MOORE INDUSTRIES

WORLDWIDE

May 2016
236-705-00C

Wireless Network Module

WNM

900MHZ, 2.4GHZ
Ethernet Serial

WNM Wireless Network Module

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Introduction

There are two generations of Model WNM our **Current** model and our older *Legacy* model.

The older *Legacy* version has four models:

900 MHz band:
WNM /ETHERNET/…/-900 MHZ/…
WNM/SERIAL /…/-900MHZ/…

2.4 GHz band:
WNM/ETHERNET/…/-2.4GHZ/…
WNM/SERIAL/…/-2.4GHZ/…

The **Current** version of the WNM began in June 2015 has only two models. The following changes are made:

Both ETHERNET and SERIAL communications are combined into a single Model number for a given band. When there is a requirement for Ethernet communications, or for serial communication, or for both communications methods, then specify the WNM Model number by:

900 MHZ band (specify for Ethernet or serial or both):
WNM/ETHERNET/…/-900MHZ/…

2.4GHZ band (specify for Ethernet or serial or both):
WNM/ETHERNET/…/-2.4GHZ/…

The **Current** WNM version Ethernet radios are slightly larger in package size. Refer to Figures 2.

Both *Legacy* and **Current** versions of the WNM ETHERNET radios are electronically compatible with one another. You will be able to use both the *Legacy* and **Current** version ETHERNET radios in the same RF network. However you can not use *Legacy* 'SERIAL only' type radios in a network with ETHERNET radios since the earlier *Legacy* 'SERIAL only' type radios use a different internal radio-to-radio modems.

It is routine to use the serial ports with the ETHERNET radios (both **Current** & *Legacy*). The serial communications uses packets within the Ethernet radio-to-radio modems link to carry the serial information. The Model WNM is not a 'serial-to-Ethernet protocol converter'. Which means, if the data originates on a serial port on one Model WNM, then it will be communicated to the serial ports (only) of the other Model WNMs. The same wording applies Ethernet origin port to other Model WNM radio(s) Ethernet destination (only) ports.

When using the serial ports on these Model WNM Ethernet radios, use care to allow at the serial device source and serial device destination for additional 'store and forward' minor time delays originating from within the Model WNM modems. Some serial protocols expect precise timing of an arriving signal or a field response signal. If the source (or destination) device has parameter adjustments to allow for timing delays, then experiment with these settings until all occasional data dropouts are eliminated. These minor time delays are more pronounced when additional repeaters or low RF signal strengths are involved. The Model WNMs do perform an automatic 'resend' of data if the first transfer of data was not successful. This 'resend' adds further minor timing delay. Ethernet based communications use a different flexibility in 'timing' of data and are very flexible in handling routine timing delays with no operator setup intervention.

Both versions of WNM radios are configured for radio and network setups using the newer WNM Config program (available from the Moore Industries Internet site which is included with the purchase of your WNM radios). The *Legacy* version WNM radios may use a wireless network using any of the four (4) network setup protocols- but only if 'all of the radios' on the network are only the first version. The available combinations may vary in the first version WNM radios if the Model WNM is 'Serial only' or an Ethernet (with serial). For any combination of first and second version WNM radio networks specify only the Point-to-Point network or the SSE- Smart Switched Ethernet type of network. The SSE may be used for any application. The SSE must be used for networks with WNM repeaters.

The WNM (Wireless Network Modem) transceivers are modern, high performance, wireless radio modems designed for reliable industrial data communications in the 902-928 MHz license-free band and in the 2.4 - 2.4835 GHz international license-free band. These wireless modems employ advanced spread spectrum frequency hopping and error detection technology to achieve very reliable noise and interference immune operation.

Both our **Current** and *Legacy* WNM models are available in two frequency band versions according to the intended communications (900 MHz or 2.4 GHz). The precise frequencies within each band and maximum power levels are factory configured and will vary for different countries. All WNM models are covered in this manual. Both WNM Current models support Ethernet and serial communications.

From Moore Industries the WNMs are pre-configured for immediate use. The WNMs provide a two-way, transparent communications link for serial data and Ethernet without the necessity to update any WNM parameters such as baud rate, parity, stop bits, protocol, broadcast messages, etc. The data stream that arrives at one WNM COM port appears at the other WNM COM port as if the original 'wired cable' were transparently connected between the WNM radio pairs. Internal (WNM-to-WNM) data transfer is via radio link data packets transferring at up to 1.1 Mbits/sec, with 128 bit AES (Advanced Encryption Standard) secure data encryption, a 32 bit CRC (Cyclic Redundancy Check), and ARQ (Automatic Resend Query) to re-send data packets for data integrity – all these activities are transparent to the user.

Reliable point-to-point communication of up to 30 miles is achieved by using the 900 MHz band for communications. This band is proven to minimize signal loss over distance and even a slight ability to penetrate and reflect off walls on indoor environments. The 2.4 GHz band is suited when required by government regulations, when physically smaller antennas are required, and/or for communications distances of 15 miles or less. The 2.4 GHz band range is limited since it is usually lower power and also does not penetrate interior walls and trees/foliage as readily as the 900 MHz band.

For expanded systems, or applications that may require communicating beyond hills or longer distances, the WNM may be configured to include repeaters with a virtually unlimited number of WNM transceiver remote sites all communicating back to a master WNM. Communications may be one-way, two-way back to the master site, or effectively from any site-to-any site.

WNM transceivers obtain optimum range by careful selection of antenna, antenna location, signal gain parameters, coaxial cable, surge protection, and configuration of the transceiver setup parameters to match your particular application. We encourage you to contact Moore Industries' support personnel to set up your WNM transceivers in advance of purchase. The WNM Configuration Manager software can also be used to make setup changes to your wireless system, such as the addition of a new WNM transceiver site for your applications.

Each WNM radio includes a 2 dBi flexible antenna which mounts directly to the RF connector on the top of the WNM. This is used for bench testing prior to system deployment. This antenna is usually replaced by a coaxial cable and a larger antenna for greater communications range.

The use of radios may be unfamiliar to some personnel. Please use this manual as your guide for your WNM radio familiarization, performance, installation guidelines, safety considerations, and diagnosis of operation.

Figure 1. *Typical WNM wireless network system using Master, Repeater and Remotes.*
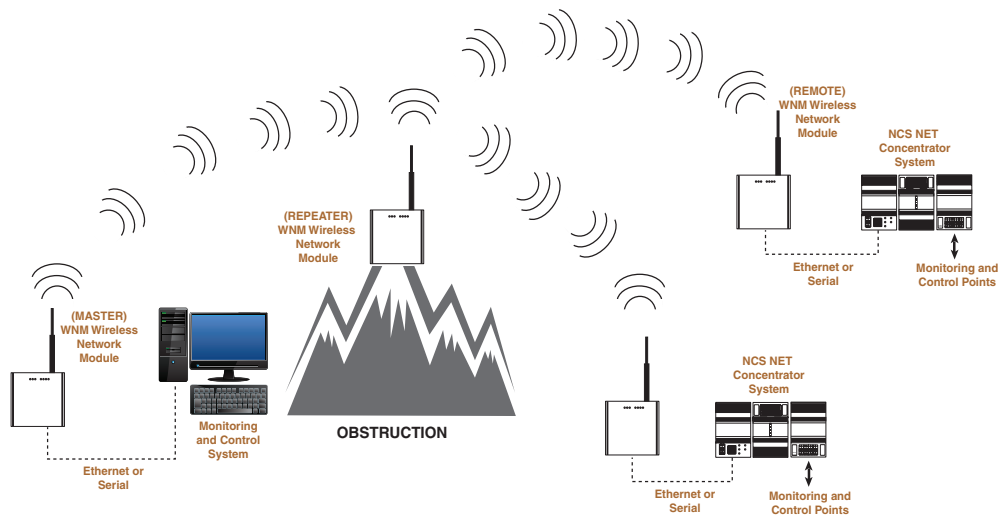
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About this Manual

Wherever you see a "***WARNING***", "***Caution***" or "***Note***" pay particular attention.

WARNING - provides information on steps to take in avoiding procedures and practices that could pose safety risks to personnel.

