MDS *i*Net 900™

Wireless IP/Ethernet Transceiver

QUICK START GUIDE

Below are the basic steps for installing the MDS iNet 900 transceiver. Detailed instructions are given in the Section 3.0, *INSTALLATION PLANNING*, on page 5 of this manual.

1. Install and connect the antenna system to the radio

- Use good quality, low-loss coaxial cable. Keep the feedline as short as possible.
- Preset directional antennas in the direction of desired transmission/reception.

2. Apply DC power to the radio (13.8 Vdc @ 500 mA)

- Connect a DC power source to the *i*Net's power connector.(Negative ground only.)
- Observe proper polarity when connecting the DC cable. See Figure 10 on page 16.

3. Review the initial configuration profile

- Connect a computer with HTTP browser to the LAN port, or a terminal to the COM1 port, to identify, and revise if necessary the MDS *i*Net 900's primary operating parameters. (See "Step 5—Review the Radio's Configuration" on page 16 for details.)

  - ✓ Operating Mode: Access Point (Master) or Station Adaptor (Remote)
  - ✓ Internet Protocol (IP) Address
  - ✓ Network Name
  - ✓ Time and Date—If event logging is enabled[1]Z?

4. Verify proper operation of the MDS *i*Net radio-modem

- See Table 2 on page 7 for an explanation of the LED status indicators.
- Refine the antenna heading for maximum received signal strength using the radio signal strength indicator (**RSSI**) function found on the browser's home page. The RSSI display will be in dBm.

5. Connect the user's equipment to the MDS *i*Net's LAN, COM1or COM2 ports

- LAN—Use a RJ-45 Ethernet connector/cable.
- COM2—Recommended for serial-based data equipment.
  Use a DB-9 female connector. Interface is RS-232/EIA-232 compatible.
- COM1—Reserve, if practical, for use to connect terminal for unit configuration.
  Use a DB-9 male connector. Interface is RS-232/EIA-232 compatible.

  (See Table 9 on page 34 for pin descriptions and Figure 9 on page 16 for port defaults.)

6. Verify proper operation of the user's equipment

- A properly configured system will work exactly as it would if the data equipment were communicating through a conventional wired system. (See Table 4.6 on page 18)
- The LINK LED will blink intermittently under normal operation if it connects with another MDS iNet 900 transceiver.
- Use the IP "PING" command to verify the Access Point can be contacted by the Station Adapter.

---

1. While this may be of value, the time and date setting does not seem like a primary parameter and is beyond the scope of this draft.

TABLE OF CONTENTS

Copyright Notice

This Installation and Operation Guide and all software described herein are protected by copyright. Copyright 2001, Microwave Data Systems, Inc. All rights reserved.

Serviceability of this Manual

While every reasonable effort has been made to ensure the accuracy of this manual, product improvements may result in minor differences between the manual and the product shipped to you. If you have additional questions or need an exact specification for a product, please contact our Customer Service Team using the information at the back of this guide. Microwave Data Systems Incorporated reserves its right to correct any errors and omissions. Updated information may also be available on our Web site at www.microwavedata.com.

Operational Safety Notices

RF Exposure

The radio equipment described in this guide emits radio frequency energy. Although the power level is low, the concentrated energy from a directional antenna may pose a health hazard. Do not allow people to come within two meters (6 feet) of the antenna when the transmitter is operating.

This manual is intended to guide a professional installer in installing, operating and performing basic system maintenance on the described equipment.

FM/UL/CSA Notice
MDS i Net 900 When Approved

This product is available for use in Class I, Division 2, Groups A, B, C & D Hazardous Locations. Such locations are defined in Article 500 of the National Fire Protection Association (NFPA) publication NFPA 70, otherwise known as the National Electrical Code.

The transceiver has been recognized for use in these hazardous locations by three independent agencies —Underwriters Laboratories (UL), Factory Mutual Research Corporation (FMRC) and the Canadian Standards Association (CSA). The UL certification for the transceiver is as a Recognized Component for use in these hazardous locations, in accordance with UL Standard 1604. The FMRC Approval is in accordance with FMRC Standard 3611. The CSA Certification is in accordance with CSA STD C22.2 No. 213-M1987.

FM/UL/CSA Conditions of Approval
MDS i Net 900 When Approved

The transceiver is not acceptable as a stand-alone unit for use in the hazardous locations described above. It must either be mounted within another piece of equipment which is certified for hazardous locations, or installed within guidelines, or conditions of approval, as set forth by the approving agencies. These conditions of approval are as follows:

1. The transceiver must be mounted within a separate enclosure which is suitable for the intended application.

2. The antenna feedline, DC power cable and interface cable must be routed through conduit in accordance with the National Electrical Code.

3. Installation, operation and maintenance of the transceiver should be in accordance with the transceiver's installation manual, and the National Electrical Code.

4. Tampering or replacement with non-factory components may adversely affect the safe use of the transceiver in hazardous locations, and may void the approval.

5. When installed in a Class I, Div. 2, Groups A, B, C or D hazardous location, observe the following:

⚠ **WARNING**

EXPLOSION HAZARD

Do not disconnect equipment unless power has been switched off or the area is know to be non-hazardous.

Refer to Articles 500 through 502 of the National Electrical Code (NFPA 70) for further information on hazardous locations and approved Division 2 wiring methods. [1]Z?

FCC Notice, U.S.A.
MDS *i*Net 900 When Approved

The MDS iNet 900 transceivers comply 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.

This device is specifically designed to be used under Section 15.247 of the FCC Rules and Regulations. Any unauthorized modification or changes to this device without the express approval of Microwave Data Systems may void the user's authority to operate this device.

Furthermore, this device is indented to be used only when installed in accordance with the instructions outlined in this manual. Failure to comply with these instructions may also void the user's authority to operate this device.

FCC Information

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environ-

---

1. This seem like this note should be a DANGER classification if there is a potential for an explosion. Please verify.

ment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

1.0   ABOUT THIS MANUAL

This guide presents installation and basic operating instructions for the MDS *i*Net 900™ transceiver. Following installation, we suggest keeping this guide near the equipment for future reference.

The terms Access Point and Station Adapter are abbreviated as "A.P." and "S.A." in various technical illustrations and tables used in this manual wherever space is at a premium.

This manual does not cover all possible MDS iNet 900 user-controllable parameters and/or diagnostic tools. For an in-depth description of all of the features and controls of the MDS iNet 900, please read the *MDS iNet Network Manager's Manual*, P/N 05-xxxxA01.

2.0   PRODUCT DESCRIPTION

The MDS *i*Net 900 transceiver, shown in Figure 1, is designed to provide network managers with a easy-to-install wireless local area network (LAN) services with plug-and-play hardware. For basic services, just hook up an antenna, connect your Ethernet LAN to the radio's LAN port, apply primary power, and you are done. And, no license is required.

The transceiver is a spread-spectrum radio designed for operation in the license-free 900 MHz frequency band. The MDS *i*Net 900 provides reliable communications up to distances of 30 miles (50 km), even in the presence of weak signals or interference.

Only two user-controllable parameters need to be checked at the time of installation—the radio's Access Point/Station Adapter operating mode, and "network name" of the unit.

The MDS *i*Net 900 transceiver is based on the IEEE 802.11 wireless LAN specification. From this perspective, *i*Net transceivers serve as "Access Points" and "Station Adapters". An Access Point is a wireless hub that provides connectivity into a wired Ethernet LAN. This connectivity is achieved through remote Station Adapters. From a radio perspective, an Access Point also works as a "master station" providing synchronization signaling for the remote radios (Access Point units).

A Station Adapter provides wireless connectivity to and Access Point to one or more Ethernet devices connected to its local interface. From a radio perspective, the Station Adapter also works as a remote radio that communicates to a master radio (Access Point).

Users with a mixture of equipment with Ethernet and serial data inter-faces can choose to use one of the two user-configurable serial ports. This flexibility allows the iNet transceiver to provide services in data networks that are on a path from legacy serial/EIA/RS-232-based hard-ware to the faster and more easily interfaced Ethernet world. The radio and data interfaces are easily arranged via the COM1 port or via the LAN (Ethernet) port using HTTP.

Figure 1. The MDS iNet 900 Transceiver

The transceiver is housed in a compact and rugged cast-aluminum case that needs only be protected from direct exposure to the weather. It con-tains a single printed circuit board with all necessary components for radio operation and data communications.

2.1 Transceiver Features

Listed below are several key features of the MDS *i*Net 900 transceivers. These are designed to ease the installation and configuration of the radio, while retaining the ability to make changes in the future.

- Plug-and-Play Connectivity—Ethernet bridge configuration option requires virtually no setup
- High Speed—512 kbps is 50-times faster than 9.6 kbps radios
- Long Range—30 miles (50 km) in wireless LAN configuration
- Robust Radio Communications—Designed to operate in high-interference environments
- Industrial-Grade Product—Extended temperature range for trouble-free operation in extreme environments
- Serial Ports—IP gateway to legacy serial interface based equip-ment
- Same hardware for Access Point and Station Adaptor configu-rations

2.2 Spread Spectrum Radios— How Are They Different?

The main difference between a traditional (licensed) radio system and the *i*Net transceivers is that these units "hop" from channel to channel many times per second using a specific hop pattern applied to all radios in the network. A distinct hopping pattern is provided for each of the network name, thereby minimizing the chance of interference with other spread spectrum systems. In the USA, and certain other countries, no license is required to install and operate this type of radio system.

