device</li><li>Does not blink when the radio is repeating data sent by other serial devices</li></ul>
	RX	<ul style="list-style-type: none"><li>Blinks when the radio is receiving data from an upstream radio (Master, or another Repeater)</li></ul>

Note that when the ENCOM PULSE Link application is used to configure or test a Wireless Modem, the serial data indicators actually show when the Wireless Modem is communicating with the computer.

### RSSI Indicators

Three LEDs, stacked in a column, are used to present the RSSI (Received Signal Strength Indication). When more LEDs are ON, this generally means the signal strength is greater, resulting in more reliable communications.

- One LED indicates that the link is weak
- Two LEDs indicate that the link should be acceptable
- Three LEDs indicate that the link should be strong and very reliable

The LEDs provide feedback on the health of the RF link. If the LEDs are OFF or blinking, you do not have reliable RF communications. Please refer to the Troubleshooting section in this document for more information.

# WIRELESS MODEM

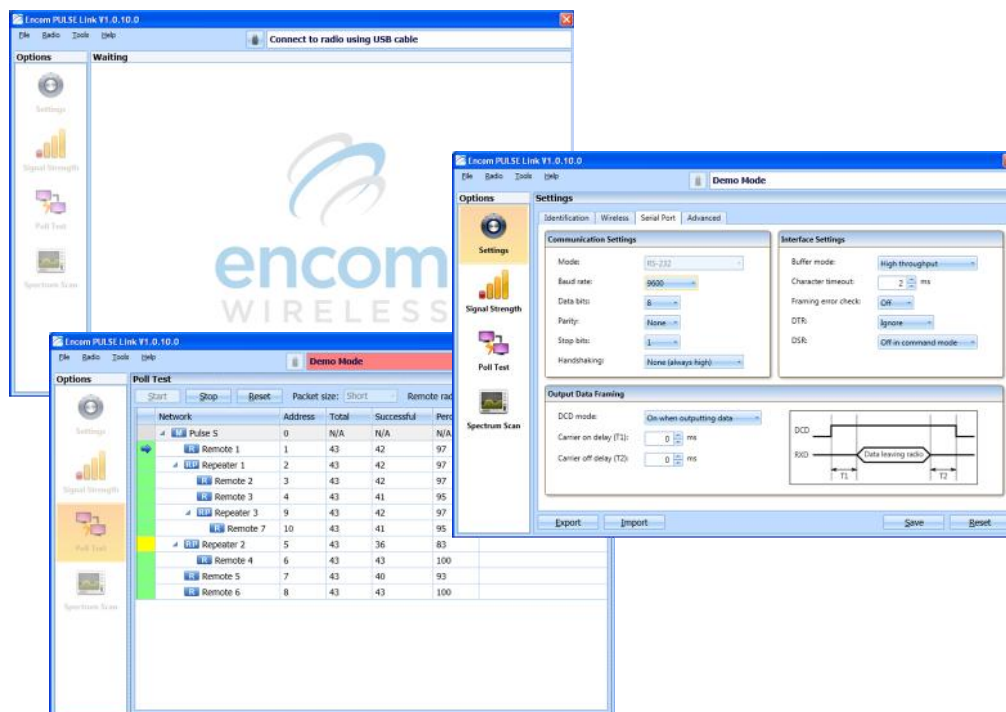
## PULSE '2070' USER MANUAL

## Software

### Overview

ENCOM supplies an application called PULSE Link that can be used to:

- Configure your ENCOM Wireless Modems
- Optimize the performance of your wireless network
- Diagnose network and communication issues



### Installation

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The PULSE Link installation package can be downloaded from the ENCOM website. This package will install both an application and a USB driver on your PC.

Please refer to the PULSE Link User Manual if you require additional assistance.

### Connecting the Modem to a Computer

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The ENCOM PULSE modem has a USB connector on the front panel that is reserved for interaction with the PULSE Link application.

Once the PULSE modem has been installed and powered up:

- Start the PULSE Link application on your PC
- Connect the USB cable to your PC and your Wireless Modem

PULSE Link will detect the PULSE modem and will automatically retrieve the current settings.

### Operation

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The PULSE Link manual describes how the application can be used to configure modems, optimize performance, and troubleshoot issues.

Please refer to the PULSE Link User Manual if you require additional assistance.