Caution - provides information on steps to take in avoiding procedures and practices that could risk damage to the WNM or other equipment.
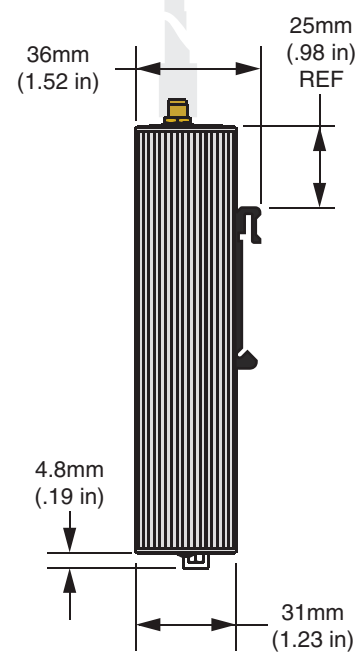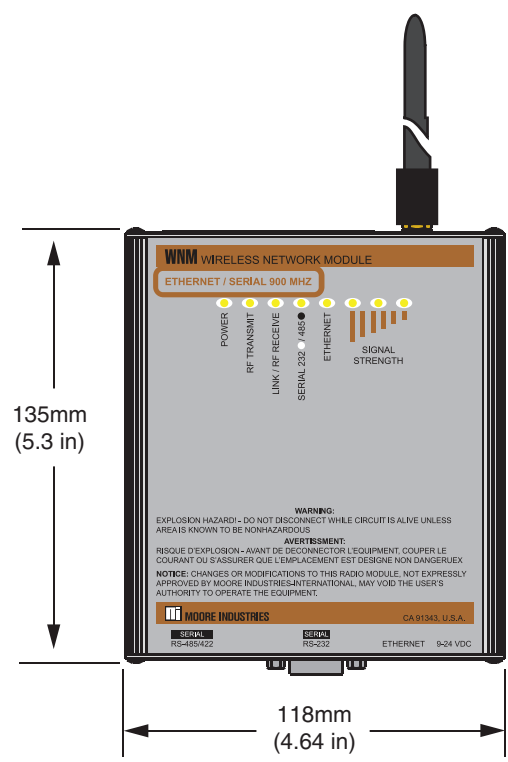
Note - provides information to help you avoid minor inconveniences during calibration, installation, or operation of the WNM.

Specifications

Operating Frequency	902-928 MHz; 2.4-2.4835 GHz (Frequency bands may vary by country)
Transmitter Range	**Range:** Up to 30 miles (48km), line-of-sight using 902-928 units; up to 15 miles (24km) using 2.4-2.4835 units; both sites using highly-directional antennas and direct line-of-sight RF path **Output Power:** 10mW to 1W; 10-30dbm (programmable levels) Modulation: Spread spectrum, frequency hopping (programmable) NOTE: Transmitter power may vary by country. Communications range is affected by antenna types and installation heights, coax length, RF power, pathway attenuation due to weather, propagation, foliage and terrain; electrical/RF interference and data rates.

Receiver Sensitivity	1.1Mbps:-97dBm; 345kbps:-104dBm; both at 10-6 BER
Channel Data Rates	1.1Mbps or 345kbps
RF Data Transfer	**Error Detection:** 32 bit CRC; ARQ (Auto Resend Query) **Security:** 128 bit AES encryption
Protocols	**Ethernet RJ45 Port:** All standard IEEE Ethernet 802.3 protocols **Serial Data Ports:** Data sent within TCP packets; MODBUS RTU, DF1, ASCII and DNP3
Operating Modes	Point-to-point; Smart Switched Ethernet; and Store and Forward Repeater (programmable)
Connectors	**RF:** SMA-RP **Serial Data Ports:** DB9F (RS-232) and 5 pin with mate (RS-485/422) with RS-485 terminator switches; **Ethernet:** RJ45 for data and configuration

Antenna	Flexible SMA-RP-male with flex base (optional external antennas)
Indicators	LEDs for: Power, RF Transmit, Link/RF Receive, RS-485/232, Signal strength; Ethernet
External Power	**Voltage:** 10-24Vdc **Power:** 12 Watts peak, 5 Watts receive
Enclosure	Extruded aluminum with 35mm DIN top hat mount
Ambient Conditions	**Operating and Storage Range:** -40°C to +75°C (-40°F to +167°F) **Relative Humidity:** 5 to 95%, non-condensing **Shock:** IEC 60068-2-6 (20G, 3 axis) **Vibration:** IEC 60068-2-27 (5g, 10-150 Hz)
Weight	454g (1 lb.)

Figure 2. *WNM Current Installation Dimensions.*

900 MHZ

2.4 GHZ
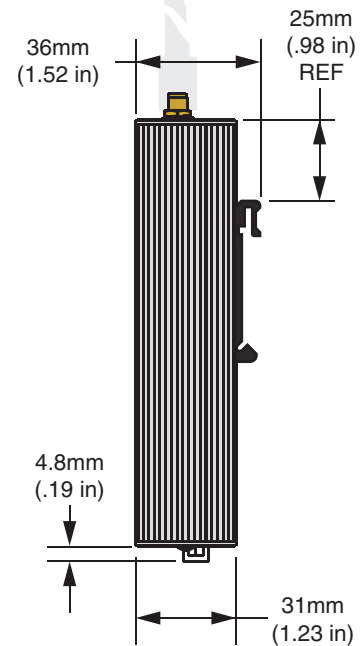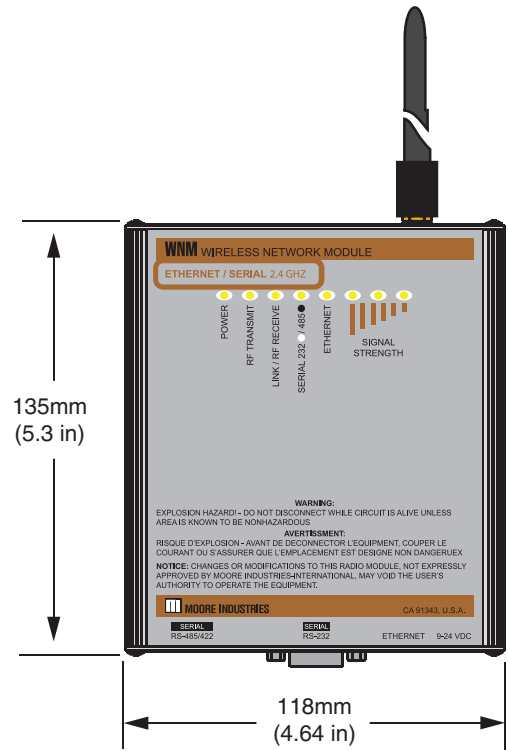
Figure 3. *WNM Legacy Installation Dimensions.*
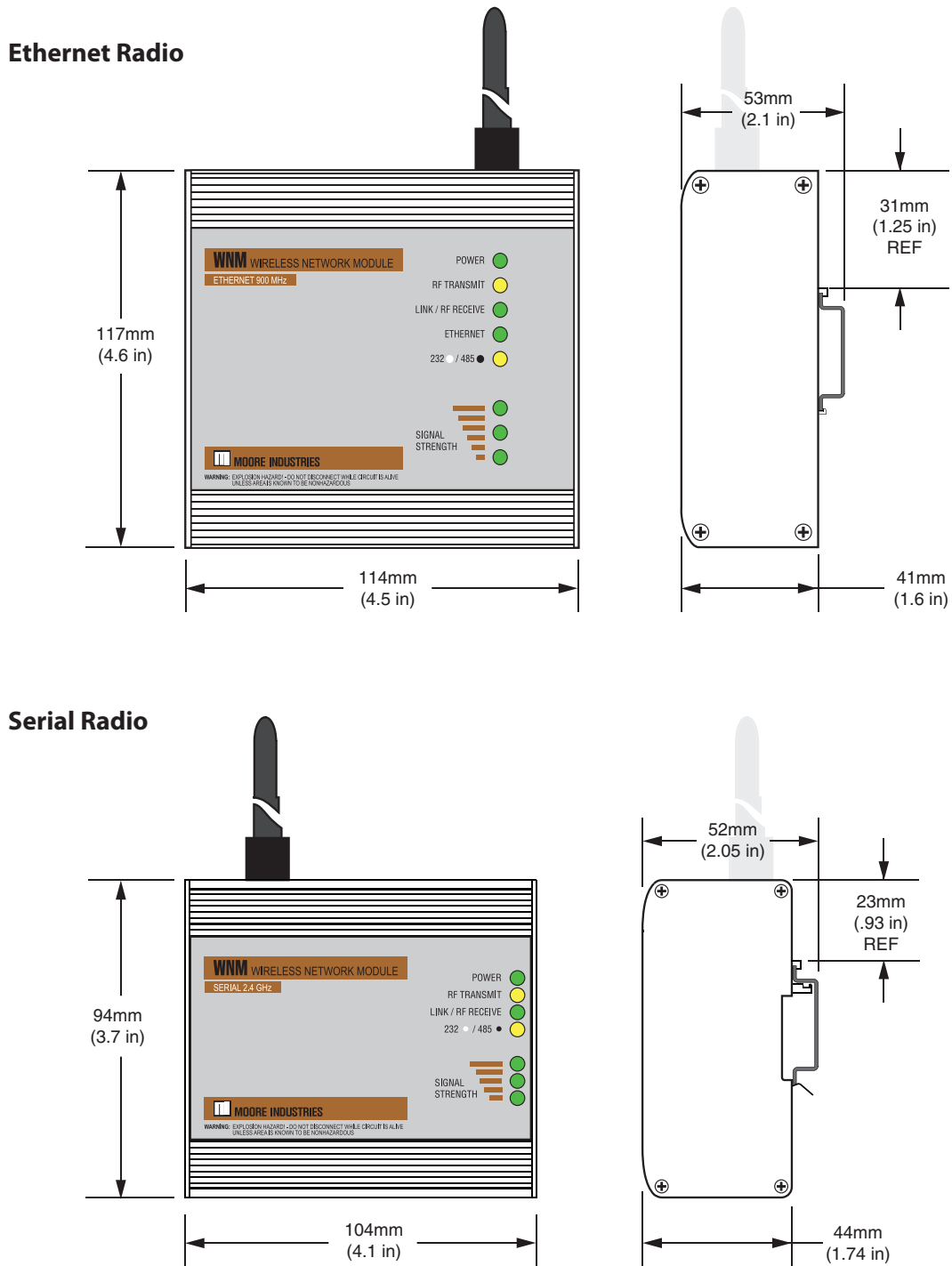
Ethernet Radio

