

## OverAir Solutions

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# OS2400 User's Manual



PRELIMINARY

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# FCC RULES

The statements contained in this section "FCC RULES" are required. If the Locus Inc. OverAir Solutions OS2400 radio is used as a component of any device, these statements must be a component of that device's product documentation.

## FCC COMPLIANCE STATEMENT

The Locus Inc. Overair Solutions OS2400 device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. this device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

### WARNING:

Changes or modifications to this radio module not expressly approved by its manufacturer, Locus Inc., could void the user's authority to operate the equipment.

### NOTE:

The Locus Inc. OverAir Solutions OS2400 module is labeled with an FCC ID 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 OS2400. Wording on the label similar to the following should be used:

- "Transmitter Module FCC ID: OQ7OS2400"
- OR
- "This device contains Transmitter Module FCC ID: OQ7OS2400."

**Gain / User Proximity to Antenna**

To meet the FCC requirements for safety, it is important to keep the radio's antenna a safe distance from the user. The calculation of a safe distance is based upon the radio's max output power (250mW) and the antenna's gain.

<i>Antenna gain (dB)</i>	<i>Locus Inc. approved antennas (Manufacturer: mfg number)</i>	<i>Distance (cm)</i>	<i>Distance (in)</i>
2	NCC: N24ARSMA1 NCC: N2400SM8 NCC: NOV2400SMA	4.0	1.6
5	NCC: N24HGASM1B NCC: NOV24HEARSMA2B	6	2.2
6	MaxRad: MFB-24006	6.5	2.5
8	MaxRad: MFB-24008 MaxRad: MP24008FSMA	8.0	3.1
9	Mobile Mark: 0D9-2400	9.0	3.5
11	MaxRad: MP24011FSMA	12.0	4.4
13	MaxRad: MP24013FSMA	15.0	6.0
15	Astron: P-2415	18.0	7.0

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## Maximum Antenna Gain / Output Power

The FCC transmitter power limit for this type of radio is 30 dBm (or 1 watt). In addition, to ensure safety, the output of this module is limited to 250mW. To meet the FCC requirements for emissions, the following restrictions on antenna gain must be adhered to when establishing a radio network.

### **Point-Multipoint network:**

**max power 250 mW / max antenna gain 12 dBi**

The transmitter power reference for a Point-Multipoint network is 30 dBm (1 watt) of output power with a maximum antenna gain of 6 dBi. For each 1 dB decrease of output power below this reference point, the antenna gain can increase by 1 dB.

The OS2400 radio module has a maximum output power of 250 mW or 24 dBm. Therefore the maximum allowable antenna gain at full output power is 12 dBi in a Point-Multipoint application.

$$(30\text{dBm} - 24\text{dBm}) + 6\text{dBi} = 12\text{dBi}$$

### **Point-Point network:**

**max power 250 mW / max antenna gain 24 dBi**

The transmitter power reference for a Point-to-Point network is 30dBm (1 watt) of output power with an antenna gain of 6dBi. For each 1 dB decrease in output power below this reference point, the antenna gain can increase by 3 dB.

With the OS2400 radio module's maximum output power of 250 mW, the maximum allowable antenna gain is 24 dBi in a Point-to-Point application.

$$(30\text{dBm} - 24\text{dBm}) + (6\text{dBi} * 3) = 24\text{dB}$$

All of the Locus Inc. approved antennas meet this Point-to-Point antenna gain / output power emissions requirement. For a list of the antennas approved by Locus, Inc. for use with its OverAir Solutions OS2400 module, see "MANUFACTURER-APPROVED ANTENNAS" on page 13.

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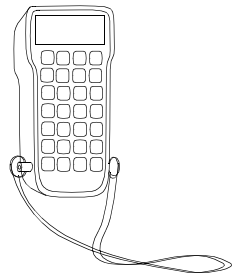
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# RADIO NETWORK BASICS

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## RADIO NETWORK DEFINED

The radio network provides a wireless communication link between a Master Device and any Remote Device that could be connected to that Master Device using a serial cable. For example, a Master Device and its associated Remote Device can be a computer with a printer, a computer with a scanner or a scanner with a printer. A radio link can be used in a situation where a Master Device and its Remote Device are located such that a serial cable connection between them is impractical or impossible.

The simplest network of radios consists of one Master Radio and one Remote Radio. The Master Radio is cabled to the Master Device, the Remote Radio is cabled to the Remote Device that is to be in communication with the Master Device. In the example illustrated below the Master Device is a computer and its Remote Device is a hand held terminal.