## Troubleshooting

### General

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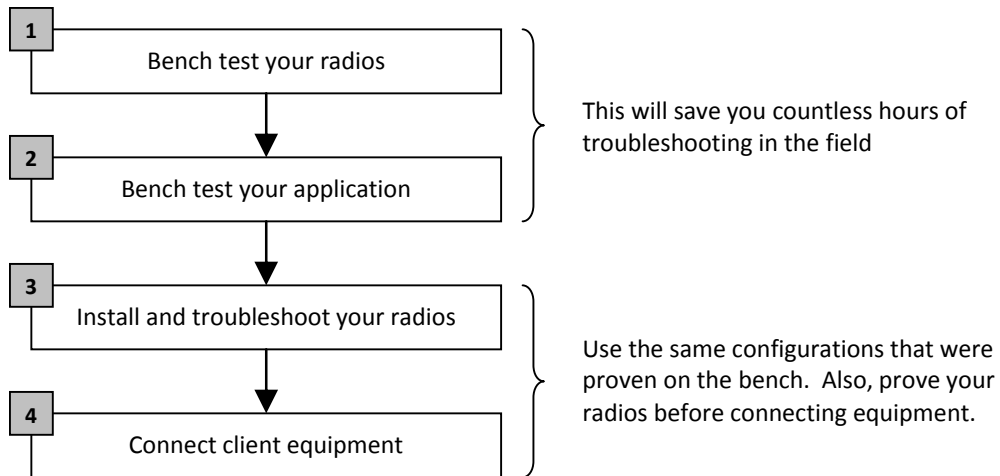
This section describes basic troubleshooting procedures for PULSE deployments. By way of example, we describe the steps that would be followed when interconnecting Traffic Controllers. However, the principles are the same for any type of serial device.

<b>NOTE</b>	<p><b>ENCOM includes diagnostic facilities in the PULSE Link application that allow you to confirm the RF link integrity from the Master to each and every Remote. Please refer to the Poll Test section of the PULSE Link manual for more information.</b></p> <p><b>ENCOM is not responsible for client equipment configuration or data cabling issues, unless we provide the complete solution.</b></p>
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There are two distinct scenarios that are addressed in this manual. The first section provides tips and hints that are useful when deploying a new system. The second provides hints and tips in the event that you need to resolve performance degradation or failure issues in an existing deployment.

### New Deployments

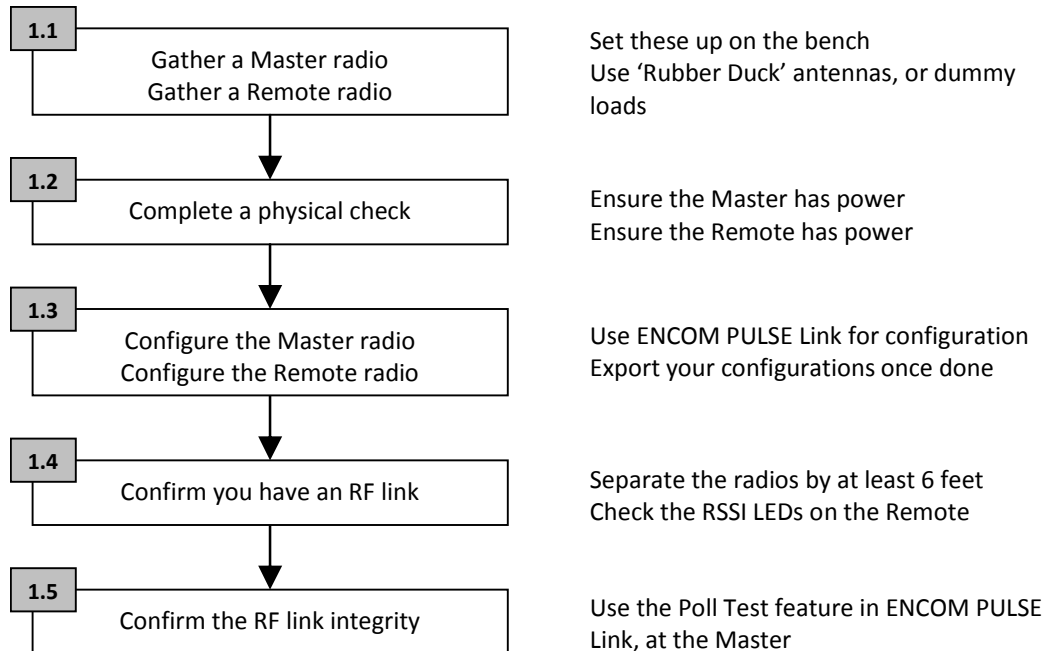
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### Bench Test Your Radios

When working on the bench, your first task is to confirm that the radios communicate reliably with one another. The steps below will help you create your first link.