Serial Radio

Figure 3. *WNM Optional Mounting Bracket P/N 207-256-07*
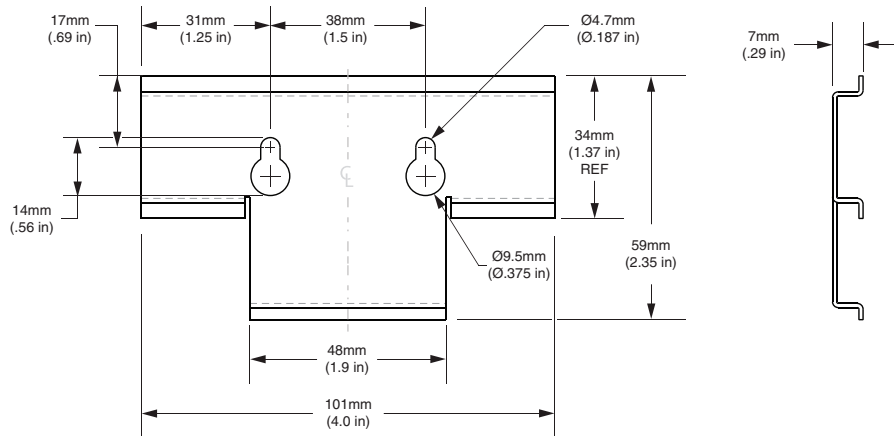
Figure 4. *WNM Terminal Designations For Ethernet and Serial Models*

Current Ethernet 900MHz & 2.4GHz

Legacy Ethernet 900MHz & 2.4GHz

Top

Bottom

Legacy Serial 900MHz & 2.4GHz

Top

Bottom
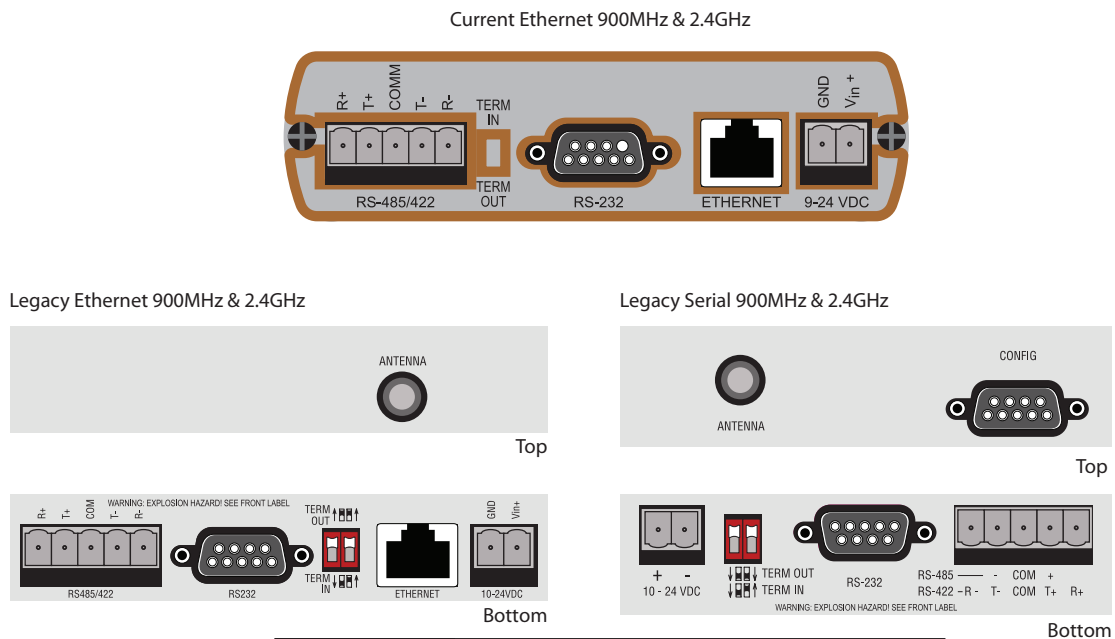
Input Type	Terminal	Description	
		2-Wire RS485	4-Wire RS485 and 4 wire RS422
RS485/422	R +	Jumper to "T+"	to other device 'T+'
	T +	to other device '+'	to other device 'R+'
	COM	shield, if used *	shield, if used *
	T -	to other device '-'	to other device 'R-'
	R -	Jumper to "T-"	to other device 'T-'
RS232	N/A	wired as DCE; same serial data content as RS485/422 and as Ethernet	
Term In/Out	N/A	RS485 only if required. Insert termination resistors to minimize noise.	
Ethernet	N/A	Use straight Ethernet cable to LAN switch or crossover cable to NCS.	
Power	GND	Power Supply return (-), connects to WNM case/ground *	
	Vin +	Power Supply (+), 10 to 24 Vdc regulated	
Config	N/A	wired as DCE; no data; use for WNM Legacy Serial only configuration only	

* Use care when grounding WNM to prevent ground loops. Power supply GND is internally connected also to WNM metal case, RF connector, DB9 connectors, signal GND within DB9, and COM. Ground cables properly. Do not use WNM as a grounding junction block. Avoid ground loops by following proper shield grounding practices.

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Quick Setup Guide

WARNING
Please review the Important Safety Information in the Installation section of this manual before proceeding.

The following guide provides an outline of the steps to planning, configuring and installing your WNM network. For more detailed information please refer to the relevant topics in this manual.

Network Architecture

1. Hand sketch your system on paper as to physical layout (map). This includes the host site plus all remote sites. It includes antenna positions, distances, hills, and intervening buildings/obstructions in the radio signal pathway.

2. Determine where the 'Master radio' is to be located (usually adjacent to the host NCS/PLC/DCS).

3. Determine the need to provide a radio repeater site for 'far distant' sites that cannot 'see' the 'Master radio'. More than one repeater may be required.

4. Determine if communications are to be Ethernet, Serial, or both.

5. For long distance radio paths, or radio paths that intersect other radio systems, perform a radio 'site survey' using actual radios to confirm that radio communications paths are reliable for the various sites.

6. Determine your network architecture (one site to one other site, or more than two sites)

Installation Planning

1. Select best locations for the WNM(s). Generally these would be located closest to their antenna, not their process control equipment, to achieve the best communication range. The WNM is usually installed at the entrance of a building in a weather resistant housing. Also included is any RF (lighting) coax cable surge protection plus a lighting earth rod at ground level. Preferred is a short coax cable length from the rooftop/tower to the WNM.

2. Select the optimum locations for your antennas. Ideally these will be the physically highest points such as atop a mast/pole at the top of a building or tower with a straight line of site from the antenna to distant antenna(s) at other locations. The higher the location of the antenna, the fewer opportunities for the RF signal to reflect from nearby surfaces to degrade the overall RF signal strength.

3. Select suitable antenna types. An omnidirectional antenna is well suited for master control points with remote sites in different directions. A directional (Yagi) antenna is best suited for point-to-point applications. Other antenna types are available that are better suited for applications where it is desirable to 'hide' the presence of the antennas. These may include spike or flat panel antennas. Consult Moore Industries for selection of these antennas.

4. Select antenna gains. An antenna with increased gain is generally recommended to offset the losses of RF coaxial cable and to increase effective radiated power for improved communications range.

Warning:
Local and National Government guidelines limit the effective radiated RF energy. Moore Industries will assist in calculating the correct radio power, antenna gains and RF cable losses for your particular installation.

Configuration

Your WNM radios are pre-configured at Moore Industries and are ready to use out of the box. If your radios are purchased as part of a Moore Industries' system, the radios have already been tested with your particular system. The WNMs are also tagged to identify their relative installation location.

The WNM Configuration program can be used to modify and save the WNM setup and also to monitor WNM radio performance. Please see the Configuration section for more information.

Bench Setup

It is recommended to test your system setup in a lab environment before installing in the field (if this is practical).

1. Before connecting your WNM radios, hook up your system with cables (Ethernet/serial) and verify your system is successfully communicating.

2. Replace the cables with the pre-configured WNMs (using the tags to identify their network location). For this test, the flexible antenna already installed on the WNM can be used.

3. Power up the system and simulate a signal at one site. Monitor its appearance on the other site. Check led activity on each WNM communications port (see Figure 7 in Operation & Diagnostics section for LED information).

4. Simulate data signals between all sites and verify that they are communicating.

Field Installation

1. Move the WNMs into their final (permanent) enclosures.

2. Replace the short flexible antennas on the WNMs with their coaxial cables, surge suppressors and antennas. The short antennas should be stored safely (for future maintenance purposes, as desired).

3. Verify the correct WNM radios (refer to factory tags regarding Master and various Remote) are installed at their correct sites.