2.3 Typical Applications

Wireless IP/Ethernet LAN Connectivity

This is the most common application of the MDS *i*Net 900 transceiver. It consists of a central control station (Access Point) and one or more associated Station Adapter units, as shown in Figure 2. A LAN provides communications between a central host computer and remote terminal units (RTUs) or other data collection devices. The operation of the radio system is transparent to the computer equipment with the Access Point station serving as the gateway to the WAN or host computer.
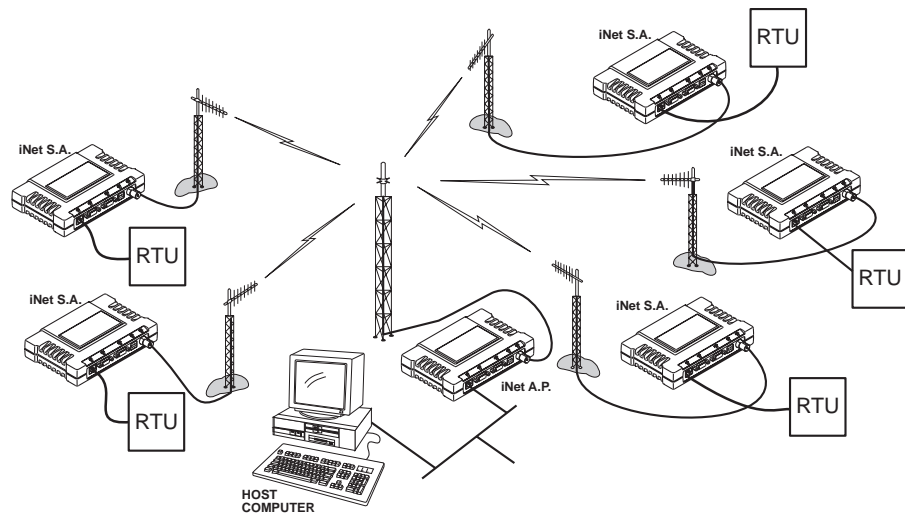

Figure 2. Typical wireless LAN

Point-to-Point System

A point-to-point configuration (Figure 3) is a simple arrangement consisting of just two radios—a Access Point and a Station Adapter. This provides communications link for the transfer of data between two locations.
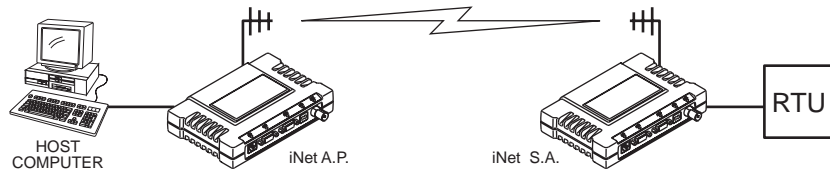
Figure 3. Typical point-to-point link
(A LAN connection may be used in place of a Host Computer)

Dealing with difficult terrain

In some geographical areas there may be obstacles that make communication between iNet transceivers difficult. These obstacles commonly are large buildings, natural geological formations or dense foliage. These obstacles can often be overcome with a repeater station. See "REPEATER ASSITED LANS" on page 28 for descriptions of basic repeater configurations.

2.4 Accessories

The MDS iNet 900 transceiver can be used with one or more of the accessories listed in Table 1. Contact the factory for ordering details.

Table 1. Accessories

Accessory	Description	MDS P/N
A/C Power Adapter	A small switching power supply module designed for continuous service. UL approved. Output 13.8 Vdc @ 500 mA.s	03-xxxxA01
LAN Antenna	Small and flexible 1/4 wavelength antenna plugged directly into the radio's ANTENNA port. Suitable for short-range local area networks.	03-xxxxA01
TNC to N Adapter	Short length of coaxial cable (6"/15 cm) used to connect the radio's TNC antenna connector to a Type N commonly used on large diameter coaxial cables.	03-xxxxA01
Ethernet RJ-45 Cross-over Cable	Cable assembly used to cross-connect the Ethernet ports of two iNet radios used in a repeater configuration. (Cable length = 3'/1M)	03-xxxxA01
Flat-Surface Mounting Brackets	Brackets: 2" x 3" plates designed to be screwed onto the bottom of the transceiver for surface-mounting the radio.	82-1753-A01
	Screws: 6-32/1/4˝ with locking adhesive. (Industry Standard MS 51957-26)	70-2620-A01
19˝ Rail Mounting Brackets	Adaptor for mounting one MDS iNet 900 radio in a standard 19-inch equipment rack.	03-xxxxA01

Table 1. Accessories *(Continued)*

DIN Rail Mounting Brackets	Adaptor for mounting one MDS iNet 900 radio in a DIN standard equipment rack.	03-xxxxA01
Short-Range Antenna	Short 1/2-wave antenna. Mounts directly onto the radio's coaxial connector. Suitable only for short-range LANs, such as within a building or small campus.	03-xxxxA01

3.0   INSTALLATION PLANNING

The installation of the radio is not difficult, but it does require some planning to ensure station reliability and efficiency. This section provides tips for selecting an appropriate site, choosing an antenna system, and reducing the chance of harmful interference.

3.1   General Requirements

There are three main requirements for installing the radio—adequate and stable primary power, a good antenna system, and the correct interface between the transceiver and the data device.

Figure 4 shows a typical Station Adapter installation. An external directional antenna is normally used and an RTU/PLC is connected to one of the serial ports (COM1/COM2). 13.8 Vdc is supplied to the Station Adapter by an external source.
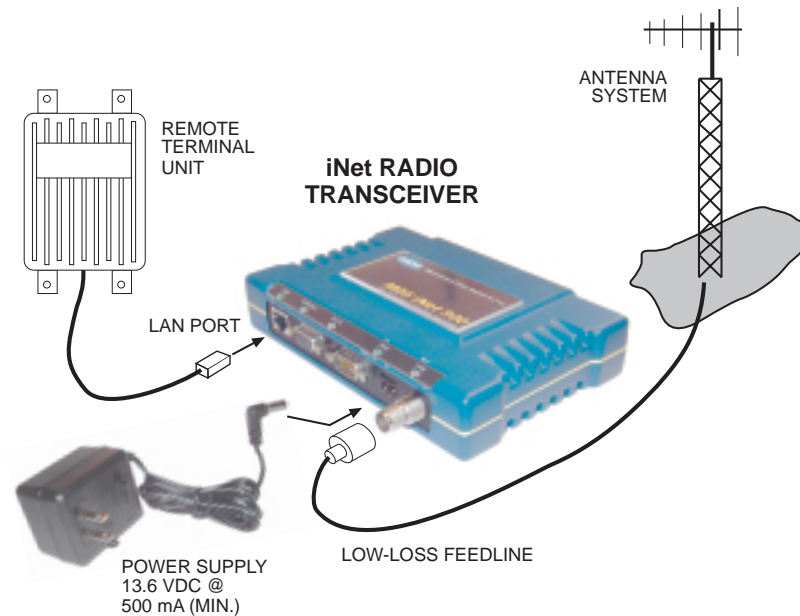

Figure 4. Typical Station Adapter arrangement
(RTU can be connected to any compatible LAN or COM Port)

3.2 Site Selection

For a successful installation, careful thought must be given to selecting proper sites for the Access Points and Station Adapters. Suitable sites should provide:

- Protection from direct weather exposure
- A source of adequate and stable primary power
- Suitable entrances for antenna, interface or other required cabling
- Antenna location that provides an unobstructed transmission path in the direction of the associated station(s)

These requirements can be quickly determined in most cases. A possible exception is the last item—verifying that an unobstructed transmission path exists. Radio signals travel primarily by line-of-sight, and obstructions between the sending and receiving stations will affect system performance. If you are not familiar with the effects of terrain and other obstructions on radio transmission, the discussion below will provide helpful background.

Terrain and Signal Strength

While the 900 MHz band offers many advantages over VHF and lower UHF frequencies for data transmission, the band is more prone to signal attenuation from obstructions such as terrain, foliage or buildings in the transmission path.

A line-of-sight transmission path between the central Access Point station and its associated remote access station site(s) is highly desirable and provides the most reliable communications link. A line-of-sight path can often be achieved by mounting the station antenna on a tower or other elevated structure that raises it to a level sufficient to clear surrounding terrain and other obstructions.

The importance of a clear transmission path relates closely to the distance to be covered by the system. If the system is to cover only a limited geographic area, say up to 3 miles (4.8 km), then some obstructions in the transmission path can usually be tolerated with minimal impact. For longer range systems, any substantial obstruction in the transmission path could compromise the performance of the system, or block transmission entirely.

Much depends on the minimum signal strength that can be tolerated in a given system. Although the exact figure will differ from one system to another, a Received Signal Strength Indication (RSSI) of –80 dBm or stronger will provide acceptable performance in many systems. While the equipment will work at lower signal strengths, this provides a "fade

margin" to account for variations in signal strength which may occur from time-to-time. RSSI can be measured with a terminal connected to the COM1 Port or with a HTTP browser to the LAN (Ethernet) connector. (See Section 4.6 on page 18 for details.)

Conducting a Site Survey

If you are in doubt about the suitability of the radio sites in your system, it is best to evaluate them before a permanent installation is begun. This can be done with an on-the-air test (preferred method); or indirectly, using path-study software.

An on-the-air test is preferred because it allows you to see firsthand the factors involved at an installation site and to directly observe the quality of system operation. Even if a computer path study was conducted earlier, this test should be done to verify the predicted results.

The test can be performed by first installing a radio and antenna at the proposed Access Point station site and then visiting each Station Adapter site with a transceiver and a hand-held antenna. (A PC with a network adapter can be connected to each radio in the network to simulate data during this test using the PING command.)

With the hand-held antenna positioned near the proposed mounting spot, a technician can check for synchronization with the Access Point station (shown by a lit LINK LED on the front panel) and measure the reported RSSI value. (See Section 4.6 on page 18 for details.) If adequate signal strength cannot be obtained, it may be necessary to mount the station antennas higher, use higher gain antennas, select a different site or consider installing a repeater station. To prepare the equipment for an on-the-air test, follow the general installation procedures given in this guide and become familiar with the operating instructions found in Section 4.0 on page 13.

If time is short, and a site survey is impractical, a computer path study is a good alternative. Factors such as terrain, distance, transmitter power, receiver sensitivity, and other conditions are taken into account to predict the performance of a proposed system. Contact MDS for more information on path study services.

Table 2.iNet Front Panel LED Functions

LED Label	Activity	Indication
LAN	ON	Link integrity OK
	Blinking	Data TX/RX
	OFF	LAN not detected
COM1 (Console)	ON	Not Defined
	Blinking	Data TX/RX
	OFF	No data detected

Table 2.iNet Front Panel LED Functions

LED Label	Activity	Indication
COM2	ON	Not Defined
	Blinking	Data TX/RX
	OFF	No data detected
PWR	ON	Primary power (DC) present
	Blinking	Slow = Sleep mode
		Quick = Alarm present
	OFF	Primary power (DC) absent
LINK (Access Point)	ON	Default state
	Blinking	Data Tx/Rx
	OFF	Not Defined
LINK (Station Adapter)	ON	Associated to AP
	Blinking	Data Tx/Rx
	OFF	Data Tx/Rx

3.3 A Word About Radio Interference

The *i*Net 900 transceivers share frequency spectrums with other services and other Part 15 (unlicensed) devices in the USA. As such, near 100% error-free communications may not be achieved in a given location, and some level of interference should be expected. However, the radio's flexible design and hopping techniques should allow adequate performance as long as care is taken in choosing station location, configuration of radio parameters and software/protocol techniques.