**Note:** Do not connect data cables from the radios to your client equipment at this time.



If you are having difficulty establishing a reliable RF link, ENCOM recommends that you:

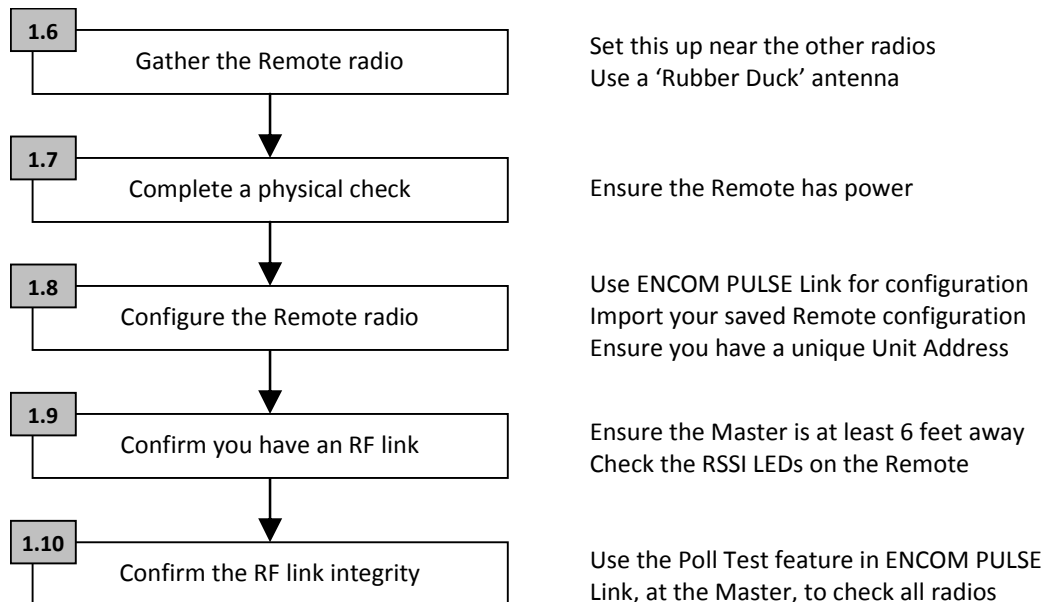
- Double check the configuration of the radios
- Increase antenna separation
- Check for sources of interference (other radios in the vicinity)

# WIRELESS MODEM

## PULSE '2070' USER MANUAL

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Once the first link is working perfectly, add radios to your network one at a time. The steps below need to be performed for each additional radio.