4. Repeat your communications test.

5. If there are problems, note all LED status indicators and contact Moore Industries technical support.

Caution:
The optimum and safe use of WNM radios, coaxial cable, surge protection devices, and antennas requires an added RF (radio frequency) knowledge that may not already be in the experience set for some designers, installers and maintenance personnel. Please review all topics of this manual for more detailed information and review and comply with any local building codes.

Network Architecture

Prior to configuring your WNMs, you must first design your network to determine the location, number and types of WNMs required. Please review the sections below for more information on radio and network types to help in your network design.

1. Hand sketch your system on paper as to physical layout (map). This includes the host site plus all remote sites. It includes antenna positions, distances, hills, and intervening buildings/obstructions in the radio signal pathway.

2. Determine where the 'Master radio' is to be located (usually adjacent to the host NCS/ PLC/ DCS). All radio communications will be routed through the Master radio regardless of data origin and data destination.

3. Determine the need to provide a radio repeater site for 'far distant' sites that cannot 'see' the 'Master radio'.

4. Determine if communications are to be Ethernet, serial, or both.

5. Perform a radio 'site survey' using actual radios to confirm that radio communication paths are reliable for the various sites. This is particularly important for long distance radio paths plus radio paths that intersect other radio systems.

6. Contact Moore Industries-International technical support staff for any questions and assistance.

Radio Type

Each network consists of a one Master radio plus one or more Remote radios. If a radio (Master or Remote) pathway is obstructed or too distant to another radio, then a Repeater radio must be added to the link.

Master Radio

All WNM communication network types must have a Master radio. There is always only one Master radio per WNM communications network. The Master radio is physically identical to any other radio. It is given its Master assignment and its own address at the time of network configuration. In most WNM communications networks, the Master radio is used to direct radio traffic to/from each of the other radios. Thus, in most networks, radio traffic to/from all of the other radios is routed through the Master radio. The Master radio is usually located at the site that has the most data transfer. An example would be the host computer site of a large facility that communicates with multiple remote locations. By locating the Master radio at this busy site, the minimum number of radio pathway transactions is required for network communications.

Remote Radio

All network types have one or more Remote radios. The Remote radio is physically identical to any other radio. It receives its Remote assignment at the time of network configuration. In most WNM network types, the Remote radio communicates via a radio addressing pathway through the Master radio. This includes communications from one Remote site to another Remote site, in most networks. The Remote radios are usually located at the remote sites. Remote radio sites may be added at any time to the network by configuring the remote to communicate with a particular other radio address, usually the Master or a Repeater.

Repeater Radio

A Repeater radio is required only when the radio pathway is too distant or an obstruction exists between the two sites. The Repeater radio is physically identical to any other radio. It receives its Repeater assignment at the time of network configuration. The Repeater radio is situated at a location that can 'see' both of the other sites. A single Repeater may also be used to communicate with multiple remote sites. The Repeater is a digital 'store and forward' type of repeater in which an addressed radio packet is received, briefly stored within the repeater, and then the packet is transmitted to the next radio. The Repeater radio configuration has its own address, plus an assigned list of radios it is permitted to communicate with on the network. A Repeater uses one antenna for all communications. So the antenna pattern (directions) must be considered for all relevant sites. If a new radio site is edited (added, removed, change of address) on a network, then the Repeater configuration needs to be updated also.

A Repeater is also a Remote site. Thus any Repeater also inputs and outputs data from its own site just as at regular Remote site. Any Repeater may serve both functions- Remote site and Repeater site simultaneously.

Network Type

There are a number of different network types available which determine how the master and remote radios communicate with each other. Selection of different network types optimizes data transfer depending on the application. Available network types depend on the type of radio you are configuring (Serial or Ethernet) and not all network types are available on all radios.

For Serial (*Legacy* Version Only) communication, there are four network types:

    P2P - Peer To Peer

    PMP - Point to Multipoint

    E2E - Everyone to Everyone

    PTP - Point To Point

For Ethernet (*Legacy* and **Current** Version) communication, there are two network communications types:

    P2P - Peer to Peer

    SSE - Smart Switched Ethernet.

P2P (Peer to Peer) Network (Serial or Ethernet)

In P2P (Peer to Peer) networks, all communications are always routed through the Master radio. Communications may be from:

a)   any remote to the Master WNM radio;

b)   the Master WNM to any WNM remote radio;

c)   any WNM remote radio via the Master WNM and then to any other WNM remote radio; and

d)   any WNM remote radio via the Master WNM and then broadcast to all WNM remote radios.

PMP (Point to Multipoint) Network (Serial only)

In PMP (Point to Multipoint) networks, the application is well suited for a polled network in which an addressed message is broadcast from the WNM Master to all WNM remotes. Then only the properly addressed WNM remote radio responds back only to the WNM Master. MODBUS RTU communications is typical of this structure. The sequence in Point to Multipoint networks is:

a) Master radio broadcasts to all WNM remote radios;

b) the proper WNM remote radio responds back to the Master. The other WNMs are silent.

E2E (Everyone to Everyone) Network (Serial only)

In E2E (Everyone to Everyone) networks, all WNM remote sites communicate with all other WNM sites by routing their messages via the WNM Master radio. The WNM Master radio then sends this message to every WNM remote radio. This method is bandwidth intensive since all data is sent to all WNM sites.

PTP (Point To Point) Network (Serial only)

In PTP (Point To Point) networks, some WNM radio sites may be too remote for reliable direct radio communications. The Point To Point network provides a repeater communications link. Located in between these two distant sites are dedicated WNM radio repeaters programmed for the task of receiving the message from one WNM radio, briefly storing the data, then forward (transmit) the message to the next WNM radio site. This next site may be another WNM repeater or may be the destination.

SSE (Smart Switched Ethernet) Network (Ethernet only)

Smart Switched Ethernet (SSE) configuration creates a network suitable for any communication pattern between WNMs. It efficiently determines whether to broadcast to all radios or direct to a single radio on a packet by packet basis. This encompasses PTP, PMP and E2E network topologies. Each radio is able to communicate with any or all other radios.

Suggestion: For all Model WNM networks (except Serial only first version models) specify SSE. The SSE is suitable for all Ethernet (or Ethernet with serial) applications.

WNM Configuration

The WNM radios are pre-configured at Moore Industries prior to shipping. They are also tagged to indicate where each WNM is to be installed. If no changes are required, then this section may be skipped. However, the WNM Configuration program also provides the ability to examine each existing WNM setup, edit and save the setup, and also to monitor WNM radio performance.

Note:
There are differences in Ethernet radio versus Serial only radio network types and their respective configurations. These are explained in the previous Network Type Section.

The WNM Configuration program is the software tool to design and configure the WNM communications network hardware. The network consists of a one Master radio plus one or more Remote radios. If a radio (Master or Remote) pathway is obstructed or too distant to another radio, then a Repeater radio assignment is made.

In all networks, the WNM Configuration program uses the identical radio hardware, but configures these with their respective task (Master, Remote or Repeater) plus addressing.

General Radio Configuration

Prior to configuration, have your system architecture completely documented in writing for each WNM site.

WNM radios are configured one at a time. However, once a network has been configured and successfully tested, edits may be performed on installed WNM radios at remote sites by communicating through the WNM Master radio.

Note:
There is a sequence to editing radio configurations. This editing may be performed on the bench or 'on the air' in an 'already configured and operational' communications network. Use care when editing 'on the air' to edit the furthest WNM site address (and pathway) one at a time prior to editing any intermediate sites (repeaters) or nearby sites such as the master. All sites need to 'know' through the configuration process their particular pathway back to the Master. If the Master or a repeater is configured prior to the furthest remotes, then the communication pathway addressing is incorrect (discontinuous) for the further downstream remote WNM's. This will require a field trip to program the 'now incorrectly (discontinuous) addressed' remote sites on an individual basis.

It is recommended that all WNM radio configurations be performed on the workbench and checked for successful communications prior to being deployed into the field site. Should the radio signal strength exceed -40 dBm (a very strong RF signal being received), some radio performance may be temporarily degraded such as occasional missed packets. If so, relocate the antennas, separate the radios further, or disconnect the antennas during workbench testing.

When starting a WNM radio network configuration, always begin with the Master radio. Then configure each additional radio one at a time until all radios are configured. The WNM Config program enables you to semi-graphically lay out your entire network identifying the WNM master radio, all other WNM radios, and the network links in-between radio sites. Use this same program to save your setups on a PC, recall these setups from storage memory for future editing / growth to the network, and also to download the setups from each WNM.

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Installing the WNM Configuration Program

Refer to Table 1 for the equipment needed.

1. Insert the Moore Industries Interface Solution PC Configuration Software CD into the CD drive of the PC. Access the CD and open the *WNM Configuration Tools* folder.