In general, keep the following points in mind when setting up your communications network:

1. Systems installed in rural areas are least likely to encounter interference; those in suburban and urban environments are more likely to be affected by other devices operating in the license-free frequency band and by adjacent licensed services.

2. If possible, use a directional antenna at remote sites. Although these antennas may be more costly than omnidirectional types, they confine the transmission and reception pattern to a comparatively narrow lobe, which minimizes interference to (and from) stations located outside the pattern.

3. If interference is suspected from a nearby licensed system (such as a paging transmitter), it may be helpful to use horizontal polarization of all antennas in the network. Because most other services use vertical polarization in this band, an additional 20 dB of attenuation to interference can be achieved by using horizontal polarization.

4. Multiple *i*Net 900 Access Point transceivers can co-exist in proximity to each other with only very minor interference *as long as they are each assigned a unique network name*. Each network name has a different hop pattern. Additional isolation can be achieved by using separate directional antennas with as much vertical or horizontal separation as is practical.

5. If constant interference is present in a particular frequency zone, it may be necessary to "lock out" that zone from the radio's hopping pattern. The radio includes built-in software to help users identify and remove blocked frequency zones from its hopping pattern.

6. If interference problems persist even after removing blocked zones, try reducing the length of data streams. Groups of short data streams have a better chance of getting through in the presence of interference than do long streams.

7. The power output of all radios in a system should be set for the lowest level necessary for reliable communications. This lessens the chance of causing unnecessary interference to nearby systems.

3.4   Antenna & Feedline Selection

Antennas

The equipment can be used with a number of antennas. The exact style used depends on the physical size and layout of a system. Contact your MDS representative for specific recommendations on antenna types and hardware sources.

In general, an omnidirectional antenna (Figure 5) is used at the Access Point station site. This provides equal coverage to all of the Station Adapter sites.

NOTE: Antenna polarization is important. If the wrong polarization is used, a signal reduction of 20 dB or more will result. Most systems using a gain-type omnidirectional antenna at the Access Point station employ vertical polarization of the signal; therefore, the remote antenna(s) must also be vertically polarized (elements oriented perpendicular to the horizon).

When required, horizontally polarized omnidirectional antennas are also available. Contact your MDS representative for details.

A
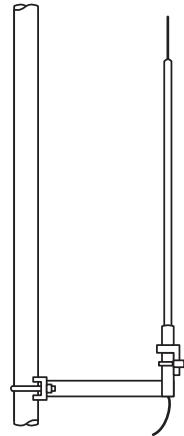
Figure 5. Omnidirectional antenna for *i*Net 900 transceiver

**Figure 6. Omnidirectional antenna for
*i*Net 900 transceiver (mounted to mast)**

At Station Adapter sites and units in point-to-point LANs, a directional Yagi (Figure 7) antenna is generally recommended to minimize interference to and from other users. Antennas are available from a number of manufacturers.
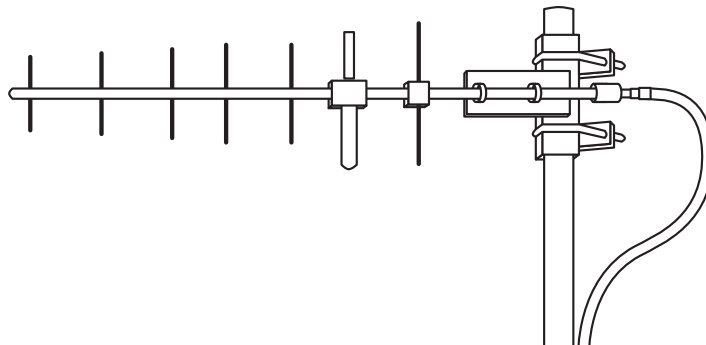
Figure 7. Typical Yagi antenna (mounted to mast)

Feedlines

The choice of feedline used with the antenna should be carefully considered. Poor-quality coaxial cables should be avoided, as they will degrade system performance for both transmission and reception. The cable should be kept as short as possible to minimize signal loss.

For cable runs of less than 20 feet (6 meters), or for short range transmission, an inexpensive type such as Type RG8A/U may be acceptable. Otherwise, we recommend using a low-loss cable type suited for 900 MHz, such as Heliax®.

Table 3 lists several types of popular feedlines and indicates the signal losses (in dB) that result when using various lengths of cable at 900 MHz. The choice of cable will depend on the required length, cost considerations, and the amount of signal loss that can be tolerated.

Table 3. Length vs. loss in coaxial cables at 900 MHz

Cable Type	10 Feet (3.05 Meters)	50 Feet (15.24 Meters)	100 Feet (30.48 Meters)	500 Feet (152.4 Meters)
RG-8A/U	0.85 dB	4.27 dB	8.54 dB	42.70 dB
1/2 inch HELIAX	0.23 dB	1.15 dB	2.29 dB	11.45 dB
7/8 inch HELIAX	0.13 dB	0.64 dB	1.28 dB	6.40 dB
1-1/4 inch HELIAX	0.10 dB	0.48 dB	0.95 dB	4.75 dB
1-5/8 inch HELIAX	0.08 dB	0.40 dB	0.80 dB	4.00 dB

3.5   How Much Output Power Can be Used?

The transceiver is normally supplied from the factory set for a nominal +30 dBm (1 Watt) RF power output setting; this is the maximum transmitter output power allowed under FCC rules. The power must be *decreased* from this level if the antenna system gain exceeds 6 dBi. The allowable level is dependent on the antenna gain, feedline loss, and the transmitter output power setting. Power considerations for point-to-multipoint and point-to-point systems using the *i*Net 900 transceivers are discussed in the next sections.

NOTE: In some countries, the maximum allowable RF output may be limited to less than 1 watt (For example, 100 mW /+20 dBm). Be sure to check for and comply with the requirements for your area.

Calculating System Gain

To determine the maximum allowable power setting of the radio, perform the following steps:

1. Determine the antenna system gain by subtracting the feedline loss (in dB) from the antenna gain (in dBi). For example, if the antenna gain is 9.5 dBi, and the feedline loss is 1.5 dB, the antenna system gain would be 8 dB. (If the antenna system gain is 6 dB or less, no power adjustment is required.)

2. Subtract the antenna system gain from 36 dBm (the maximum allowable EIRP). The result indicates the maximum transmitter power (in dBm) allowed under the rules. In the example above, this is 28 dBm.

3. If the maximum transmitter power allowed is less than 30 dBm, use one of the transceiver's control tools as described in *PROGRAMMING* on page 21 to set the power accordingly.

For convenience, Table 4 lists several antenna system gains and shows the maximum allowable power setting of the radio. Note that a gain of 6 dB or less entitles you to operate the radio at full power output—30 dBm (1 watt).

Table 4. Antenna system gain vs. power output setting (USA)

Antenna System Gain (Antenna Gain in dBi* minus Feedline Loss in dB†)	Maximum Power Setting (in dBm)	EIRP (in dBm)
6 (or less)	30	36
8	28	36
10	26	36
12	24	36
14	22	36
16	20	36

* Most antenna manufacturers rate antenna gain in dBd in their literature. To convert to dBi, add 2.15 dB.

† Feedline loss varies by cable type and length. To determine the loss for common lengths of feedline, see Table 3 on page 11.

For details on how to set the power level via the Ethernet/HTTP interface, See "Programming Via an HTTP/Web Browser" on page 22 for details.

4.0 INSTALLATION

A typical transceiver product shipment consists of an iNet 900 transceiver and a manual. Check the contents against the packing list secured to the outside of the shipping box. Accessories and spare parts kits, if any, are wrapped separately. Inspect all items for signs of damage and save all packing materials for possible re-shipment.

Below are the basic steps for installing a *i*Net 900 transceiver. In most cases, these steps alone will be sufficient to complete the installation. Should further information be required, contact the factory at the number given on the inside back cover of this manual.

If you are installing a traditional repeater system, you should also see "TRADITIONAL REPEATER CONFIGURATION WITH TWO RADIOS" on page 20 for important details on antennas and cabling.

NOTE: It is recommended that the Access Point station be installed *first.* In this way, it will be possible to quickly check the operation of each associated Station Adapter unit as it is placed on the air.

MDS *i*Net 900 transceivers are shipped from the factory set to the "Station Adapter" mode unless they are marked differently.

4.1 Step 1— Mounting the Transceiver

Mount the transceiver to a stable surface. (Fasteners/anchors are not supplied unless specified when the order.) Figure 8 shows the dimensions of the transceiver case and its mounting bracket. If possible, choose a mounting location that provides easy access to the connectors on the end of the radio and an unobstructed view of the LED status indicators. Four threaded holes are located on the bottom of the radio which are suitable for connecting mounting hardware. Use 6-32 x 1/4 inch screws to attach mounting hardware to the bottom of the radio. (See Figure 8 on page 14 for dimensions.)

TOP

4.5″ (11.4 cm)

6.75″ (17.15 cm)

FRONT

BOTTOM

2.5″ (6.35 cm)

THREADED HOLES
FOR MOUNTING
SCREWS (4)
#6-32 X 1/4″

4.85″ (12/3 cm)

SIDE

4.25″ (10.8 cm)

1.25″ (3.17 cm)