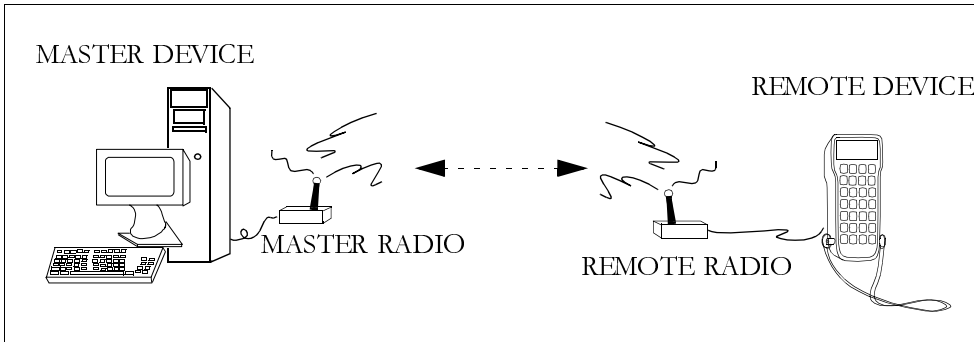
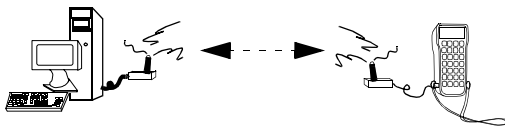


Illustration of: **MASTER and REMOTE defined**

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# ANTENNA INSTALLATION

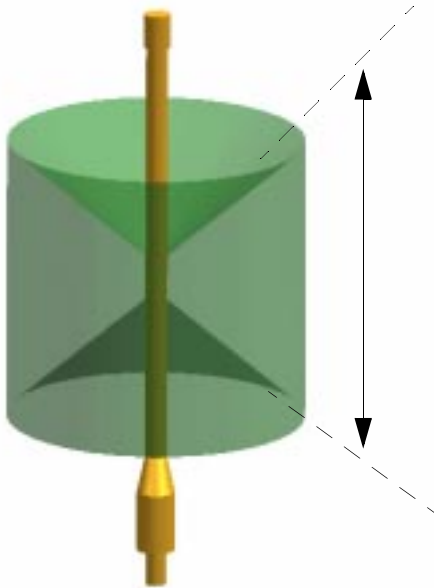
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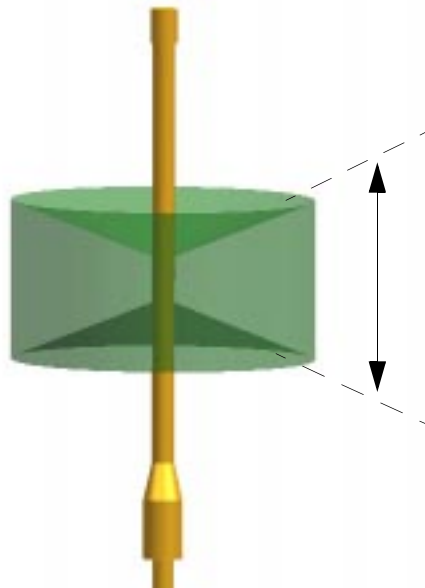
## ANTENNA BASICS

### Gain

In general, an antenna is not uniformly responsive (either as a transmitter or a receiver) in the 3-D environment around it. An antenna's responsiveness is "focussed". The gain rating of an antenna is a measure of its "focus". The concept of gain is illustrated below using a whip antenna as an example..



Whip antenna  
wide beam width,  
low gain



Whip antenna  
small beam width,  
high gain

A low gain antenna has a relatively wide beam width, a high gain antenna a narrower one.

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Beam width is used to characterize both the focus of the transmitting antenna and that of the receiving antenna.

When determining the appropriate gain antenna, there are several considerations:

- with the same amount of transmit power, a high gain antenna can transmit farther than with a low gain antenna.
- if both the transmitting and the receiving antennas are high gain (narrowly focused) and they are not aligned so that their focii meet, the transmitted signal will not be received. The narrower the focus, the trickier the antenna alignment.

Antenna gain is quantified in dBi. An antenna's gain and beam width/angle can be found on the manufacturer's specification sheets.

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## MANUFACTURER-APPROVED ANTENNAS

Locus Inc. has tested and approved the use of these antennas with its OverAir Solutions OS2400 radio module.

<i>Antenna type</i>	<i>Gain</i>	<i>Connector type</i>	<i>Mfg</i>	<i>Mfg part number</i>
1/2 wave whip, articulating	2dBi	reverse polarity SMA	NCC	N24ARSMA1
1/2 wave whip	2dBi	reverse polarity SMA	NCC	N2400SM8
1/2 wave whip, articulating	2dBi	reverse thread SMA	NCC	NOV2400SMA
collinear array whip, articulating	5dBi	reverse polarity SMA	NCC	N24HGASM1B
collinear array whip, articulating	5dBi	reverse thread SMA	NCC	NOV24HEARSMA2B
collinear array whip	9dBi	N	Mobile Mark	OD9-2400
collinear array whip	8dBi	N	MaxRad	MFB-24008
collinear array whip	6dBi	reverse thread N	MaxRad	MFB-24006
patch	13dBi	reverse thread SMA	MaxRad	MP24013FSMA
patch	11dBi	reverse thread SMA	MaxRad	MP24011FSMA
patch	8dBi	reverse thread SMA	MaxRad	MP24008FSMA
Yagi	15dBi	N	Astron	P-2415

## Whip antennas

A whip antenna can be short or long. Generally the taller the antenna, the higher the gain.

Some whip antennas are short enough that they can be connected directly to the radio. Some whip antennas are hinged and are classified as "articulated" whips.