2. Double-click the installation program located in the folder. Follow the prompts to correctly install the program.

Table 1. *Necessary Equipment to Configure the WNM*

Device/Item	Specifications
Power Supply	12 - 24Vdc, @1Amp
Personal Computer	Microsoft Windows based PC; 300 MHz Pentium processor (or equivalent); 128Mb RAM; 20MB free disk space on hard drive; Microsoft Windows 2000, XP, Vista, 7 or newer.
For Serial WNM for Serial Only	Available serial COM port (or USB port with RS232 adapter) on PC and Cable to connect to WNM radio DB9 'CONFIG' connector (included with WNM)
For All Ethernet WNM	Ethernet LAN switch (hub) with standard RJ45 Ethernet cable; or Ethernet port with RJ45 crossover cable for direct connection to the WNM (included with WNM); A static Ethernet IP address for your computer; A static IP address, Subnet Mask and Gateway address for each WNM device you plan to install.

Connecting the WNM to the PC

Connect the computer to your WNM Master radio as follows. These same connections apply to all other WNM radios. Connect the computer to only one WNM radio at a time.

For Ethernet WNM radio (WNM/ETHERNET...):

Connect an Ethernet crossover cable directly from the laptop RJ45 connector to the WNM radio RJ45 connector.

Or;

Connect a straight Ethernet cable from the laptop RJ45 connector to an Ethernet LAN switch (or hub) and then another straight Ethernet cable from the Ethernet LAN switch (or hub) to the WNM radio RJ45 connector.

For Serial only WNM radio (WNM/SERIAL...):

The radio is a DCE device. The laptop is a DTE device. Use a straight DB9-to-DB9 serial cable between the laptop DB9 serial port and the WNM 'CONFIG' DB9 serial connector. This DB9 connector is on the same side as the RF connector.
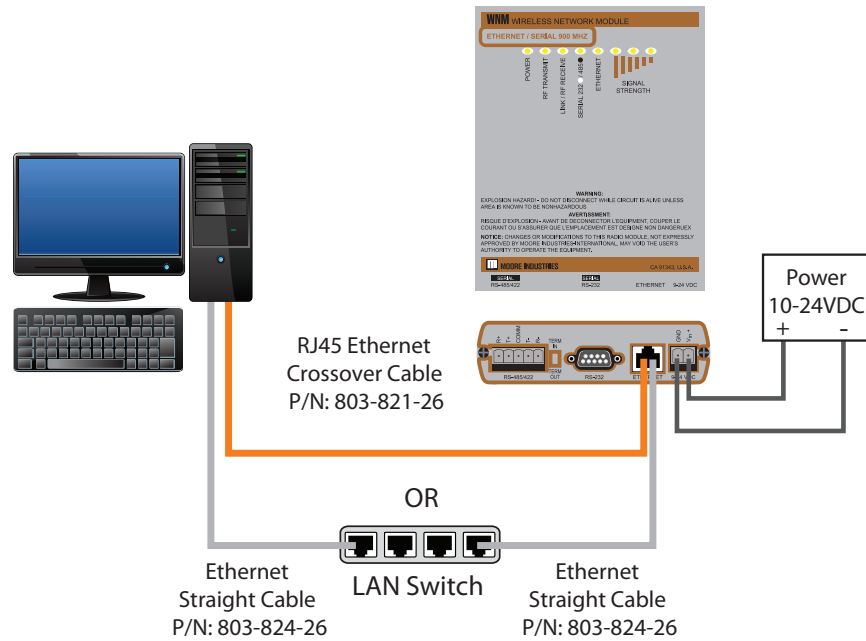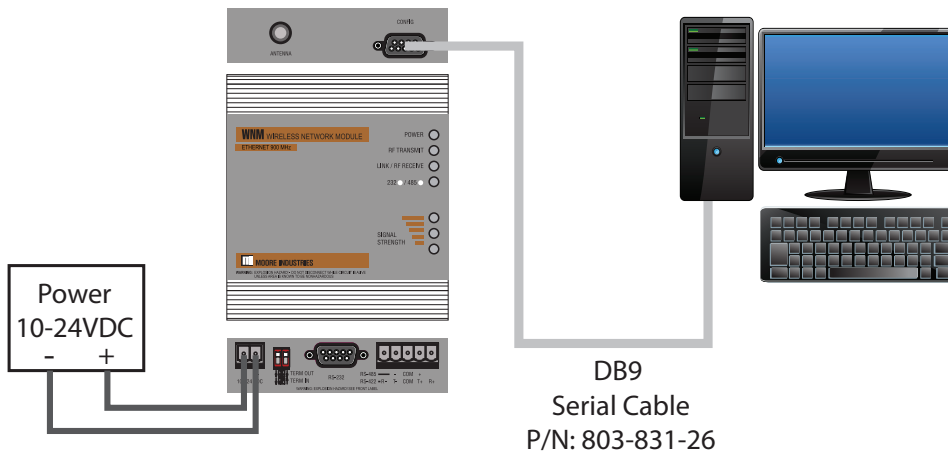
Figure 5. *Connecting WNM Ethernet radio to PC*

Figure 6. *Connecting WNM Serial only Legacy to PC*

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WNM Configuration Example

Load and run the WNM Configuration program. The following is familiarization to set up a small network and then download to the respective WNM radios.

1. Navigate to 'Configure' and click. This activates the pull down menu.
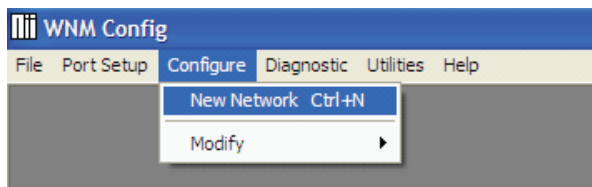
2. If defining a new radio network, then select "New Network" and click. If you have previously saved Network Configuration files, then these are available via 'Modify' and a list of saved networks will appear.
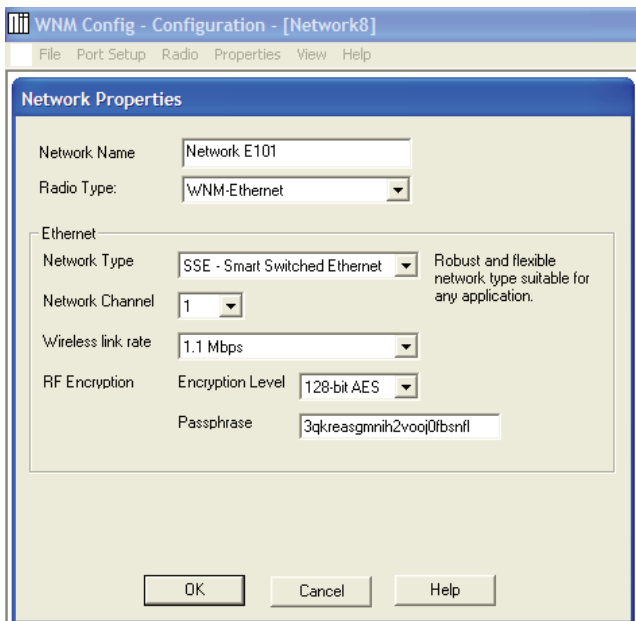
3. The Network properties screen appears.

a) Assign the 'Network Name' for this radio network. This is later saved on the laptop hard disk as the filename for this particular network. In the future, these saved networks may be retrieved via 'Configuration', 'Modify', then the network name.

b) Select 'Radio Type' using the pulldown menu. Available selections are:

   WNM- Ethernet (Legacy version or Current version)

   WNM- Serial (Legacy version only)

   Subsequent pulldown menus dynamically changed based upon your selection here. You will want to select 'IFHE' for all Ethernet Model WNM.

c) Select 'Network Type' Selection options are on a pulldown menu. For all Ethernet radios, select 'SSE-Smart Switched Ethernet'. For 'Serial only' select your preferred network type.

d) Select 'Network Channel'. WNM radios communicate on groups of frequencies labeled here as a 'channel'. If no other radio networks are operating nearby, select any channel. If multiple radio networks are operating nearby, then select a different channel for each network to minimize the risk of brief radio interference from other networks momentarily sharing the same frequencies.

e) The Wireless Link Rate is entered here. For all Ethernet radios usually the highest rate is entered. The exception is to use a lower rate to improve the signal-to-noise when communicating very long distances and thus low RF signal levels are present, or when interference from external sources is expected.

   In Serial only radios, usually the highest rate is entered. This will minimize store and forward time delays. If a noisy RF path or low level RF signals are expected, then use a lower rate. You may need to adjust this rate, based upon application experience, to minimize data delays arriving at the destination site. This Model WNM data rate is the radio-to-radio RF modem. It is not the same as the serial port (RS232/RS485/RS422) port rate.

f) RF Encryption Level is normally set at 128-bit AES via the pull down menu. Optionally you may select 'Disabled' if no encryption is desired. Passphrase is alphanumeric, upper and lower case.

g) The 'Help' button hyperlinks to the Internet version of this technical manual. The Internet version of the technical manual is always the most up-to-date.

4. Click the OK button on the bottom of the screen to accept the network. This also downloads a default template consisting of a default 'two radio' network. You can also add new radios to the network as desired.