4.75″ (12 cm)
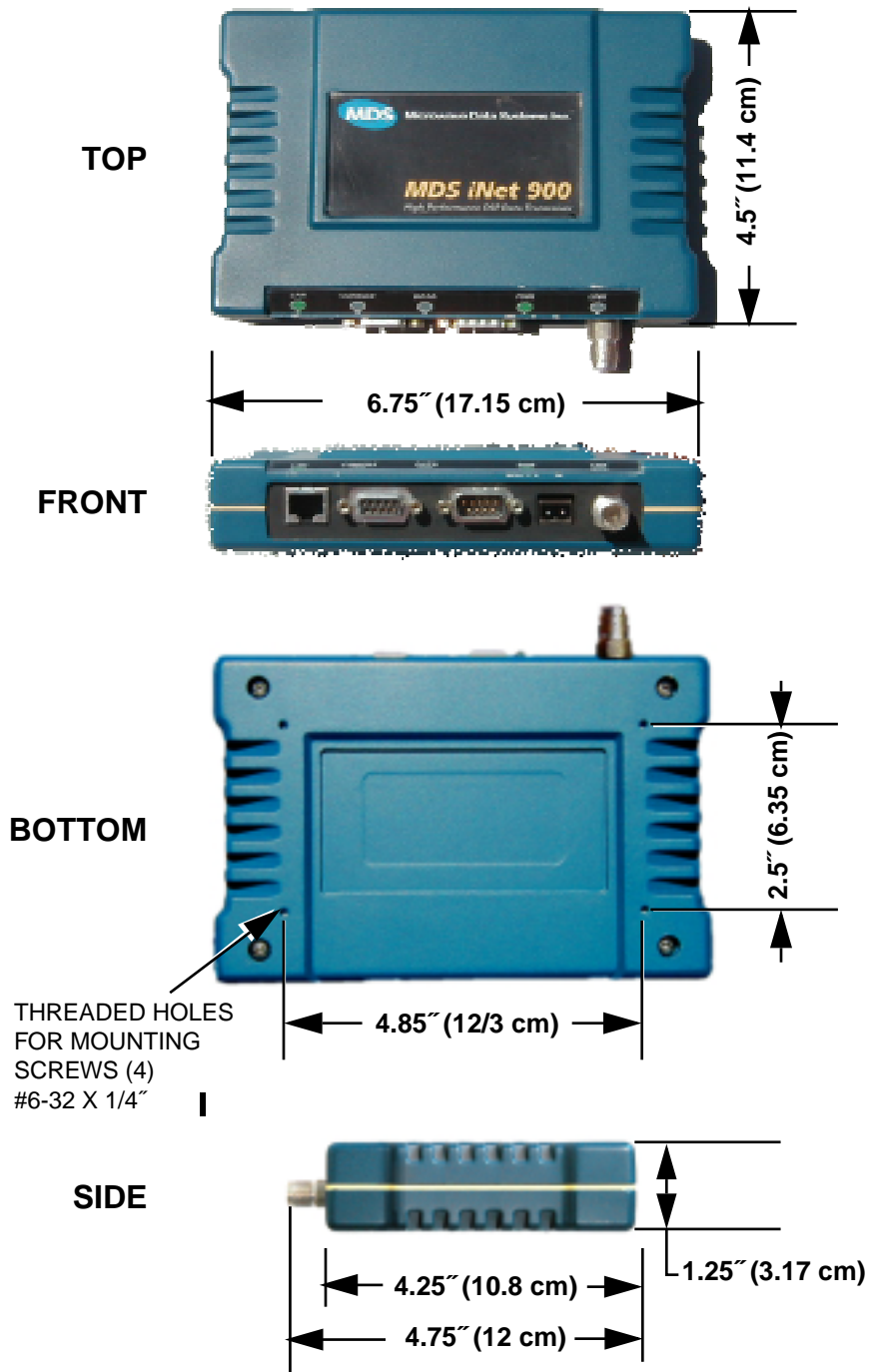
Figure 8. Transceiver dimensions

CAUTION

POSSIBLE
EQUIPMENT
DAMAGE

The screws holding the brackets to the radio are 5⁄16 inch (8 mm) long or shorter to prevent damage to the radio's PC board when they are tightened. If these screws are replaced for any reason, the new screws must not exceed this length. The radio's case is made of a durable cast-aluminum, however, the use of the wrong sized screws can damage the screw sockets on the cover.

4.2 Step 2—Install the Antenna and Feedline

Antennas should be mounted in the clear and in accordance with the manufacturer's instructions. Additional information on antennas and feedlines is contained in Section 3.4 (page 9).

NOTE: Strong fields near the antenna can interfere with the operation of the low-level RTU circuits and change the reported values of the data being monitored. For this reason, the antenna should be mounted at least 10 feet (>3 meters) from the radio, RTU, sensors and other components of the system.

4.3 Step 3—Connect the Data Equipment

Connect the data equipment to one of the transceiver's three ports: LAN, COM1 or COM2. Use only the required pins for the application—do not connect anything to unused pins. See Figure 19 on page 33 details on COM1 Port and Figure 20 on page 34 for the COM2 Port. Figure 9 on page 16 identifies the port's factory defaults.

NOTE: The data cabling between the transceiver and the connected device should be kept as short as possible. Cable runs over 50 feet (15 meters) may require the use of a EIA-422 signaling adapter. Consult the factory for further information.

Configuration Toolbox Access

Figure 9 on page 16 shows the default functions and services for the front panel interface connectors. The three data ports—LAN, COM1 and COM2—are user configurable through the use of a terminal connected to the COM1 port or a HTTP browser through the Ethernet port.

NOTE: The data communications parameters and functions described in the installation procedures and shown in Figure 9 on page 16 are based on factory defaults. If the COM1 Port is configured to transport data, connect to it with a terminal program and use the **ESC + K** sequence to reset the radio's data interface ports to the default settings.

Connect a terminal to COM1 to access the menu driven configuration and control tool. The menu will automatically display on the terminal's screen. To use a HTTP browser, connect to the Ethernet port and type in **HTTP:// + unit IP address**. The unit's IP address can be found through the use of a terminal connected to the COM1 port.

LAN
- 10BaseT
- IP/Ethernet Port
- Connect IP Data Equip.

ANTENNA
- 50Ω TNC

COM1
- DCE Console/Terminal
- 115,200 bps/8N1
- No Handshaking

COM2
- DTE Serial Data Equip.
- 9600 bps/8N1
- Full Handshaking
- Connect Legacy Equip.

PRIMARY POWER
- 13.8 Vdc @ 500 ma (10.5–30 Vdc)
- Negative Ground
- +/Left –/Right
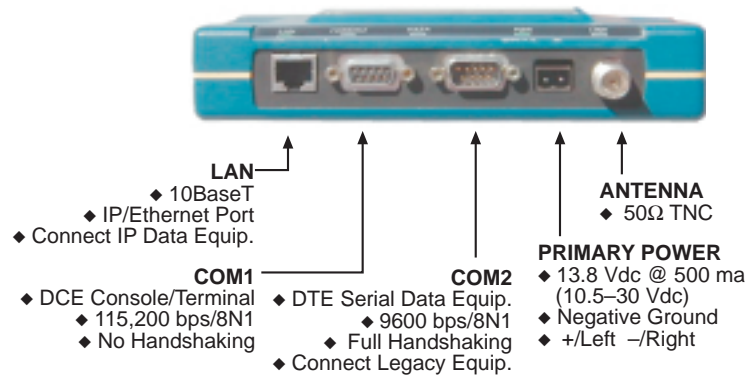
Figure 9. MDS iNet Interface Default Configuration & Functions

4.4   Step 4—Measure & Install Primary Power

The primary power at the transceiver's power connector must be within 10.5–30 Vdc and be capable of furnishing up to 500 mA. The optimum voltage is 12 Vdc. Be sure to observe proper polarity as shown in Figure 10.
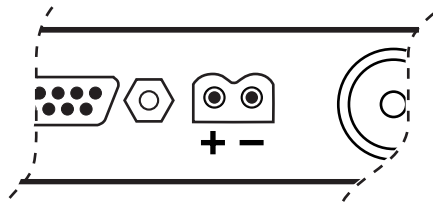
Figure 10. Primary Power (DC) Polarity

NOTE: The radio is designed for use only in negative ground systems.

The power supply used with the transceiver should be equipped with overload protection (NEC Class 2 rating), to protect against a short circuit between its output terminals and the transceiver power connector.

4.5   Step 5—Review the Radio's Configuration

There are two essential settings for *i*Net 900 transceivers that should be known before placing the radio into service. They are:

Radio Operating Mode—Access Point or Station Adaptor

Network Name—Unique name of the radio network used to generate the hopping pattern.

NOTE: Transceivers are normally shipped from the factory pre-configured as remotes.

There are additional settings for *i*Net 900 transceivers that may need changing before placing the radio into service. They are:

Unit IP Address—Must be a unique number to allow for IP access through the Ethernet Port.

Transmitter Power Output Level—Default is 1 Watt. Adjust as necessary for compliance with FCC guidelines.

NOTE: The IP address is important if the radio's LAN (Ethernet) port will be used for IP-based data communications or for unit configuration.

The following procedures are summaries only. For more detailed instructions on using the menu-based COM1 and the HTTP/Bowser interfaces, see See "PROGRAMMING" on page 21.

Procedure

With Terminal Program

a. Connect a personal computer's serial communications port (COM1 or COM2) to the COM1 Port connector on the radio transceiver. (See Figure 9 on page 16 for location. Data defaults: 115,200 kpbs/8N1.)

b. Launch a terminal emulator program, such as Hyperterminal, on the computer.

c. Depress the **ENTER** key. The radio will respond with the start-up screen of a text-based Management Toolbox.

d. Select the desired options to review existing settings and to initiate necessary changes such as the IP address and other network parameters.

A login with password will be required to make any changes to the radio. (Default password= **admin**)

e. Record the unit Mode, IP Address and Network Name settings on a label and place it on the transceiver's cover

f. Exit the set-up tool.

g. Repeat the above steps for each transceiver in the network.

With HTTP Browser

a. Connect a personal computer's Ethernet port to the EHTERNET Port connector on the radio transceiver. (See Figure 9 on page 16 for location.)

NOTE: It may be necessary to change your IP access to the local area network on which the MDS iNet 900 radio is attached. The radio's IP address should be listed on the unit's packaging slip. If it is not, you can find it out using the preceding procedure to communicate with the radio through the COM1 Port.

a. Launch a Web-browser (HTTP) program, such as Internet Explorer™, on the computer.

b. Type in "**HTTP://**" followed by the radio's IP address. For example "**http://192.168.1.1/**". [1]Z? (Default = 192.168.1.**1)**

c. The Management Toolbox startup screen will appear.

d. Select the desired options to review existing settings and to initiate necessary changes such as the IP address and other network parameters.

   A login with password will be required to make any changes to the radio. (Default password= **admin**)

e. Record the unit Mode, IP Address and Network Name settings on a label and place it on the transceiver's cover.

f. Exit the Management Toolbox.

g. Repeat the above steps for each transceiver in the network.

4.6 Step 6—Connect the User Data Equipment

If the radio network seems to be operating properly based on observation of the unit's LEDs, connect the user equipment to one of the data ports. Use the IP **PING** command to verify the link integrity with the Access Point unit.

4.7 Step 7—Check for Normal Operation

Procedure

a. Apply primary power to the radio.

---

1. The address 127.0.0.1 has also been suggested as the default. Which is correct?

b. Observe the transceiver LED status panel (Table 2 on page 7) for the proper indications. In a normally operating system, the following LED indications will be seen within a few seconds of start-up:

- PWR lamp lit continuously
- LINK lamp blink intermittently

If the LINK LED is not on, check the received signal strength indicator for an adequate signal level from the radio network's Access Point station. It may be necessary to reposition the radio's antenna for better reception/signal strength, or if a directional antenna is used, rotate it until the signal is optimized.