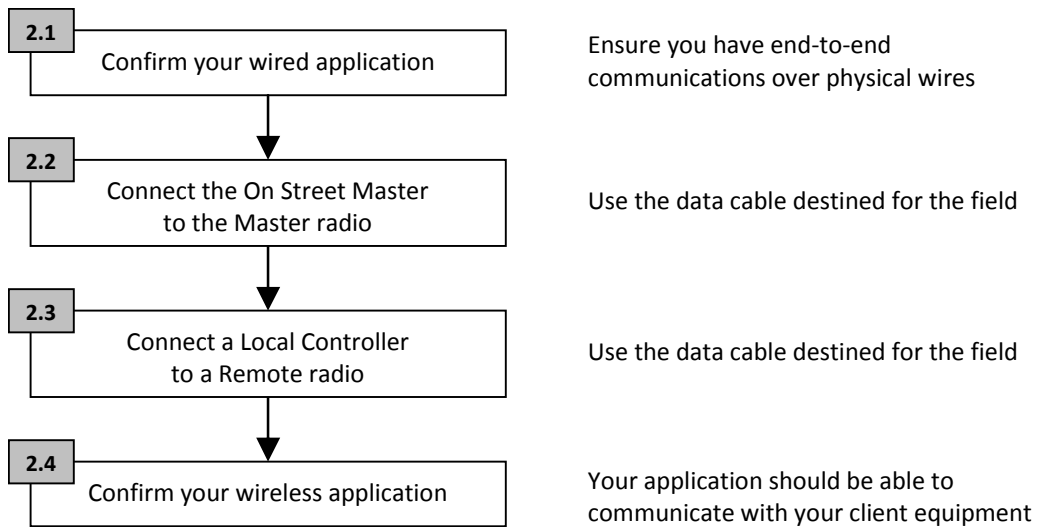


Once the RF link integrity has been confirmed, **all of your ENCOM PULSE modems are working correctly**. You can now focus on end-to-end serial communications.

### Bench Test Your Application

The intent of bench testing your application is to confirm end-to-end, Master Controller to Remote Controller communications. When complete, you will have proven your radio configuration, your data cables, and your system timing. This is much easier to do on the bench than in the field.

Initially, you only want to connect enough client equipment to communicate over one wireless link. This is described in the steps below.





# WIRELESS MODEM

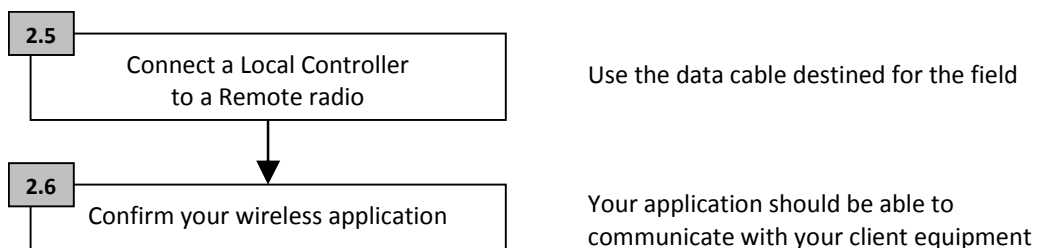
## PULSE '2070' USER MANUAL

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If you are having difficulty communicating reliably with your client equipment, the issue is most likely related to the serial interfaces. Also note that since the RF link integrity has already been confirmed, the issue is probably outside of ENCOM's control. Common issues are listed in the table below.

Possible Problem	Recommendations
Serial data cables	<p>Check for proper signal direction with the help of a 'break-out' box</p> <p>The Tx and Rx LEDs on the modem are invaluable, and can help diagnose your issue</p>
PULSE modem configuration	<p>Confirm that the serial settings in the Master and Remote are consistent with the serial settings in the client equipment</p> <p>You may need to adjust the serial settings and timing parameters in the PULSE modems depending on your application</p>