Navigate to 'Radio'. From the pulldown menu select 'Add Radio'. 'Radio 3' appears. Use your mouse to click on Radio 3 and drag to a position below 'Radio 2'. Use your mouse to point at the black dot of 'Radio 3' and drag this point towards 'Radio 1'. This dragging defines the communications link between 'Radio 1' and 'Radio 3'. If you incur a mistake, then use the mouse to highlight the unwanted radio, navigate to the top of screen to 'Radio' and from the pulldown menu select 'Remove Radio'.
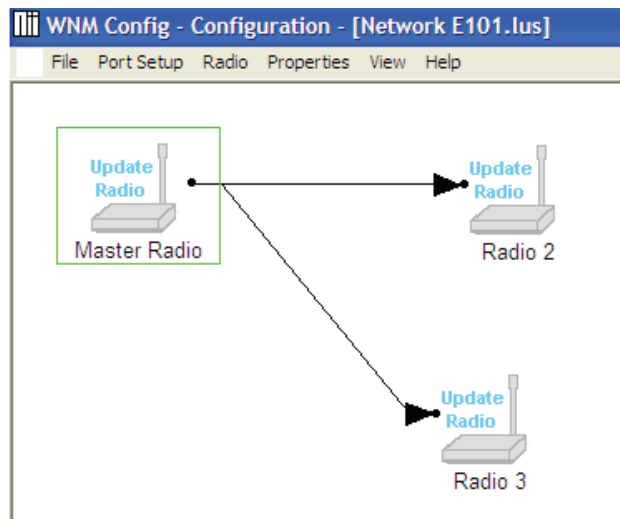
Setting Up the Master Radio

The WNM radios are designed to operate as a transparent communications link. That is, the WNM radio replaces the original Ethernet cable or serial cable that previously joined a field instrument with another field instrument or with the host DCS/PLC.

Every radio network requires one Master WNM radio plus one or more Remote WNM radios. From the above screen, navigate to 'Master Radio'.
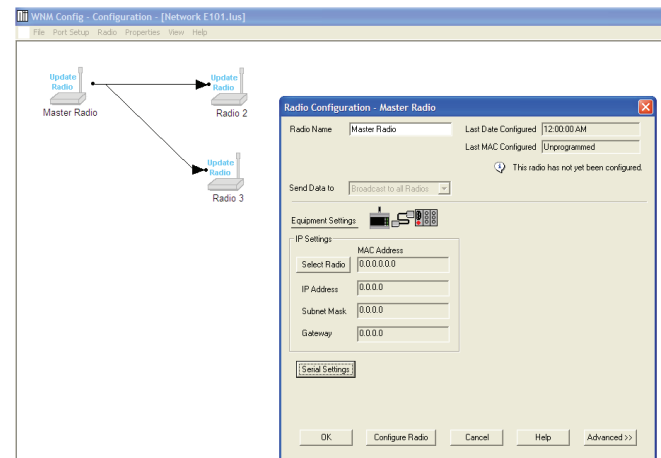
The settings of this screen are straightforward. The default settings usually apply without modification.

For the Master radio, the Ethernet IP address assigned by the IT Department for this particular network. This IP address is for this particular WNM on the network. Use this address to obtain diagnostic information for this radio. Each WNM Ethernet radio is to be assigned a different IP address. The 'Gateway' for the Master Radio is frequently its own 'IP' address. The 'Gateway' for remote WNM radios is usually the same as shown here, also shown are the 'Serial settings' options with 'Serial Protocol Encapsulation'.
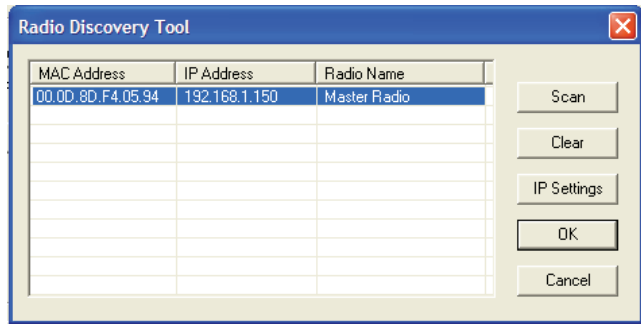
When communicating with serial, the WNM and the DTE equipment must be configured for the same serial port setups of baud rate, word length, parity, stop bits, and handshaking

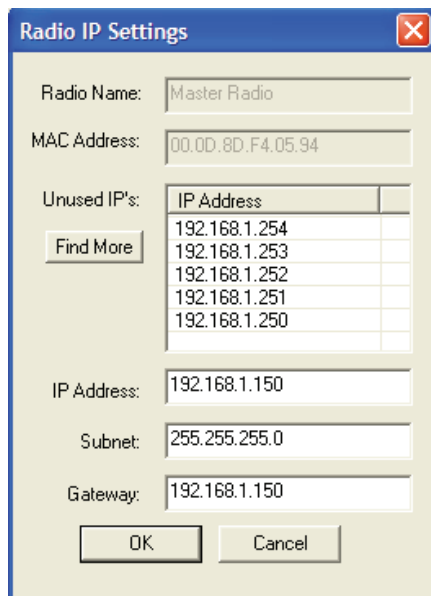Not shown here are the 'Advanced Settings'.

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With the Master Radio physically connected to the laptop computer via an Ethernet cable, press the 'Select Radio' button. The WNM Config program will perform a 'Discovery Scan' to identify what radios are interrogate the Master radio for its MAC address and initial IP address, Subnet Mask and Gateway. An example of this WNM Config scan is:

If the WNM Config program does not successfully identify the Model WNM IP address; or the 'Config Radio' button does not operate then perform the following checks:

> a) Verify the computer (or laptop) does not have a second Ethernet port already active. Your WNM Config may be attempting to communicate with a different computer (laptop) port.

> b) If on a laptop, temporarily disable the laptop 'wireless' button. This wireless button usually connects to the outside Internet.

> c) Inspect the laptop computer security programs, firewall settings and antivirus programs.

> d) Verify your own computer (laptop) Ethernet port is not already using the identical Ethernet port IP address assignment for itself or another device on this Ethernet cable.

> e) The Ethernet cable is not connected to the Model WNM, or the Model WNM is not powered to ON, or the Model WNM is not already communicating with other WNM radios in the same network (for example: configuring a Model WNM at a remote site via wireless).

If the Master radio is already operating in a network and the other radios are communicating with this Master Radio, then all radios will be listed. In the above screen, only the Master Radio is active. By pressing on the 'Clear' button, the list is erased. Use the 'Scan' button to perform a new Discovery. This is helpful if the 'Radio Name' column does not clearly identify particular radio hardware.

Upon successful identification of the Master Radio, use the mouse to highlight the desired radio. Then select IP Settings. The WNM Config program will further discover additional information and display as follows:

This is the existing IP address, Subnet, and Gateway for the Master Radio. This is the same screen to edit these three settings. Upon completion of edits, press the 'OK' button on this Radio IP Settings screen. Press 'OK' on the 'Radio Discovery Tool' screen. This returns you to the earlier 'Radio Configuration – Master Radio' screen. The Master radio hardware is not yet 'configured' with this new IP information. Press the 'Configure Radio' button to download this information to the Master Radio.
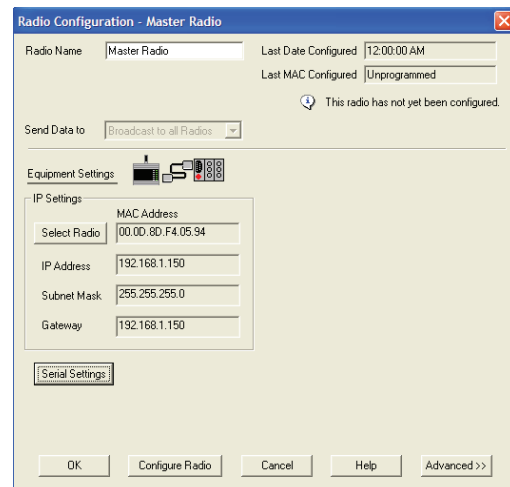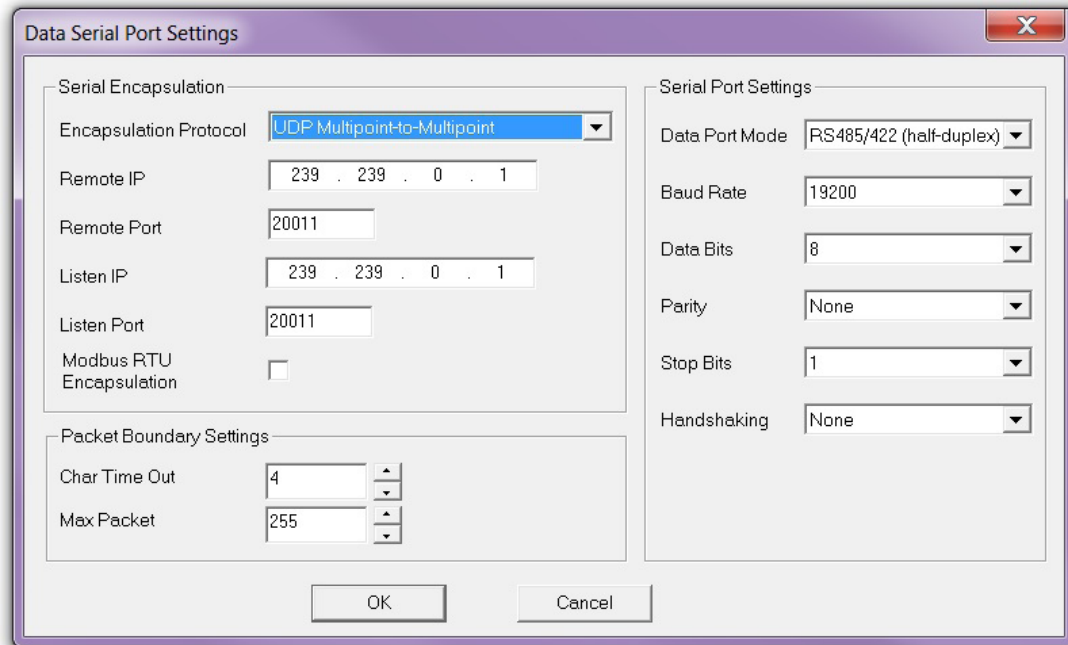
Navigate with the mouse on this screen and activate the 'Serial Settings' button. This is to configure the serial port setups on this WNM radio. Use the setup as shown here for most RS485 serial networks. You may choose to use an alternative setup including baud rates as desired for your unique application. As with any serial communication, the baud rate (parity, start bits, stop bits, etc.) of one end of a cable (radio) needs to be identical at the other end of the cable (radio). If not successful, then revert to the above setup as a starting point for most applications. It is OK to configure this serial setup now even though you may not use this until much later, or not at all.