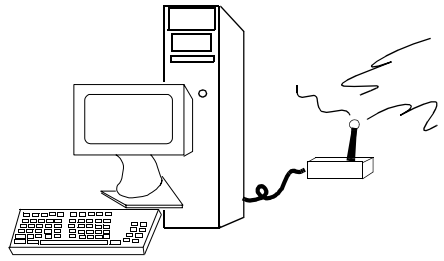


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# GETTING STARTED

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## SETUP OVERVIEW

A new radio network must be configured to function as required for the specific application. The configuration consists of cabling together the devices and the software configuration using the Iris Setup Application.

There are three main steps in the configuration of a new radio network:

- IDENTIFYING THE SERIAL PORT  
(and setting the serial parameters baud rate, parity, data bits, stop bits)
- DESIGNING THE NETWORK
- CONFIGURING THE RADIOS

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## IRIS Setup Application

The Iris Setup Application provides a user interface for the configuration and maintenance of the network. It graphically reflects the physical layout of the component radios.

The Setup Application provides a means to:

- **configure new** networks or radios:
  - assign roles (Master or Remote) to the radios.
  - define data paths
  - set the radio's operation parameters (baud rate, parity, etc.)
- **edit** existing networks or radios:
  - add or delete Remote Radios (in point-multipoint networks only)
  - re-assign roles to the radios.
  - re-assign operation parameters
- **diagnose** functioning of existing networks.

With a MASTER cabled to the PC, the status of each REMOTE can be displayed.

Note: It is recommended that the **Iris Setup Application** be **installed on only one computer** and that the network configuration be done from only that one computer.

When a network is designed, the configuration settings are stored in a database which is internal to the Iris Setup Application. When networks are modified, the Iris Setup Application depends upon the retrieval of the network's configuration history. Modification of networks is easier if the Iris Application Software is installed on only one computer and that all network-related configurations be done using that one computer. To keep some concepts clear, the computer into which the Iris Setup Application has been installed will be referred to as the Configuration PC.

## IDENTIFYING the SERIAL PORT

### CONFIGURE SERIAL PORT (configuration PC's)

From the main menu of the Iris Setup Application select:

- SERIAL PORT
- CONFIGURE

The displayed dialog box has three tabs. From any of the three associated dialog boxes, select:



- ❑ **OK** to confirm/enter any changes made and return to the Setup Software main menu.
- ❑ **CANCEL** to discard any changes and return to the Setup Software main menu.

From the first of the tabbed dialog boxes the serial port is identified.

- **PORT**

- ❑ **COM port selection:** The term COM port refers to the hardware connections which are usually located on the back of the computer. It is through cables connected to these hardware ports that the computer COMMunicates with other devices.

From the drop down list, select the COM port to be used. The Iris Setup Application automatically determines and displays the available serial ports.

Note: The determination of the designation (name) of each COM port can be accomplished several ways:

- ◆ look for a label at the connector on the back of the PC.
  - ◆ consult the computer's documentation.
  - ◆ experiment, trial and error.
  - ◆ check (and or adjust) the PC's BIOS configuration.
- ❑ Select **OK**.

In general, this is the extent of the required configuration. The factory set serial port parameters and handshaking defaults for the Configuration PC are listed below.

## Serial Port Defaults: Configuration PC

These are the factory set serial port parameters for the Configuration PC. Change these defaults with care.

- Baud rate: 115200 (default).
- Parity: None (default).
- Data Bits: 8 (default).
- Stop Bits: 1 (default).
- Handshaking:

It is suggested that the handshaking defaults **not** be changed.

- ◆ Xon/Xoff OFF
- ◆ Rts/Cts ON (Request to Send/Clear to Send)
- ◆ Dtr/Dsr OFF (Data Terminal Ready/Data Set Ready)

## DESIGNING the NETWORK

### Define network name, type and channel

#### CONFIGURE NEW NETWORK

From the main menu of the Iris Setup Application select:

- **CONFIGURE**
- **NEW NETWORK**
  
- **Network Name:** Use up to 20 alpha/numeric characters. The Iris Setup Application will use this assigned name in all subsequent references to this network. The name cannot be easily changed. Choose an appropriately descriptive name.
- **Network Type:** The drop down list includes all available network types. The definition of the network types is by illustration below.