In-service operation of the MDS *i*Net 900 transceiver is completely automatic. Once the unit has been properly installed and configured, operator actions are limited to observing the LED status indicators for proper operation. See Table 2 on page 7 for details on the LED functions.

4.8   Performance Optimization

After the basic operation of the radio has been checked, you may wish to optimize its performance using some of the suggestions given here. The effectiveness of these techniques will vary with the design of your system and the format of the data being sent.

Complete instructions on using the unit's configuration options referenced within this section are can be found in Section 6.0, *PROGRAMMING* (beginning on page 21).

Antenna Aiming

For optimum performance of directional antennas, they must be accurately aimed in the direction of desired transmission. The easiest way to do this is to point the antenna in the approximate direction, then use the remote radio's built-in Received Signal Strength Indication (RSSI) feature to further refine the heading for maximum received signal strength.

RSSI can be read by connecting a terminal (COM1 Port) or Internet browser (LAN Port) to the *i*Net 900 radio and requesting the **RSSI** reports.

In an *i*Net 900 system, RSSI readings are only meaningful when initiated from a *Station Adaptor*. This is because the Access Point station typically receives signals from several remote sites, and the RSSI would be continually changing as the Access Point receives from each remote in turn.

Antenna SWR Check (Z? Major revision needed?)

It is necessary to briefly key the transmitter[1]Z? for this check by placing the radio in the **SETUP** mode (page 42) and using the **KEY** command on the HHT. (To unkey the radio, enter **DKEY**; to disable the setup mode and return the radio to normal operation, enter **Q** or **QUIT**.)

The SWR of the antenna system should be checked before the radio is put into regular service. For accurate readings, a wattmeter suited for 1000 MHz is required. One unit meeting this criteria is the Bird Model 43™ directional wattmeter with an 5J element installed.

The reflected power should be less than 10% of the forward power ($\approx$2:1 SWR). Higher readings usually indicate problems with the antenna, feedline or coaxial connectors.

If the reflected power is more than 10%, check the feedline, antenna and its connectors for damage.

5.0 TRADITIONAL REPEATER CONFIGURATION WITH TWO RADIOS

5.1 Overview

Two MDS *i*Net 900 radios may be connected "back-to-back" through the LAN Ports to form a repeater station. (The cable must be a "cross-over" Ethernet cable for this to work). This configuration is sometimes required in a network that includes a distant Station Adaptor that would otherwise be unable to communicate directly with the Access Point station due to distance or terrain.

A repeater works by re-transmitting data from the outlying remote site to the Access Point station and vice versa. It introduces a small amount of end-to-end transmission delay, but this is not a problem in most systems.

The geographic location of a repeater station is especially important. A site must be chosen that allows good communication with *both* the Access Point and the outlying remote site. This is often on top of a hill, or other elevated terrain from which both sites can be "seen" by the repeater station antennas. A detailed discussion on the effects of terrain is given in Section 3.2, *Site Selection* (beginning on page 6).

The following paragraphs contain specific requirements for repeater systems.

---

1. Is it true that we still need to key the transmitter to use the RSSI function to aim the antenna?

5.2 Antennas

Two antennas are required at repeater stations—one for each radio. Measures must be taken to minimize the chance of interference between these antennas. One effective technique for limiting interference is to employ **vertical separation**. In this arrangement, one antenna is mounted *directly* over the other, separated by at least 10 feet (3 Meters). This takes advantage of the minimal radiation exhibited by most antennas directly above and below their driven elements.

Another interference reduction technique is to cross-polarize the repeater antennas. If one antenna is mounted in the vertical plane, and the other in the horizontal plane, an additional 20 dB of attenuation can be achieved. (Remember that the corresponding stations must use the same antenna orientation when cross-polarization is used.)

5.3 Network Name

The two radios that are wired together at the repeater site *must* have different network names. To set or view the network names, see "PROGRAMMING" on page 21 and Table 5 on page 26 for details.

5.4 Interface Wiring

A null-modem cable (Figure 11) is required between the COM1 port connectors of the two radios forming a repeater station. This allows them to freely exchange data even though they are both configured as DCE devices.

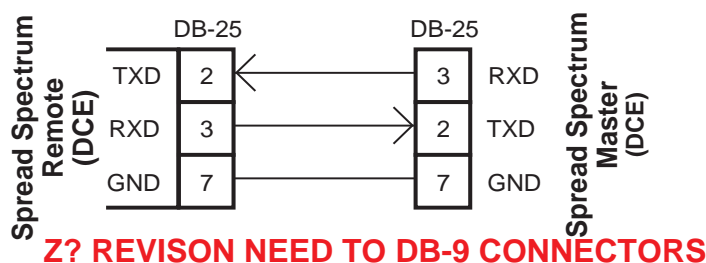

Z? REVISON NEED TO DB-9 CONNECTORS

Figure 11. Data interface cable wiring for null-modem cable
(used for traditional repeater)

6.0 PROGRAMMING

There are no manual adjustments on the transceiver. Programming and control is performed remotely, using one of these methods:

- HTTP (Browser) via the iNet 900's ETHERNET Port

- Telenet via the iNet 900's ETHERNET Port (To Be Developed)

- ASCII Terminal or emulator via the COM1 Port

This section needs further development. The only items that commonly need changes are the unit's network name, IP address, power level and system mode—Access Point or Station Adapter.

6.1   Programming Via an HTTP/Web Browser

A wide range of configuration, control and diagnostic tools are available through a Web browser communicating with the radio via the Internet Protocol (IP). The following is a brief overview of the HTTP interface and several key configuration parameters since detailed help is available on-line.

Making the Connection

Connect a personal computer's Ethernet port to the EHTERNET Port connector on the radio transceiver. (See Figure 9 on page 16 for location.)

NOTE: It may be necessary to change your IP access to the local area network on which the MDS iNet 900 radio is attached. The radio's IP address should be listed on the unit's packaging slip. If it is not, you can find it out using the preceding procedure to communicate with the radio through the COM1 Port.

Start-up Screen
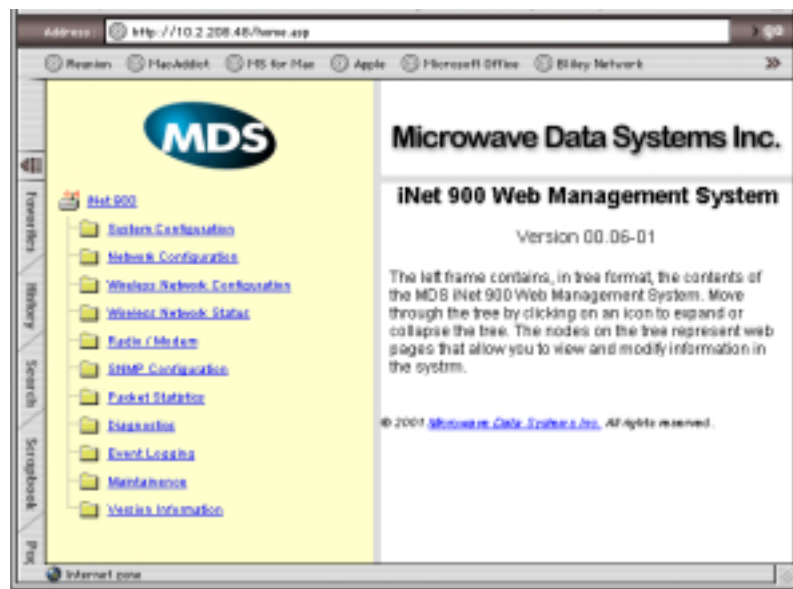
Figure 12. MDS *i*Net Web Management System Start-up Screen

The startup screen is the gateway to many radio performance monitoring and configuration functions. Interact with it as you would any Web site.

System Configuration Screen
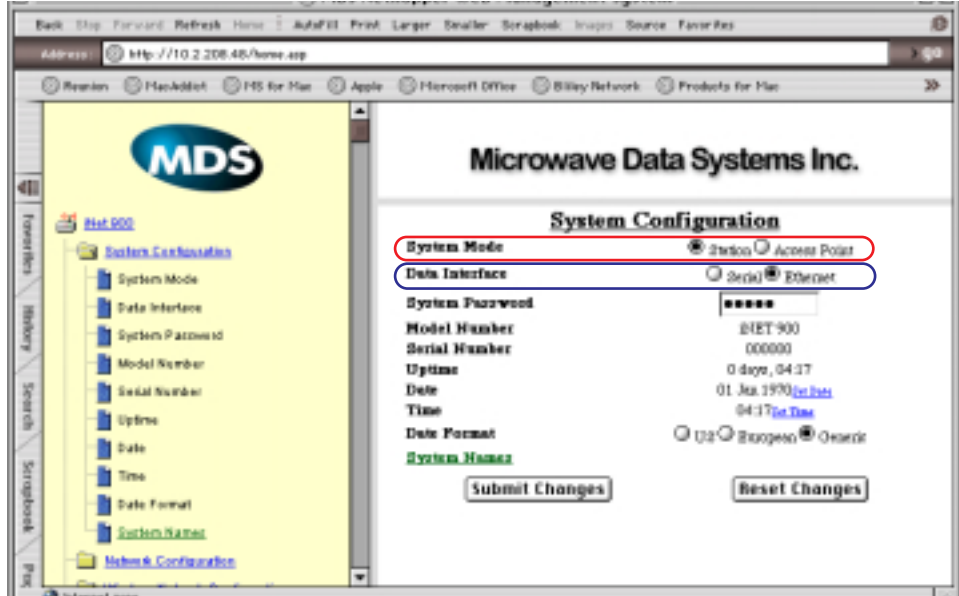
Figure 13. System Configuration Screen
(Items discussed are outlined with red and blue.)

System Mode   This screen is the location where you will check and set, if necessary, the "System Mode". If the unit will serve as the Access Point station and Access Point (gateway) into the IP network, click on **Access Point**. There should only be one radio in each iNet network set to **Access Point**. All other radios in the system should be set to **Station**.

Data Interface   Here too is the location for choosing the primary data port for the radio. By default, it is the ETHERNET Port. If you are connecting lower speed, RS/EIA-232 devices, click on the **Serial Port** button, and then the **Submit** button to implement the change.

Radio/Modem Screen [1]**Z?**

Figure 14. Radio/Modem Menu Items
(Item discussed are outlined with red.)

---

1. This direction is a guess as the setting controls are not active on my prototype.

RF Power Output

This screen is the location where you will check and set, if necessary, the radio's RF power output. The default is one Watt. If you need to lower the power, click on the **RF Output Setpoint** menu item, type in the desired power level in dBm on the right-hand portion of the screen and then click the **Submit** button to implement the change.