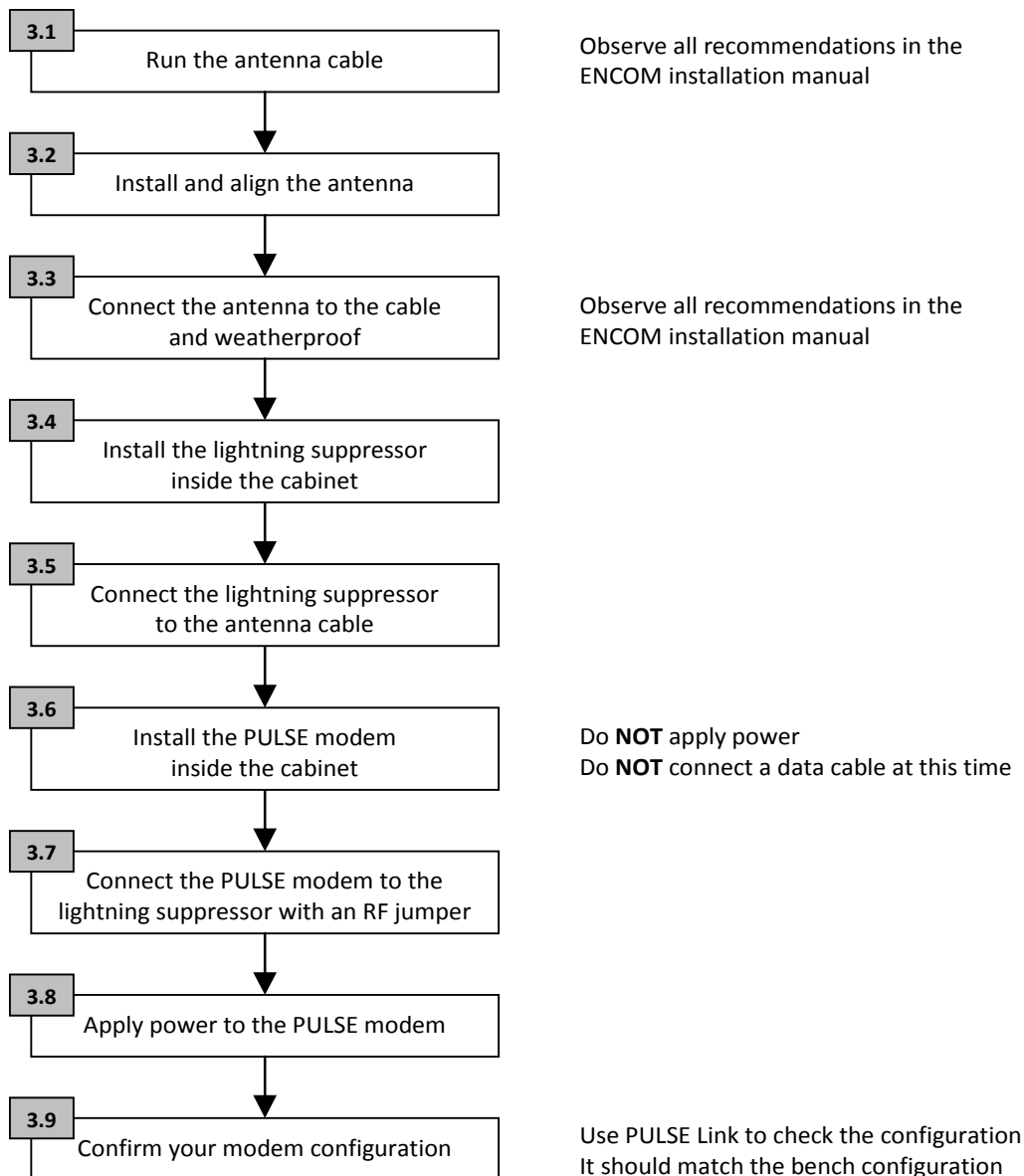
Once the application is working over the first wireless link, you can add client equipment incrementally. For each additional Controller you would like to test:



### Install and Troubleshoot Your Radios

You need to confirm that your radios communicate reliably in the field before connecting your client equipment. This is same strategy that was applied on the bench.

All PULSE modems and antennas need to be installed first. **Note that it is presumed all sites were qualified with site surveys.** The following steps need to be performed at each site.

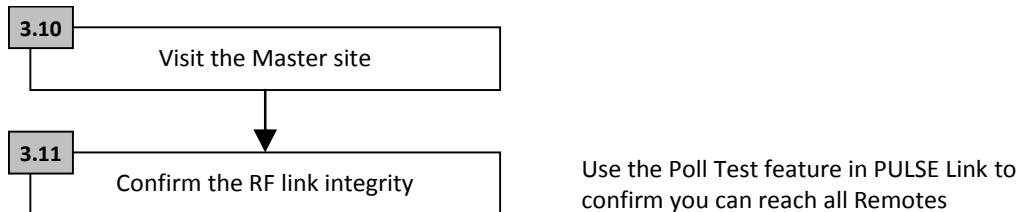


# WIRELESS MODEM

## PULSE '2070' USER MANUAL

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At this point, all PULSE modems and antennas are in the field. They should all have power, and should all have valid configurations. The next task is to troubleshoot your wireless network.



Everything should work reliably, without issue, if you configured and tested your network on the bench. However, if you are having difficulty establishing reliable RF communications, ENCOM recommends that you:

- Confirm the PULSE modems are powered, and antenna cables are connected
- Double check the modem configurations
- Check the antenna alignment
- Consider changing antennas or antenna cables, at problematic sites

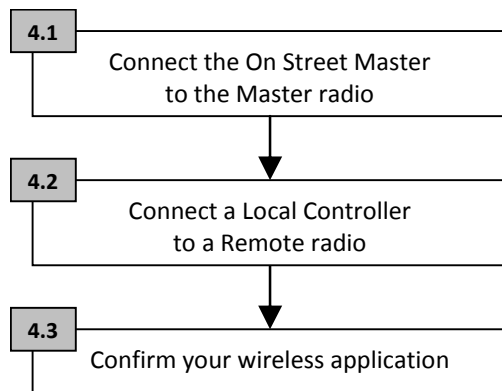
Once the RF link integrity has been confirmed, **all of your ENCOM PULSE modems are successfully deployed and are working correctly.**