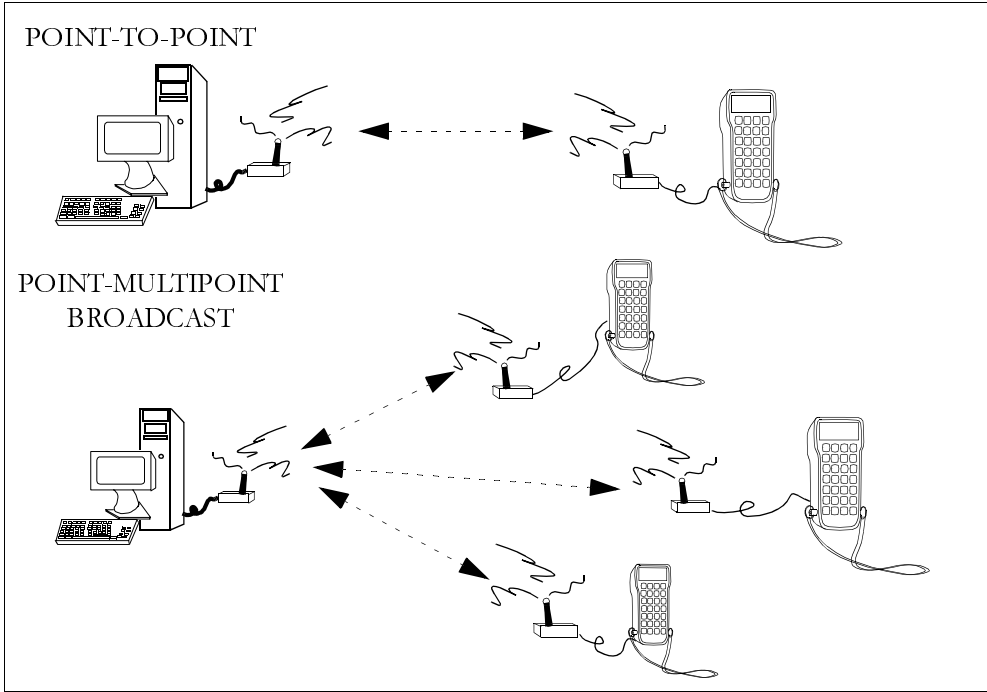


Illustration of: **Network types**

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- **Channel:** Channel selection is used to allow the operation of up to 8 different networks in the same location. For network functionality these channel requirements **must** be adhered to:
  - The Master Radio and Remote Radio (or Remote Radios) of each network **must** be assigned to the same channel.
  - Networks in close proximity **must** be assigned to different channels. Caution: If two networks are close\* to each other and both are assigned to the same channel, the two networks could interfere with each other, causing no communication in either network.

\* Note: the term "close" cannot be finitely quantified. Terrain characteristics, building structure and structure composition are factors in the propagation of radio signals.
- **OK:** to confirm/enter the selected network configuration.

## Graphically layout the network

### Point-to-Point Network

In Point-to-Point networks there is one Master Radio cabled to a Master Device and a Remote Radio 1 cabled to a Remote Device.

- Once **OK** is selected from the Network Properties dialog box, a graphical illustration of the network with its connections is displayed:
  - The automatic display of two radios, a Master Radio and Remote Radio 1, side by side with a solid arrow connection is the default display for both Point-to-Point and Point-Multipoint Broadcast network types.

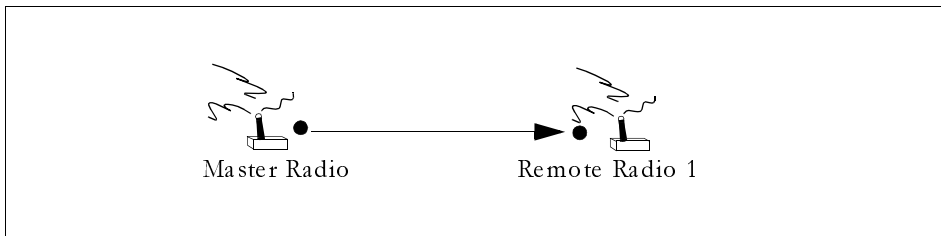


Illustration of: **Default graphic of new network.**

- ❑ To move a radio on the screen, select the radio using the mouse's left button function (left-mouse-click). Holding the mouse button down, drag the radio graphic to the desired location on the display. This does not change the function of the radio or the network.

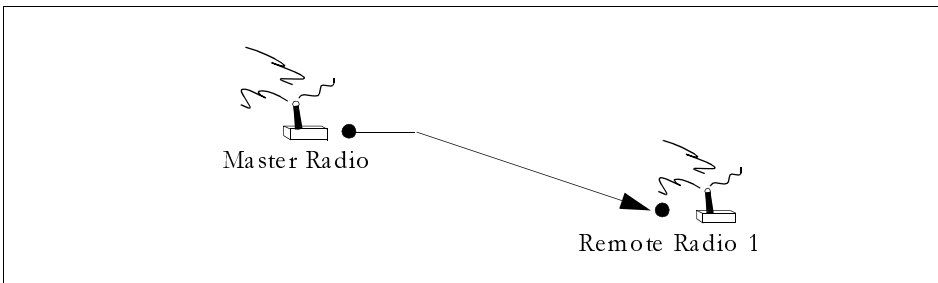


Illustration of: **Radio placement changed by the user.**

- **SAVE** the definition of the new network.

Select:

- ❑ FILE
- ❑ CLOSE

A dialog box will appear asking "Save changes to *Network name.lus*?"

- ❑ Select YES to save the current network definition.

The Windows *Save AS* dialog box will appear. The network name can be changed at this time. This is the last time that the network name can be edited.

**Do not change the default directory.** The Iris Setup Application uses the default directory to maintain network related data.

- ❑ Select SAVE.

Note: For Point-to-Point networks **the addition or deletion of radios is invalid.**

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## Point-Multipoint Broadcast Network

As with a Point-to-Point network, the graphical layout of the Point-Multipoint Broadcast network begins with the automatic display of two radios, a Master Radio and a Remote Radio 1, side by side with a solid arrow connection between them.

In Point-Multipoint Broadcast there is one Master Radio cabled to a PC and several Remote Radios cabled to Remote Devices.