Select the 'Advanced>>' button to display the RF power settings. Normally this is not required. Do not exceed the minimum amount of power required to provide reliable communications. Do not exceed permitted RF power (including effects of coaxial cable losses plus antenna gains) permitted in your country. The 'Broadcast' or 'Retry' identifies the maximum number of attempts for successful RF packet communications should the earlier attempts be unsuccessful. The greater this number, the slower the overall data rate, but increases the likelihood of successful data transfer in weak RF signal path such as long distance. To send these new RF setups to the Master radio, press the 'Configure Radio' button as performed in the earlier step.

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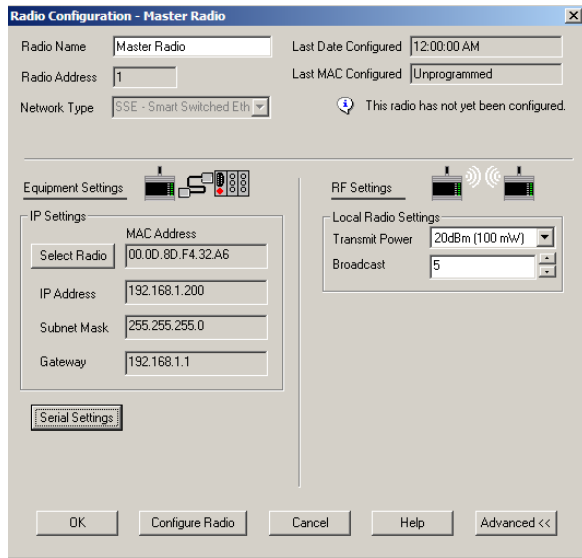
Each time the 'Configure Radio' button is pressed, the entire radio setup is sent to the particular WNM radio. A graphic bar shows progress of the download. This requires a few seconds with the bar progressing. Upon conclusion is displayed an error message or a success message.
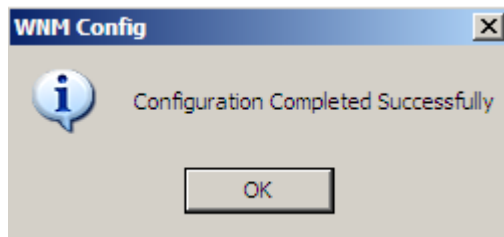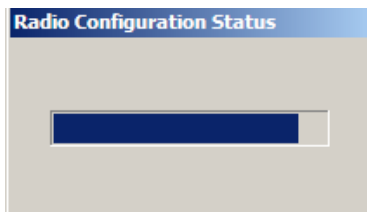


Setting Up Remote Radios

The step by step sequence to add additional radios is identical to adding the third radio as described 'Setting Up the Master Radio'. You may add as many radios as desired. The procedure to program a remote WNM radio is identical to the process for the Master radio.

Caution:
Once a radio network is established and communication exists via the radios, then edits may be made from the laptop connection via the Master Radio. If editing the IP address, use care to start with the furthest remote site and work backwards toward the Master. Otherwise the communication address path will be discontinuous, dropping communications, then it will be necessary to physically travel to each of the remote sites to correct the discontinuous address path.

Repeater Setup

To add a repeater to an existing network, use WNM Configuration and open the network file. Navigate the mouse to the Radio menu at the top of the screen and select 'Add Repeater'. A new Radio will appear with two separate black color dots. Relocate the arrow paths by navigating the mouse to highlight an existing path pointer line. Note the appearance of two small green dots on the path line. Use the mouse to grasp the green dot behind the arrow head and drag the green dot to the new location. Configure the Repeater radio in the same manner as before with the other WNM radios. In the setup field 'Radio Network Settings', check the box marked 'Use this radio as a Repeater'. Note that this is a change to the network. Thus the radios on both sides of the new Repeater will also need to have their configurations updated via their respective 'Configure Radio' buttons.
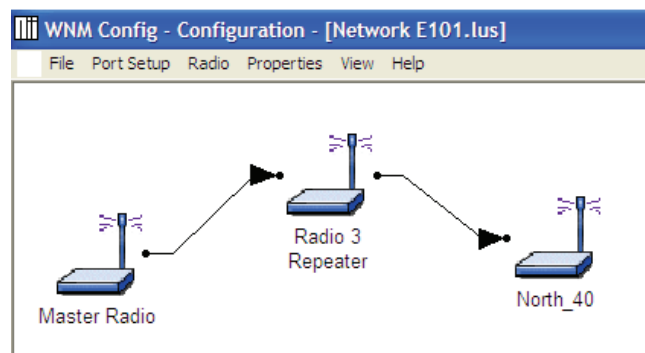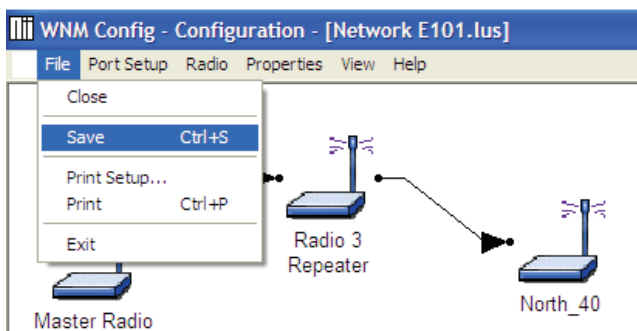
Save Configuration

To save a network Configuration, navigate to the WNM Config program 'File' pulldown menu and select 'Save'. The file is saved as identified on the top bar of the screen. The file contains the graphics and configurations of all radios. Note that it is permitted to save a network configuration file whether the individual radios have been downloaded via their respective 'Configure Radio' buttons, or not. Thus you can create one or all of the network configuration files in advance of downloading onto the WNM hardware. Once the network file is stored, its name may be edited conveniently via Windows Explorer. This may be a timesaving convenience if most networks are virtually identical to others. There is no 'Save As' feature in WNM Config'. All files are saved in the same folder as WNM Configuration program.

Loading a Network Configuration

Previously stored network configurations can be retrieved from the computer. To open a previously saved network configuration navigate to the WNM Configuration program 'Configure' pulldown menu and use the mouse to highlight 'Modify' from the pulldown menu. A list of previously saved network files will appear. Highlight and click to select.
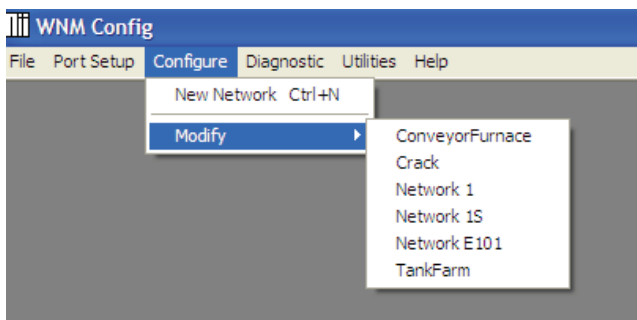
After a configuration has been edited, it may be saved.

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Bench Setup

Prior to field installation, it is recommended to test your process control / telemetry / SCADA system on the workbench. This may be a portion or may be the entire system. The WNM provides a transparent extension of the original communications media (cable). That is, if the WNM is to replace an Ethernet cable or a serial twisted pair cable for a long distance path, then for the 'Bench Setup' test you will replace a portion of the original cable(s) with a pair of WNM radios.