### Connect Client Equipment

Once your ENCOM PULSE modems are successfully configured and deployed, your client equipment can be attached to the modems. This final stage of the deployment should be the simplest, given that:

- You have already confirmed your wireless application on the bench
- All ENCOM PULSE modems are successfully deployed and proven

Initially, you only want to connect enough client equipment to communicate over one wireless link. This is described in the steps below.



Your application should be able to communicate with your client equipment

# WIRELESS MODEM

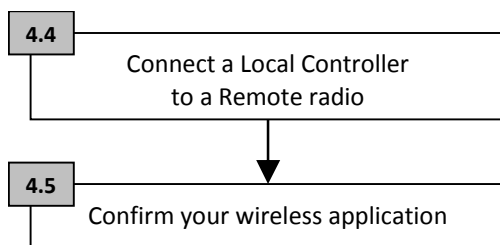
## PULSE '2070' USER MANUAL

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If you are having difficulty communicating reliably with your client equipment, the issue is most likely related to the client equipment or the serial interfaces. Also note that since the RF link integrity has already been confirmed, the issue is probably outside of ENCOM's responsibility. Common issues are listed in the table below.

Possible Problem	Recommendations
Client equipment	Ensure the telemetry ports are enabled Ensure Controllers are correctly configured
Serial data cables	Ensure you are using the same cables that were tested on the bench  You can try swapping cables from known working locations
PULSE modem configuration	Confirm you have the same serial settings that were used on the bench

Once the application is working over the first wireless link, you can add remaining client equipment incrementally.



Your application should be able to communicate with your client equipment

### Existing Deployments

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If a deployed network no longer performs as it once did, start by assessing if there is anything in your system that has recently changed:

- Application software upgrades
- Client equipment upgrades
- IT changes (new equipment, policy changes, etc.)

Check for environmental changes:

- Construction
- Foliage

Determine if you are able to reach no Controllers, all Controllers except one, or some Controllers.

- If all Controllers are unreachable, the problem is likely at or near the Master
- If one Controller is unreachable, the problem is likely at or near that Controller
- If some Controllers are unreachable, check a network map to see if unreachable Controllers are all downstream from a Repeater

Visit each site that you suspect may have an issue.

- Perform a physical check (confirm power, cables, antenna)

Always debug the RF links before debugging the serial connections.

- Connect a PC to the Master radio and use the Poll Test feature in PULSE Link to confirm if all PULSE radios are communicating
- If you do not have a reliable RF link, try swapping one or more radios for known good ones

If the RF links are operating reliably, check the serial connections

- Check the Controller configuration, and cabling
- If a Controller cannot be reached, try swapping the radio at that location for a known good one
- Try swapping the Controller as a last resort

### Appendix A: RF Exposure

#### FCC

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This equipment has been designed to comply with FCC RF exposure requirements outlined in Parts 2.1091, 2.1093, and 15.247(b)(4). Deviation from the recommended installation may violate RF exposure requirements.

**To comply with FCC RF exposure requirements for mobile transmitting devices, only use or install this transmitter at locations where there is at least 23cm (9") separation distance between the antenna and all persons.**

#### Health Canada

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The installer of this radio equipment must ensure 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's website [www.hc-sc.gc.ca](http://www.hc-sc.gc.ca).

## Appendix B: Declaration of Conformity

### FCC

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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
- (2) This device must accept any interference received including interference that may cause undesired operation.

### Warning (Part 15.21)

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Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

### Industry Canada

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This device complies with Industry Canada RSS-210 specifications



# WIRELESS MODEM

## PULSE '2070' USER MANUAL

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ENCOM Wireless, based in Calgary, Canada, provides field-proven, cost-effective wireless data solutions for municipal and industrial clients, with applications in the areas of:

- \* Intelligent Transportation Systems
- \* Public safety communications
- \* Municipal corporate security and IT networks
- \* Water and waste water management
- \* Electrical utilities
- \* Oil and gas

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