### ADD A RADIO

To add other Remote Radios to the network:

- **RADIO**
- **ADD**

An additional radio icon will automatically appear near the Master. It is up to the user to connect the new Remote Radio 2 to the Master Radio using the mouse's left button function (left-mouse-click):

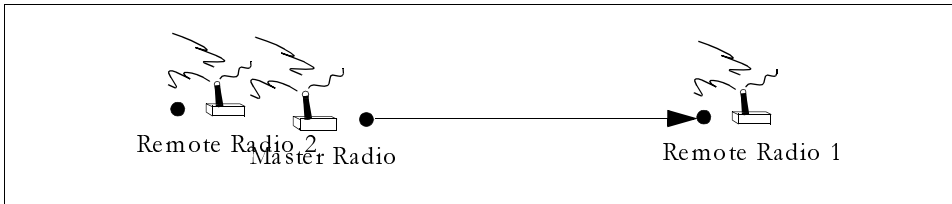
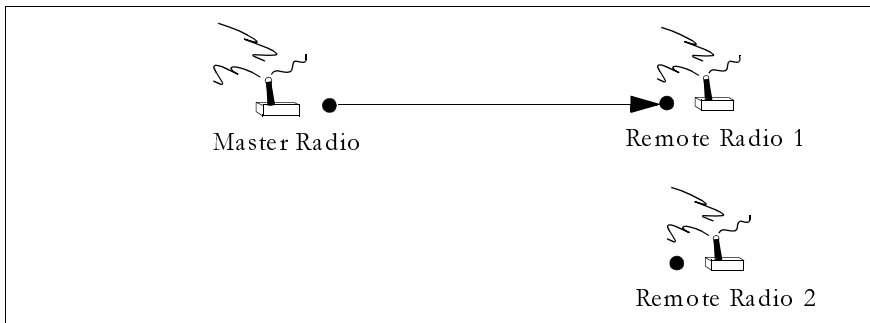


Illustration of: **Default placement of ADDED Radios.**

- Left-mouse-click on the Remote Radio 2 icon.
- Holding the mouse button down, drag the Remote Radio 2 to the desired location on the display.
- Release the mouse button..



- ❑ Left-mouse-click on the "node" (see illustration below) to the right of the Master.
- ❑ Holding the mouse button down, drag the mouse near to the node at the left of Remote Radio 2.
- ❑ Release the mouse. A line with an arrow will **then** appear connecting the Master and the Remote Radio 2.

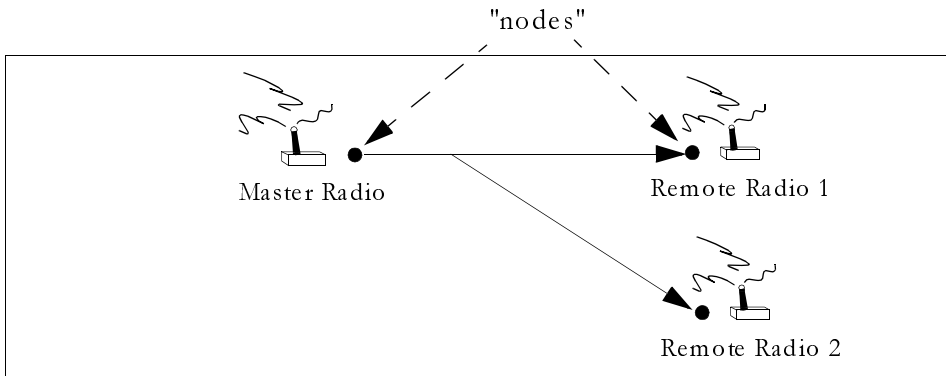


Illustration of: **Radio added to Point-Multipoint Broadcast**

## DELETE A RADIO

If a Remote Radio has been added in error, that Remote Radio can be deleted:

- ❑ Select the Remote Radio with a left-mouse-click. A selected radio is surrounded by light green square.

Select:

- ❑ RADIO
- ❑ DELETE

**OR**

- ❑ Press the Delete key on the computer keyboard.

Note: The **Master Radio cannot be deleted**. Deletion of a Master Radio is an invalid function.

- **SAVE** the definition of the new network.

Select:

- FILE
- CLOSE

A dialog box will appear asking "Save changes to *Network name.lus?*

- Select YES to save the current network definition.

The Windows *Save AS* dialog box will appear. The network name can be changed at this time. This is the last time that the network name can be edited.

**Do not change the default directory.** The Iris Setup Application uses the default directory to maintain network related data.

- Select SAVE.

## CONFIGURING THE RADIOS

So far:

- the serial port has been selected.
- the serial communication parameters of baud rate, parity, data bits and stop bits have been accepted.
- the network has been designed.

The last step in the set-up of the network is to configure the radios. The radios are configured one at a time. Each radio is cabled to the Configuration PC for the configuration process.

### Cable specifications

- Connect the first radio to power.
- Cable the radio to the PC COM port.

The cable is specified as:

- an RS232 null modem cable.
- male to male DB-9 connectors.