See Table 5, ". Common Transceiver Parameters," on page 26 for a list of common configuration parameters and their defaults.

6.2 Programming Via COM1 Port & a Terminal Program

A serial-interface based Management Toolbox is available for local configuration of the MDS *i*Net 900 transceiver.

Making the Connection

Connect a personal computer's communication port to the transceiver's COM1 Port connector on the radio transceiver. (See Figure 9 on page 16 for location.) The default interface is EIA-232 at 115,200 bps with 8N1.

Initializing the Connection

On you Windows' PC, launch a terminal program, such as MS Windows' Hyperterminal™, and select the serial port connected to the COM1 Port of the transceiver. The default interface is EIA-232 at 115,200 bps with 8N1.

Communicating with the *i*Net transceiver

The transceiver's port will automatically display the text-based Management Toolbox start-up screen as seen in Figure 15 on page 25 one the **ENTER** key is pressed.

NOTE: If the terminal program is running and your computer connected to the transceiver, you may see a series of pages of text information relating to the booting of the unit's microcomputer. Disregard this information and wait a few seconds for the display to stabilize before proceeding.

Using the Menu-Based Management Toolbox

The menu-based Management Toolbox provides access to view and configure many unit parameters and provides you with basic diagnostic tools.
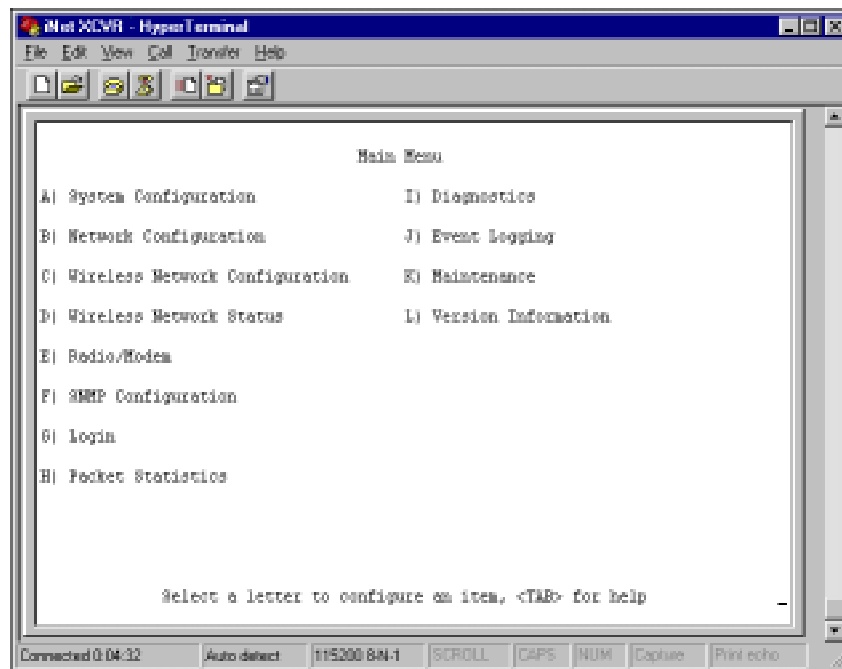
Figure 15. Management Toolbox Start-up Screen

Navigation
From the **Main Menu** you navigate by pressing the key to the left of the offering. You will then be taken to a screen associated with that function. If you select a menu item that is not user-configurable, the message "Note: This is not a configurable item." Pressing the **ESCAPE** key will navigate you to the previous menu or level.

Help
Pressing F1 from any menu will place the Management Toolbox in the Help mode; pressing the key corresponding to the menu item will provide you with useful information or instructions. Pressing the **ESCAPE** key will exit the Help Mode and return you to the previous screen.

Logging In and Password
All screens are accessible to any user. To change a user-controllable parameter, you must log into the system and enter a password. The default user password is "**admin**" in lowercase letters. The main menu item will change from **Login** to **Logout**. The user will automatically be logged out after 10 minutes of inactivity.[1]Z?

If you know that you want in advance to change one or more parameter, you should log in from the Main Menu.

Logging Out
Once you are logged in, you can go to the **System Configuration Menu** and change the password (case-sensitive). Follow any changes to the password or other parameters with an **ENTER** key to save the change.

---

1. This is a guess. Please verify value and function

Review and Changing Essential Parameters

Through the **Main Menu** you can access other screen to review and change several commonly altered parameters. The table below will provide you with a summary of the location and parameter's range of values.

Table 5. Common Transceiver Parameters[1]

Item	Screen	Values	Default
System Mode	System Configuration	Station Adapter Access Point	Station Adapter
System Password	System Configuration	1–8 alphanumeric characters. May be mixed case. **CAUTION**: Login is case sensitive.	admin (lower case)
Data Interface	System Configuration	• Ethernet • EIA/RS-232	Ethernet
Network Name	Wireless Network Configuration	1–16 alphanumeric characters. May be mixed case.	mds-wlan (lower case)
IP Address	Network Configuration Menu	Contact your network administrator	192.168.1.1[2]Z?
Power Output	Radio/Modem	20–30 dBm (0.1–1.0 Watts)	30 dBm (1.0 Watt)

1. All parameters are protected by password. You must be logged in to make any changes.
2. I was told 127.0.0.1 by Aaron Wright. Which is correct?

7.0   TROUBLESHOOTING

Successful troubleshooting of an MDS transceiver system is not difficult, but requires a logical approach. It is best to begin troubleshooting at the Access Point station, as the rest of the system depends on the Access Point for polling instructions and synchronization data. If the Access Point station has problems, the operation of the entire network will be affected.

When communication problems are found, it is good practice to begin by checking the simple things. All radios in the network must meet these basic requirements:

- Adequate and stable primary power
- An efficient and properly aligned antenna system
- Secure connections (RF, data & power)
- Proper programming of the radio's operating parameters, especially Mode selection (Access Point/Remote) and IP Network Address
- The correct interface between the radio and the connected data equipment (proper cable wiring, data format and timing).

7.1 LED Indicators

The LED status indicators are an important troubleshooting tool and should be checked whenever a problem is suspected. Table 2 on page 7 describes the function of each status LED.

7.2 Troubleshooting Chart

Table 6 provides suggestions for resolving system difficulties that may be experienced in the radio system. If problems persist, contact the factory for further assistance. Refer to the inside back cover of this guide for contact information.

Table 6. Troubleshooting Techniques

Difficulty	Recommended System Checks
Unit is inoperative.	a. Check for the proper supply voltage at the power connector.
	b. The transceiver's internal resettable fuse may have tripped. To reset it, momentarily remove and re-apply power to the radio.
Interference is suspected.	a. Verify that the system has a unique network name. Nearby systems with the same network name will cause interference.
	b. If omnidirectional antennas are used on Station Adaptors, consider changing to directional antennas. This will often limit interference to and from other stations.
No synchronization with Access Point, or poor overall performance.	a. Check for secure interface connections at the radio and the connected device.
	b. Check the antenna, feedline and connectors. Reflected power should be less than 10% of the forward power reading (SWR ≈2:1 or lower).

8.0   REPEATER ASSITED LANS

Repeater Systems

A repeater works by re-transmitting data from the outlying remote site to the Access Point station and vice-versa. It introduces a small amount of end-to-end transmission delay, but this is not a problem in most systems.

The geographic location of a repeater station is especially important. A site must be chosen that allows good communication with *both* the Access Point and the outlying remote site. This is often on top of a hill, or other elevated terrain from which both sites can be "seen" by the repeater station antennas. A detailed discussion on the effects of terrain is given in Section 3.2, *Site Selection* (beginning on page 6).

The following paragraphs contain specific requirements for repeater systems.

Option 1—*Traditional with two-radio repeater* **1Z?**

Although the range between *i*Net LANS is up to 50 miles over average terrain, it is possible to extend the range considerably by connecting two units together at one site in a "back-to-back" fashion to form a repeater, as shown in Figure 16.
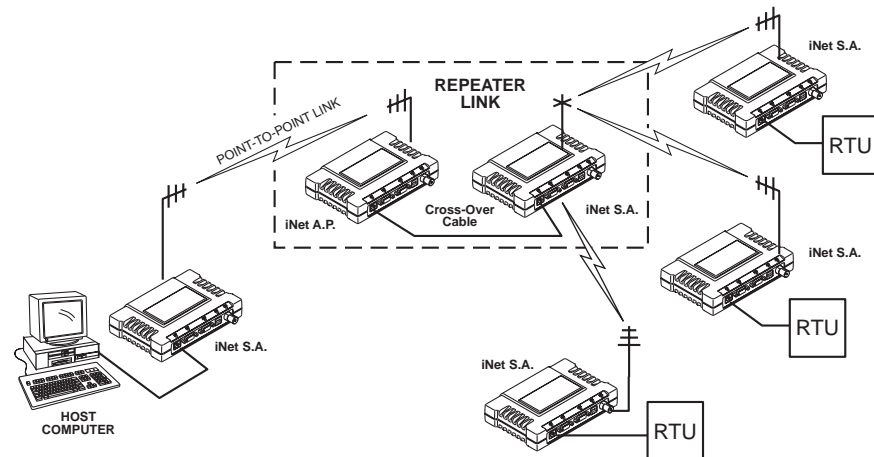
Figure 16. Typical LAN with dual-transceiver repeater

For more detailed information on this configuration, see "TRADITIONAL REPEATER CONFIGURATION WITH TWO RADIOS" on page 20

1. What are the advantages and/or limitations of each of these two repeater configurations?

Option 2—*With Store-and-Forward Station*

A LAN can be extended through the use of an alternate arrangement (see Figure 17). This second arrangement overcomes the limitations of terrain by using a single-unit repeater to re-transmit the signals of all stations in the network. The repeater is a standard MDS iNet 900 radio configured as an Access Point with data store-and-foreword.
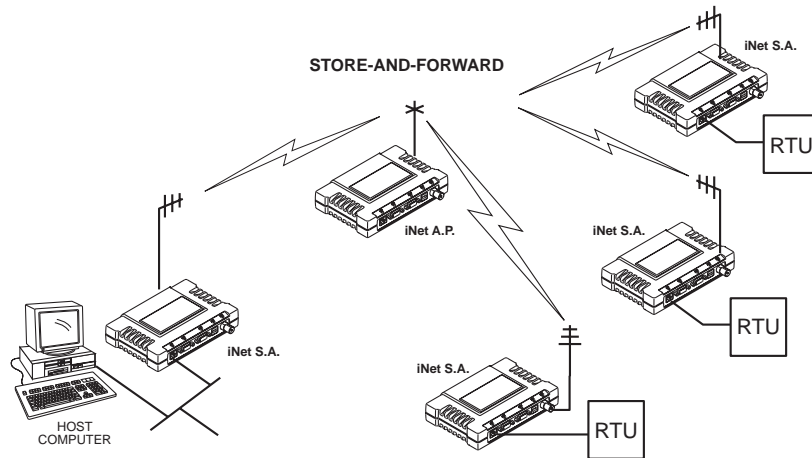
Figure 17. Typical network with store-and-forward repeater

9.0 TECHNICAL REFERENCE

The following section contains material that is not essential to using the radio, but may prove helpful in diagnosing performance problems or in gaining a better understanding of the unit's operation.