- with this pin-out specification:

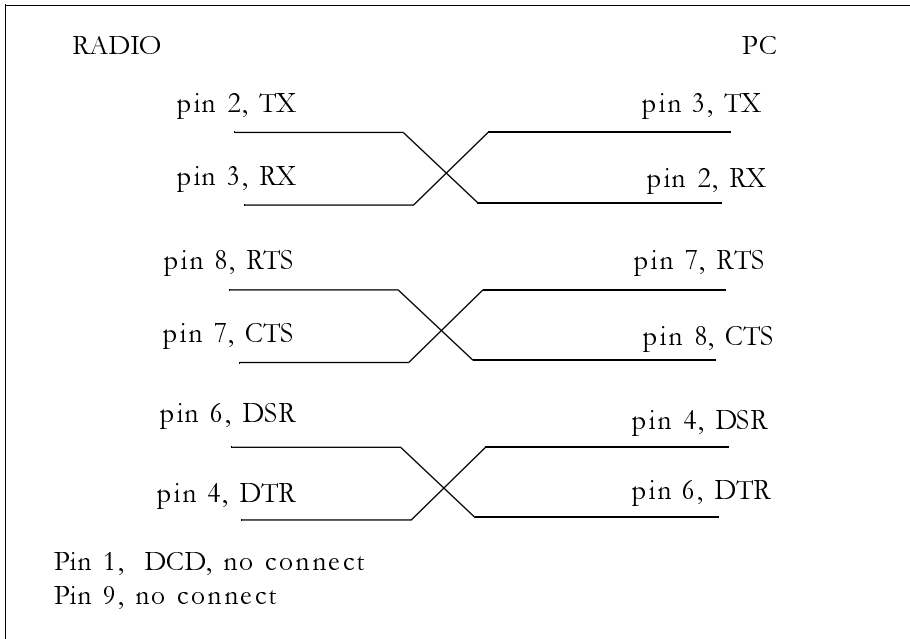
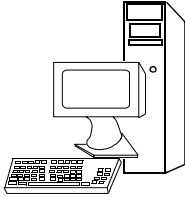


Illustration of: **Null modem cable wiring diagram**

- From the main menu of the Iris Setup Application, select:
  - CONFIGURE
  - MODIFY (modify because the network has already been designed.)
- Double left-mouse-click on the Master Radio.  
The Radio Configuration - *Network Type* dialog box is displayed.
  - Radio Name:** The name of the radio can be changed. By default all master radios are named Master Radio and the remote radios are named Remote Radio 1 for Point-to-Point networks and are numbered sequentially for Point-Multipoint Broadcast networks (for example Remote Radio 1, Remote Radio 2, etc.)
  - Last Configured:** The last configuration of the radio is identified by date and time. This field cannot be edited.

- **Serial Port Settings:** Within the Radio network there are two distinct Serial Ports for which the parameters must be set; the Configuration PC's serial port and the Radio's serial port. A clear understanding of the distinction is important for the correct setting of the serial port parameters. If the serial ports are not correctly set, the network will not communicate.

- ◆ **Configuration PC:** This serial port is configured from the Iris Setup Application main menu's SERIAL PORT/CONFIGURE function. This serial port setup is discussed in section *Serial Port Defaults: Configuration PC* on page 18.




**Configuration PC serial port**

Setup Application main menu:

- SERIAL PORT
- CONFIGURE

- ◆ **Radios:** The serial port of the radio **must** be set to match the serial port requirements of the device to which the radio will be cabled. The radios are cabled to either the Master Device or a Remote Device. The user must determine the serial port parameter requirements of baud rate, parity, number of data bits and stop bits for each Master and Remote Device. The manufacturer's documentation of each Device should have these communication requirements listed. The serial port requirements of the Devices are to be reflected in the serial port settings that are made in the Radio Configuration dialog box. If the radio's serial port settings do not match those of its associated device, no communication between radio and device is possible.



1. Determine the Device's serial port requirements. (Consult manufacturer's documentation.)
2. Configure the radio's serial port to match the requirements of the Device.
  - double left-mouse-click on radio icon.
  - set serial port settings in Radio Configuration dialog box.

- The Radio Address and Destination Address generally are not changed. These are the addresses of a Point-to-Point network. A Master Radio's address is always 1. One way to change a Remote Radio to a Master Radio is to change the Remote Radio's address to 1.
  - a Master Radio's Address is 1 Destination Address is 2
  - a Remote Radio's Address is 2 Destination Address is 1

## CONFIGURE RADIO

- Select CONFIGURE RADIO.

## PRINT NETWORK CONFIGURATION

- It is strongly recommended that the network's configuration be saved.
  - FILE
  - PRINT

- **SAVE** the radio's configuration.

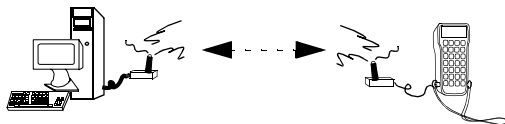
Select:

- FILE
- CLOSE

A dialog box will appear asking "Save changes to *Network name*.lus?".

- Select YES to save the current network definition. The configuration is automatically saved. The Windows *Save As* dialog box is not displayed.

Repeat the configuration process for each radio of the network.



# TROUBLESHOOTING

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Using the Configuration PC and the Iris Setup Application, the functioning of a radio network can be graphically illustrated. If communication problems arise, the source of the problem may be identified using the diagnostic graphical interface.

## VIEW OVERALL NETWORK FUNCTION

To view a graphical representation of network function, a radio must be cabled to the Configuration PC. The displayed representation depends upon which radio is cabled to the Configuratio PC.

For cable specifications see *Cable specifications* on page 24.

From the main menu of the Iris Setup Application select:

- DIAGNOSTIC
- NETWORK
- Select the network by its name. Both Point-to-Point and Point-Multipoint Broadcast networks are listed for selection.

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## Point-to-Point Network Diagnostics

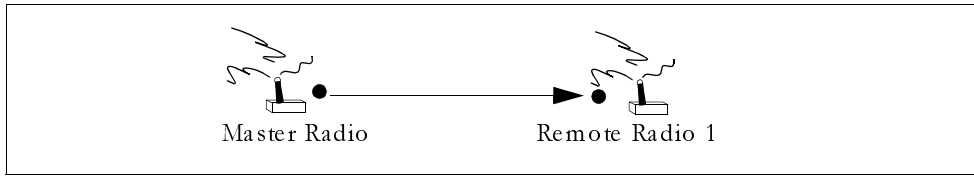


Illustration of: **Functional Point-to-Point Diagnostic**

A **network** with communications **intact** is displayed as a **solid line** with an arrowhead pointing from the node of the Master Radio to that of the Remote Radio.

With a functioning network, this representation will be displayed whether the Radio cabled to the Configuration PC is the Master or the Remote. The Configuration PC knows that if the cabled Radio reports its Radio Address as 1, it is the Master. A reported Radio Address of 2 indicates that the Radio cabled to the Configuration PC is a Remote.

## Point-Multipoint Broadcast Network Diagnostics

To view the communication links of an entire Point-Multipoint Broadcast network, the **Master Radio** must be cabled to the Configuration PC. If a Remote Radio of a Point-Multipoint Broadcast network is cabled to the Configuration PC, only that Remote Radio and its Master will appear on the diagnostic display. Each Remote Radio "knows" only of itself and its Master.

From the main menu of the Iris Setup Application select:

- DIAGNOSTIC
- NETWORK
- Select the network by its name. Both Point-to-Point and Point-Multipoint Broadcast networks are listed for selection.

The same symbolism that is used to diagnose functioning and non-functioning communication links in a Point-to-Point network, also applies to Point-Multipoint Broadcast network diagnostics. In this illustration, with the Master cabled to the Configuration PC, the Iris Setup Application indicates that communication with the Remote Radios 1 and 3 is intact, but there is a problem with Remote Radio 2.

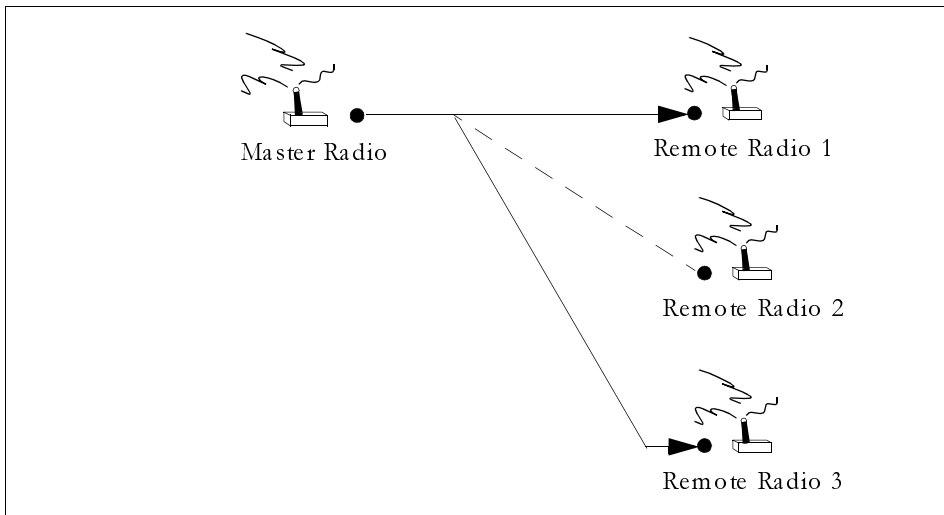
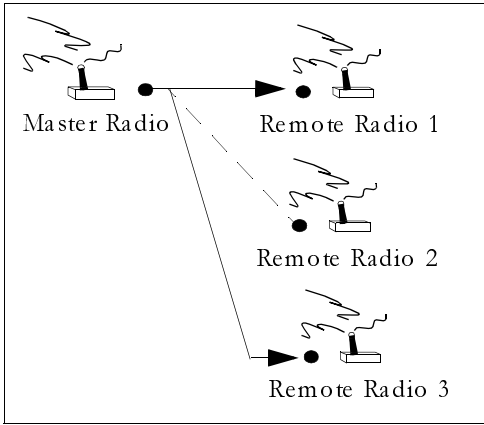


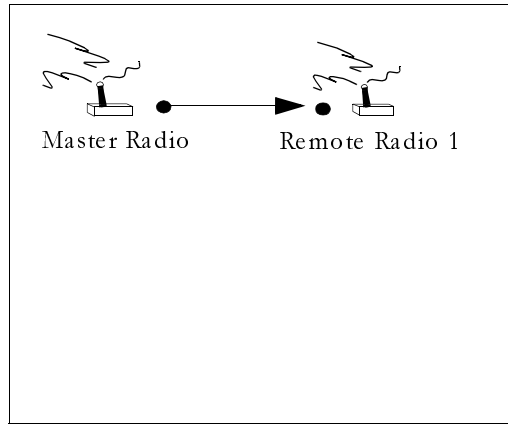
Illustration of: **Point-Multipoint Broadcast diagnostics**

The diagnostic display of a Point-Multipoint Broadcast network is dependent upon which of the radios is cabled to the Configuration PC. The following illustrates how each radio will report the same network condition.