9.1 Technical Specifications

GENERAL

Temperature Range:	–30°C to +70°C (–22° F to 158° F)
Humidity:	95% at +40°C (104° F); non-condensing
Primary Power:	10.5–30 Vdc(13.8 Vdc Nominal)
External Power Supply Options:	48 Vdc; 110–120/210–220 Vac
Supply Current (typical):	(@ 1 Watt RF Output)
Transmit:	500 mA @ 13.8 Vdc
Receive:	< 125 mA @ 13.8 Vdc
Doze Mode:	< 30 mA @ 13.8 Vdc
Size (Excluding mtg. hardware):	1.5" x 6" x 4" (H x W x D) 3.8 x 15.2 x 10.2 cm
Mounting w/Optional Hardware:	• Flat surface mounting brackets
	• DIN rail
	• 19" rack (1U high)
Weight:	0.9 kg / 2 lb
Case:	Cast Aluminum
Shock and Vibration:	MIL STD 202F, 810E, 202D

APPROVALS/HOMOLOGATION (*PLANNED*)

- FCC Part 15.247
- Industry Canada RSS-210 and RSS-139
- UL/FM Class 1, Div. 2; Groups A, B, C and D hazardous locations
- UL Listed
- CE Mark
- Contact MDS for information on availability and governmental approvals in other countries

UNIT & NETWORK MANAGEMENT

- HTTP (Embedded Web server)
- SNMPv1, MIB II, Enterprise MIB
- Text-based menu on COM1 serial port
- Telnet

DATA CHARACTERISTICS

PORTS:

Ethernet:

Interface Connectors:	RJ-45 Standard
Data Rate:	10-BaseT

Serial (2):

Signaling Standard:	EIA-232/V.24
Interface Connectors:	DB-9 female
Interface:	COM1: DCE / COM2: DTE/DCE
Data Rate:	1200–115,200 bps asynchronous
Data Latency:	<10 ms typical
Byte Length:	10 or 11 bits

OPERATING MODES:
- Configurable as Access Point or Station LAN Adapter
- CSMA/CA Wireless Protocol with Collision Avoidance (802.11)

PROTOCOLS:
- IEEE 802.11 CSMA/CD
- IEEE 802.3 (Ethernet)
- IP/Ethernet (ICMP, UDP, TCP, ARP)
- Mobile IP
- Clear-channel mode for serial async multidrop protocols including: Modbus, DNP.3, ISO Asynch[1]Z?, Bisync, BASP, Poll Select.

PHYSICAL INTERFACE:

Ethernet:	10BaseT, RJ-45
Serial:	• EIA/RS-232/V.24, DB-9F, DCE
	• EIA/RS-232/V.24/DB-9M, DTE/DCE

RADIO CHARACTERISTICS

GENERAL:

Frequency Range:	902–928 MHz ISM Band
Frequency Hopping Range:	Up to 1019 frequencies within user-configurable 3.2 MHz zones
Hop Pattern:	Based on network name
Frequency Stability:	40 ppm
Simplex Operation:	User selectable

TRANSMITTER:

Power Output (at antenna connector):	0.1 to 1.0 watt (+20 dBm to +30 dBm) ±1.0 dB, *set by user*
Duty Cycle:	Continuous

1. Is this spelling correct or should it be Async?

Modulation Type:	Binary CPFSK
Output Impedance:	50 Ohms
Spurious:	–60 dBc
Harmonics:	–80 dBc
Occupied Bandwidth:	312.5 kHz

RECEIVER:

Type:	Double conversion superheterodyne
Sensitivity:	–90 dBm @ 512 kbps < 1×10^{-6} BER
	–100 dBm @ 256 kbps < 1×10^{-6} BER
Intermodulation:	59 dB minimum (EIA)
Desensitization:	75 dB
Spurious:	70 dB minimum
Interference Ratio (BER degraded by 10^{-1}):	Co-channel:–10 dB Adjacent channel:+30 dB Two channels away:+50 dB Three channels away:+60 dB
Time Required to Synchronize with Access Point Radio:	Less than 13 seconds (typical)

9.2 Data Interface Connectors— LAN, COM1 & DATA Ports

Three data interface connectors are provided on the face of the transceiver. The first, the LAN Port, is an RJ-45 connector. The balance are two DB-9 interface connectors which use the RS-232 (EIA-232) signaling standard. Note that the connector for COM1 Port is DCE (Female DB-9) and the COM2 Port is DTE (male DB-9).

CAUTION

RADIO FREQUENCY INTERFERENCE POTENTIAL

The *i*Net 900 transceiver meets U.S.A.'s FCC Part 15, Class A limits when used with shielded data cables.

LAN (Local Area Network) Port—RJ-45 Ethernet Interface

The LAN Port is used to connect the radio to an Ethernet network. The *i*Net transceiver will provide a data link to an Internet Protocol-based (IP) data network through the radio network's Access Point station. Each radio transceiver in the network must have a unique IP address for the network to function properly. The LAN port only supports the Internet Protocol (IP).

The connector uses the standard Ethernet RJ-45 cables and wiring.

1 2 3 4 5 6 7 8
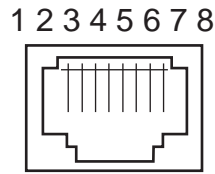
Figure 18. LAN Port (RJ-11) Pinout
*(Viewed from the outside of the radio.***)**

Table 9-7. LAN Port (IP/Ethernet)

Pin	Functions	Ref.
1	Transmit Data (TX)	High
2	Transmit Data (TX)	Low
3	Receive Data (RX)	High
4	Unused	
5	Unused	
6	Receive Data (RX)	Low
7	Unused	
8	Unused	

COM1 Port

5   1

9   6
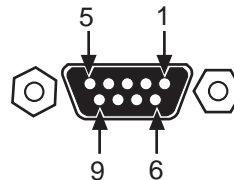
Figure 19. COM1 Port
(Viewed from the outside of the radio.

Table 8. COM1 Port Pinout

Pin	Functions	DCE
1	Unused	
2	Receive Data (RXD)	<—**[** Out
3	Transmit Data (TXD)	—>**[** In
4	Unused	
5	Signal Ground (GND)	
6	Unused	
7	Unused	
8	Unused	
9	Unused	

COM2 Port
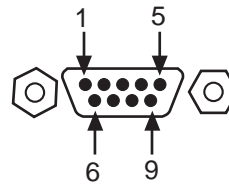
Figure 20. COM2 Port
Viewed from the outside of the radio

Table 9. COM2 Port (DTE/DCE[1])
(DB-9/RS-232 Interface, Output: Out]–>, Input: In [<–)

Pin	Functions	DTE
1	Data Carrier Detect (DCD)	In]<—
2	Receive Data (RXD)	In]<—
3	Transmit Data (TXD)	Out]—>
4	Data Terminal Ready (DTR)	Out]—>
5	Signal Ground (GND)	
6	Data Set Ready (DSR)	In]<—
7	Request-to-Send (RTS)	Out]—>
8	Clear-to-Send (CTS)	In]<—
9	*Unused*	

1. Default = DTE; User configurable to DCE

9.3 Table-Top Test Setup

It may be convenient to set up table-top network that can be used to verify the basic operation of the MDS iNet 900 transceivers and give you a chance to experiment with network designs, configurations or network equipment in a convenient location. This test can be performed with any number of MDS iNet 900 radios.

To simulate data traffic over the radio network, connect a PC or LAN to the Ethernet port of each radio. One of the MDS iNet 900 transceivers in this mini-network must be set to the Access Point Mode for proper operation.

NOTE: It is very important to use a "Network Name" that is different from ones currently in use in your area during the testing period. This will eliminate unnecessary traffic on the existing network while you become familiar with the MDS iNet 900 transceivers or evaluate variations of unit operating parameters.

Use any convenient antenna that can be connected to the transceiver's TNC connector. You may purchase a flexible one-quarter wavelength antennas from Microwave Data Systems. (P/N xx-xxxxAxx)

9.4 Using a Personal Computer to Configure the *i*Net Radio

Any personal computer with either a serial port and terminal emulator program if an Ethernet port can be used to access the iNet's test and configuration tool set. Once connected, the user will be provided with on-line user instructions for each resource.

Connecting a PC to *i*Net's LAN (Ethernet) Port

To connect a PC to the radio's LAN port, an RJ-45 to RJ-45 cross-over cable (MDS P/N 05-_____A___) is required. If desired, this cable may be purchased from a computer retail store or mail-order company.

Connecting a PC to *i*Net's COM1 Port

To connect a PC to the radio's COM1 port use a DB-9M to DB-9F cross-over cable (MDS P/N 05-_____A___). This cable may also be purchased from a computer retail store or mail-order company.

10.0 GLOSSARY OF TERMS

If you are new to spread spectrum radio, some of the terms used in this guide may be unfamiliar. The following glossary explains many of these terms and will prove helpful in understanding the operation of the transceiver.

Antenna System Gain—A figure, normally expressed in dB, representing the power increase resulting from the use of a gain-type antenna. System losses (from the feedline and coaxial connectors, for example) are subtracted from this figure to calculate the total antenna system gain.

Bit—The smallest unit of digital data, often represented by a one or a zero. Eight bits (plus start, stop, and parity bits) usually comprise a byte.

Bits-per-second—See *BPS*.

BPS—Bits-per-second. A measure of the information transfer rate of digital data across a communication channel.

Byte—A string of digital data usually made up of eight data bits and start, stop and parity bits.

Decibel (dB)—A measure of the ratio between two signal levels. Frequently used to express the gain (or loss) of a system.

Data Circuit-terminating Equipment—See *DCE*.

Data Communications Equipment—See *DCE*.

Data Terminal Equipment—See *DTE*.

dBi—Decibels referenced to an "ideal" isotropic radiator in free space. Frequently used to express antenna gain.

dBm—Decibels referenced to one milliwatt. An absolute unit used to measure signal power, as in transmitter power output, or received signal strength.