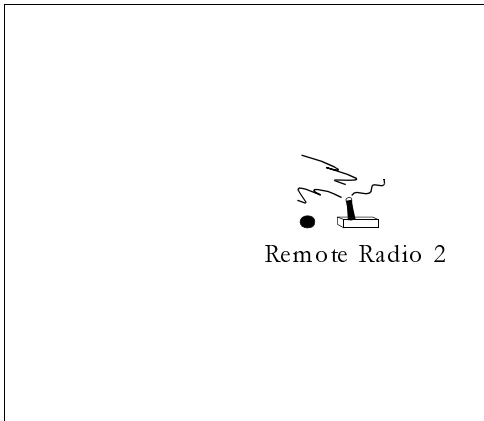
**Diagnostics with Master to Config PC**

The Master Radio "knows" of all of its Remote Radios, even ones not actively communicating.



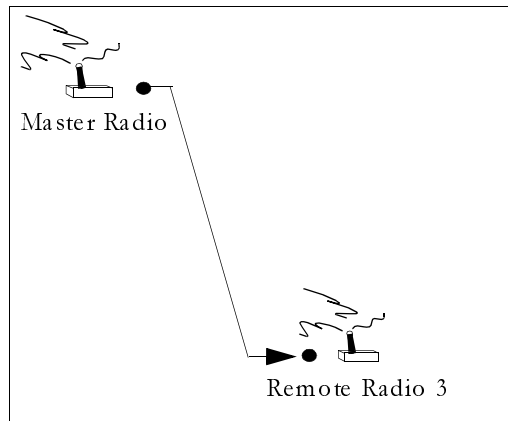
**Diagnostics with Remote 1 to Config PC**

Remote Radio 1 "knows" only of itself and its Master.



**Diagnostics with Remote 2 to Config PC**

Remote Radio 2 "knows" only of itself. There is no communication with its Master.



**Diagnostics with Remote 3 to Config PC**


Remote Radio 3 "knows" only of itself and its Master.

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Illustration of: **Each radio's report of same diagnostic condition**





<i>Graphical Diagnostic</i>	<i>Radio cabled to Config PC</i>	<i>ID of suspect Radio</i>	<i>Symptoms reported to Iris Setup Application</i>
<ul style="list-style-type: none"> <li><b>default Master only</b></li> </ul>  <p>Master Radio</p> <p>Summary: failure of the cabled Radio's hardware</p> <p>TRUBLESHOOT:</p> <ul style="list-style-type: none"> <li>check the cabled Radio's connection to its DC power source.</li> <li>check the integrity of the cable from the Radio to the Configuration PC.</li> </ul>	<p><b>Master Remote</b></p>	<p><b>Master Remote</b></p>	<ul style="list-style-type: none"> <li>There is no communication with the cabled Radio.</li> <li>The elemental component of a network is a Master. Display defaults to Master only.</li> </ul>

## Viewing a Radio's configuration

Cable the suspect Radio to the Configuration PC.

For details on cable type see *Cable specifications* on page 24.

From the Main Menu of the Iris Setup Application select:

- DIAGNOSTIC
- RADIO
- GET DATA
  
- The data related to the Radio will be displayed in a dialog box. For troubleshooting, note:
  - ◆ the transmit power
  - ◆ channel assignment of the Radio.
  
- Select DONE.

## Editing a Radio's configuration

Cable the Radio to the Configuration PC.

The cable is specified in section *Cable specifications* on page 24.

From the Main Menu of the Iris Setup Application select:

- CONFIGURE
- MODIFY
- Change the parameters as wanted.
- CONFIGURE RADIO
  
- FILE
- CLOSE

A dialog box will appear asking "Save changes to *Network name*.lus?".

- Select YES to save the configuration changes.
  
- It is strongly recommended that the new configuration be printed. See *PRINT CONFIGURATION, STRONGLY RECOMMENDED* on page 36.

## **PRINT CONFIGURATION, STRONGLY RECOMMENDED**

If the network's configuration was not printed at the time the radios were configured, a printout can still be generated from one of two places:

From the Main Menu of the Iris Setup Application:

- CONFIGURE
  - MODIFY
- OR**
- DIAGNOSTIC
  - NETWORK

From the Configure screen:

- FILE
- PRINT

From the Diagnostic screen:

- FILE
- PRINT

It is further suggested that each radio is labeled with its configuration. This labeling may make troubleshooting easier.

With the Master cabled to the Configuration PC, the Remotes can be polled for their configuration settings. Configuration changes to radios can only be made by the Configuration PC, through a cable to the Radio which is to be changed.

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