DCE—Data Circuit-terminating Equipment (or Data Communications Equipment). In data communications terminology, this is the "modem" side of a computer-to-modem connection.

DTE—Data Terminal Equipment. A device that provides data in the form of digital signals at its output. Connects to the DCE device.

Equalization—The process of reducing the effects of amplitude, frequency or phase distortion with compensating networks.

Fade Margin—The greatest tolerable reduction in average received signal strength that will be anticipated under most conditions. Provides an allowance for reduced signal strength due to multipath, slight antenna movement or changing atmospheric losses. A fade margin of 20 to 30 dB is usually sufficient in most systems.

Frame—A segment of data that adheres to a specific data protocol and contains definite start and end points. It provides a method of synchronizing transmissions.

Frequency Hopping—The spread spectrum technique used by the MDS *i*Net 900 transceivers, where two or more associated radios change their operating frequencies several times per second using a set pattern. Since the pattern appears to jump around, it is said to "hop" from one frequency to another.

Frequency Zone—The transceivers use up to 1,019 discrete channels in the 902 to 928 MHz spectrum. A group of 128 channels is referred to as a zone. The transceivers use eight frequency zones. (Five channels are reserved for network control purposes.)

Hardware Flow Control—A transceiver feature used to prevent data buffer overruns when handling high-speed data from the RTU or PLC. When the buffer approaches overflow, the radio drops the clear-to-send (CTS) line, which instructs the RTU or PLC to delay further transmission until CTS again returns to the high state.

Host Computer—The computer installed at the Access Point station site, which controls the collection of data from one or more remote sites.

Latency—The delay (usually expressed in milliseconds) between when data is applied to TXD (Pin 2) at one radio, until it appears at RXD (Pin 3) at the other radio.

MAS—Multiple Address System. A radio system where a central Access Point station communicates with several Station Adaptors for the purpose of gathering telemetry data.

Access Point (Station)—The one radio transceiver in a spread spectrum network that automatically provides synchronization information to one or more associated remote transceivers. A radio may be programmed for either Access Point or remote mode using software commands. See Section 6.0, *PROGRAMMING* (beginning on page 21).

MCU—Microcontroller Unit. This is the processor responsible for controlling system start-up, synthesizer loading, hop timing, and key-up control.

Microcontroller Unit—See *MCU*.

Mode—This refers to the programmed function of an MDS spread spectrum radio—Access Point or remote. (See also *Station Adaptor* and *Access Point Station*.)

Multiple Address System (MAS)—See *Point-Multipoint System.*

Network Address—User-selectable number between 1 and 65000 that is used to identify a group of transceivers that form a communications network. The Access Point and all remotes within a given system *must* have the same network address.[1]Z?

Network-Wide Diagnostics—An advanced method of controlling and interrogating MDS radios in a radio network.

Point-Multipoint System—A radio communications network or system designed with a central control station that exchanges data with a number of remote locations equipped with terminal equipment.

Poll—A request for data issued from the host computer (or master PLC) to a remote radio.

PLC—Programmable Logic Controller. A dedicated microprocessor configured for a specific application with discrete inputs and outputs. It can serve as a host or as an RTU.

Remote Radio—A radio in a spread spectrum network that communicates with an associated Access Point station. A radio may be programmed for either Access Point or remote mode using software commands. See Section 6.0, *PROGRAMMING* (beginning on page 21).

Remote Terminal Unit—See *RTU*.

RTU—Remote Terminal Unit. A data collection device installed at a remote radio site.

SCADA—Supervisory Control And Data Acquisition. An overall term for the functions commonly provided through an MAS radio system.

Standing Wave Ratio—See *SWR*.

SWR—Standing Wave Ratio. A parameter related to the ratio between forward transmitter power and the reflected power from the antenna system. As a general guideline, reflected power should not exceed 10% of the forward power ($\approx$ 2:1 SWR).

Zone—See *Frequency Zone*.

---

1. Is this relevant to this product?

10.1 dBm-Watts-Volts Conversion Chart

Table 10 is provided as a convenience for determining the equivalent voltage or wattage of an RF power expressed in dBm.

Table 10. dBm-Watts-Volts conversion—for 50 ohm systems

dBm	V	Po
+53	100.0	200W
+50	70.7	100W
+49	64.0	80W
+48	58.0	64W
+47	50.0	50W
+46	44.5	40W
+45	40.0	32W
+44	32.5	25W
+43	32.0	20W
+42	28.0	16W
+41	26.2	12.5W
+40	22.5	10W
+39	20.0	8W
+38	18.0	6.4W
+37	16.0	5W
+36	14.1	4W
+35	12.5	3.2W
+34	11.5	2.5W
+33	10.0	2W
+32	9.0	1.6W
+31	8.0	1.25W
+30	7.10	1.0W
+29	6.40	800mW
+28	5.80	640mW
+27	5.00	500mW
+26	4.45	400mW
+25	4.00	320mW
+24	3.55	250mW
+23	3.20	200mW
+22	2.80	160mW
+21	2.52	125mW
+20	2.25	100mW
+19	2.00	80mW
+18	1.80	64mW
+17	1.60	50mW
+16	1.41	40mW
+15	1.25	32mW
+14	1.15	25mW
+13	1.00	20mW
+12	.90	16mW
+11	.80	12.5mW
+10	.71	10mW
+9	.64	8mW
+8	.58	6.4mW
+7	.500	5mW
+6	.445	4mW
+5	.400	3.2mW
+4	.355	2.5mW
+3	.320	2.0mW
+2	.280	1.6mW
+1	.252	1.25mW

dBm	V	Po
0	.225	1.0mW
-1	.200	.80mW
-2	.180	.64mW
-3	.160	.50mW
-4	.141	.40mW
-5	.125	.32mW
-6	.115	.25mW
-7	.100	.20mW
-8	.090	.16mW
-9	.080	.125mW
-10	.071	.10mW
-11	.064	
-12	.058	
-13	.050	
-14	.045	
-15	.040	
-16	.0355	

dBm	mV	Po
-17	31.5	
-18	28.5	
-19	25.1	
-20	22.5	.01mW
-21	20.0	
-22	17.9	
-23	15.9	
-24	14.1	
-25	12.8	
-26	11.5	
-27	10.0	
-28	8.9	
-29	8.0	
-30	7.1	.001mW
-31	6.25	
-32	5.8	
-33	5.0	
-34	4.5	
-35	4.0	
-36	3.5	
-37	3.2	
-38	2.85	
-39	2.5	
-40	2.25	.1µW
-41	2.0	
-42	1.8	
-43	1.6	
-44	1.4	
-45	1.25	
-46	1.18	
-47	1.00	
-48	0.90	

dBm	mV	Po
-49	0.80	
-50	0.71	.01µW
-51	0.64	
-52	0.57	
-53	0.50	
-54	0.45	
-55	0.40	
-56	0.351	
-57	0.32	
-58	0.286	
-59	0.251	
-60	0.225	.001µW
-61	0.200	
-62	0.180	
-63	0.160	
-64	0.141	

dBm	µV	Po
-65	128	
-66	115	
-67	100	
-68	90	
-69	80	
-70	71	.1nW
-71	65	
-72	58	
-73	50	
-74	45	
-75	40	
-76	35	
-77	32	
-78	29	
-79	25	
-80	22.5	.01nW
-81	20.0	
-82	18.0	
-83	16.0	
-84	11.1	
-85	12.9	
-86	11.5	
-87	10.0	
-88	9.0	
-89	8.0	
-90	7.1	.001nW
-91	6.1	
-92	5.75	
-93	5.0	
-94	4.5	
-95	4.0	
-96	3.51	
-97	3.2	

dBm	µV	Po
-98	2.9	
-99	2.51	
-100	2.25	.1pW
-101	2.0	
-102	1.8	
-103	1.6	
-104	1.41	
-105	1.27	
-106	1.18	

dBm	nV	Po
-107	1000	
-108	900	
-109	800	
-110	710	.01pW
-111	640	
-112	580	
-113	500	
-114	450	
-115	400	
-116	355	
-117	325	
-118	285	
-119	251	
-120	225	.001pW
-121	200	
-122	180	
-123	160	
-124	141	
-125	128	
-126	117	
-127	100	
-128	90	
-129	80	.1ƒW
-130	71	
-131	61	
-132	58	
-133	50	
-134	45	
-135	40	
-136	35	
-137	33	
-138	29	
-139	25	
-140	23	.01ƒW

NOTES

IN CASE OF DIFFICULTY...

MDS products are designed for long life and trouble-free operation. However, this equipment, as with all electronic equipment may have an occasional component failure. The following information will assist you in the event that servicing becomes necessary.

FACTORY TECHNICAL ASSISTANCE

Technical assistance for MDS products is available from our Customer Support Team during business hours (8:00 A.M.–5:30 P.M. Eastern Time). When calling, please give the complete model number of the radio, along with a description of the trouble symptom(s) that you are experiencing. In many cases, problems can be resolved over the telephone, without the need for returning the unit to the factory.

Please use the following telephone numbers for product assistance:

716-241-5510 (Phone)
716-242-8369 (FAX)

FACTORY REPAIRS

Component-level repair of radio equipment is *not* recommended in the field. Many components are installed using surface mount technology, which requires specialized training and equipment for proper servicing. For this reason, the equipment should be returned to the factory for any PC board repairs. The factory is best equipped to diagnose, repair and align your radio to its proper operating specifications.

If return of the equipment is necessary, you will be issued a Returned Material Authorization (RMA) number. The RMA number will help expedite the repair so that the equipment can be repaired and returned to you as quickly as possible. Please be sure to include the RMA number on the outside of the shipping box, and on any correspondence relating to the repair. *No equipment will be accepted for repair without an RMA number.*

A statement should accompany the radio describing, in detail, the trouble symptom(s), and a description of any associated equipment normally connected to the radio. It is also important to include the name and telephone number of a person in your organization who can be contacted if additional information is required.

The radio must be properly packed for return to the factory. The original shipping container and packaging materials should be used whenever possible. All factory returns should be addressed to:

Microwave Data Systems Inc.
Customer Service Department
(RMA No. XXXX)
175 Science Parkway
Rochester, NY 14620 USA

When repairs have been completed, the equipment will be returned to you by the same shipping method used to send it to the factory. Please specify if you wish to make different shipping arrangements.

MDS

Microwave Data Systems Inc.

175 Science Parkway, Rochester, New York 14620
General Business: +1 (716) 242-9600
FAX: +1 (716) 242-9620
Web: www.microwavedata.com