In an 'Intra-cabled Bench Setup' of your system, all of the site radio hardware (master, remote(s)) are usually located usually in the same room, frequently on the same work bench, thus 'Intra-bench' test. This is a communications test, so:

a) If your system is intended to be cabled via Ethernet cable:

   i) If only two points, use an Ethernet Crossover cable between the two sites;

   ii) If multiple sites, then use straight Ethernet cables and a LAN switch.

   ii) If repeaters, then use straight Ethernet LAN cables and an Ethernet LAN switch at each repeater site.

b) If your system is intended to be cabled via twisted pair serial cable:

   i) Connect using twisted pair cable between/ among sites;

   ii) If repeaters are required, then use a twisted pair (RS485 or RS422) repeater.

1. Power up our system in the normal manner.

2. Confirm each part of the system has proper addressing (plus baud, parity, etc, as appropriate).

3. Originate a communications signal at one site. Monitor for its appearance on the other site.

4. Check led activity for each communications port. Verify that all sites are communicating.

5. Make corrections as required. Use troubleshooting tools available for each piece of site equipment, as necessary.

6. Obtain successful communications using the 'hard wired' cables (Ethernet or serial) on your 'Intra-cabled Bench Setup'.

You have verified a successful communicating on your 'Intra-cabled Bench Setup' using hard communications cables.

The next step is to perform a 'WNM Inter-Bench Setup'. This replaces the above long cables between sites. The new cables are short, and connect the process electronics to the local site WNM radio and the WNM antenna. The coax cable and out-of-doors antennas are not yet installed. Each site repeats this process. The WNM radios are pre-configured to operate as a radio network. The WNM provides the 'transparent' communications links to its counterpart WNM radios throughout the radio network system.

For the 'WNM Inter-Bench Setup' the short flexible antennas provide sufficient communications distance on the bench. When replacing the earlier bench cables with the 'short cables', please note the following:

a) If Ethernet communications are used at a site, then connect from site electronics to its own WNM RJ45 port using a crossover Ethernet cable. We suggest the 'actual' Ethernet cable that will be used in final installation. Repeat for each site.

b) If your sites use Ethernet LAN switches in its communications link path, then use regular Ethernet cables with your ethernet LAN switch. Connect from the Ethernet LAN switch to your WNM with a regular Ethernet switch. When practical use cables that are intended to be installed in service. Repeat for each site.

c) If using serial cables are used, then use the actual serial cables planned for the site to the WNM radios. Repeat for each site.

1. Recall the use of properly 'tagged' WNM at each site. If not sure of WNM setups, refer to Programming Section to obtain (or edit) WNM setups. Contact the Moore Industries support personnel and specify your project and serial numbers to obtain factory records of factory WNM setups.

2. Power up equipment in the normal manner.

3. Simulate a data signal at one site. Monitor for its appearance on the other site.

4. Check led activity for each communications port and verify that all sites are communicating. (see Operation Section for LED information)

5. Make corrections, as required, on the WNM or on the site electronics. Use troubleshooting tools available for each piece of site equipment, as necessary.

6. Obtain successful communications using WNM radios and interconnect cables on your 'Bench Setup'.

Installation

Important Safety Information
The statements contained in this section are required. Should these radios be included as part of a larger system package or be separated from this technical manual, then the following statements are to be included in the documentation that accompanies the radios.

Special Conditions of Use
This equipment is suitable for use in Class I, Division 2, Groups A, B, C and D and suitable for use in non-hazardous locations. Refer to the Certificate for details.

The equipment must be used in an enclosure that provides IP54 protection and requires a tool to access the enclosure.

External circuits must be provided with transient protection limiting the maximum voltage to no more than 40% above the maximum circuit rating.

WARNING:
Explosion Hazard
Substitution of any components may impair suitability for Class I, Division 2.

WARNING:
Explosion Hazard
Do not connect or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

WARNING:
Possibility of Lethal Voltages
Installation of an antenna, antenna structures and cables in the vicinity of power lines is dangerous and potentially lethal. Follow all safety instructions.

WARNING:
Local and National Government guidelines limit the effective radiated RF energy. Moore Industries will assist in calculating the correct radio power, antenna gains and RF cable losses for your particular installation.

In the event of accidental contact with electrical wires during installation or any future time, lethal voltages may be become present on antenna, structures, cables, and on wiring entering building. Assure cabinets are all grounded properly.

Do not connect or disconnect antenna or any other related cables during electrical storm weather in the vicinity. Always verify for the presence of electricity on all cables prior to connecting or disconnecting cables.

CAUTION:
Surge Protection Lightning / surge protection devices must be installed according to local building codes and practices. These usually require the protection devices be mounted on the cable as it enters the building/structure and be accompanied by a suitable, short length, well grounded earthing wire at that point. Follow all lightning / surge protection safety instructions.

NOTE:
Building Codes, Practices and Certifications
Please review and comply with all national, state and local building codes, building practices, site practices, the instructions for individual items and also Certifications issued to hardware items and their installation/ use. This technical manual is to inform you on general installation guidelines and is not intended to supersede any authoritative bodies or documents. Your specific application may be governed by different guidelines unique to your site.

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Industry Canada Requirements

The Model WNM is factory configured with standard antennas to be at or less than the maximum RF power allowed. Use of higher gain antenna is strictly prohibited. The antenna impedance is 50 Ohms.

To reduce potential interference to other users, the antenna type and its gain should be chosen such that the equivalent isotropically radiated power (EISP) is not more than that required for successful communication.

The installer of this equipment must insure that the antenna is located or pointed such that it does not emit RF field in excess of Health Canada limits for the general population. Consult safety Code 6 obtainable from Health Canada.

FCC and Canada IC Compliance

The Moore Industries-International WNM radio module is labeled with an FCC ID number and a Canadian Certification number. If this label is not visible when installed on an end device, the outside of the device MUST also display a label referring to the enclosed WNM device. For the corresponding WNM radio model, use wording on the label similar to the following plus include the text of the 'NOTICE' statement:

For Legacy version.

> WNM-9S: Transmitter Module FCC ID: OQ7OS2400 CANADA IC: 36561031989A

> WNM-24S: Transmitter Module FCC ID: NS907P22 CANADA IC: 3143A07P22

> WNM-9E: Transmitter Module FCC ID: NS906P21 CANADA IC: 3143A06P21

> WNM-24E: Transmitter Module FCC ID:NS907P23 CANADA IC: 3143AO7P23

For Current version.

> WNM-9E: Transmitter Module FCC ID: NS908P25 CANADA IC: 3143A-8P32

> WNM-24E: Transmitter Module FCC ID: NS908P25 CANADA IC: 3143A-8P32

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

> this device may not cause harmful interference, and,

> this device must accept any interference received, including interference that may cause undesired operation.

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

NOTICE
Changes or modifications to this radio module not expressly approved by its manufacturer, Moore Industries-International, may void the user's authority to operate the equipment.

Antenna Spacing – User Safety Requirements

The radio antenna shall be located so as to keep the radiated signal away from personnel. This is a safety requirement. To meet the requirements of FCC Part 2.1091 for radio frequency radiation exposure, the radio must be used in such a way as to guarantee a minimum of 20cm separation from the antenna and personnel. Greater distances are required for high-gain antennas. The energy is greatest at the antenna itself and diminishes rapidly as distance is increased. The FCC requirement is to not exceed RF energy exposure of 1 mW of RF energy per square centimeter to personnel. By mounting the antenna 20cm or further away, from personnel this is normally achieved.

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

EU and International Requirements

Check with local/national rules prior to ordering radio module. Each country may vary in regulations. Notify Moore Industries-International, in advance, if your application may require specific regulations and/or restrictions to comply or to avoid interference.

1. For outdoor use, France has a frequency restriction of 2.4GHz to 2.454 GHz for an output power greater than 10mW and below 100mW.

2. For outdoor use in France, the output power is restricted to 10 mW in the frequency range of 2.454 to 2.4835 GHz.

3. Each country and some regions have limitations on frequency band segments, power levels, and indoor versus outdoor antenna installations. Consult local requirements.

Field Installation

On successful completion of bench testing, move the WNMs into their final (permanent) enclosures. Replace the short flexible antennas on the WNMs to their coaxial cables, surge suppressors and antennas. The short antennas should be safely stored (for future maintenance purposes, as desired). Verify the correct WNM radios (refer to factory tags regarding Master and various Remotes) are installed at their correct sites.

Location of WNM radio

The best location for the WNM radio is physically near the antenna. A suitable location should be at a reasonable height convenient for personnel to permit routine installation and maintenance. The enclosure for the WNM should be appropriate for the environment.

If the antenna is mounted external to the building, the entrance point for the coaxial cable into the building should include a surge protector mounted in a suitable enclosure at the building entrance point and accompanied by an earthing wire with ground rods. The WNM may be mounted near this surge protector. Consult local building codes for surge protection entrances.

The goal of mounting the WNM as close as reasonably practical to the antenna is to minimize loss of radio signal strength via the RF coaxial cables. Ethernet or serial twisted pair cables have negligible signal loss and lower cost per foot of cable when compared with any RF cable. Thus locating the WNM at a point closest to its antenna each site provides for a short RF coax cable (greater signal strength) without increasing actual RF power or using larger antennas.

When installing the WNM in hazardous areas, verify compliance to manufacturer installation instructions and local building codes. This includes the use of properly sized enclosures, enclosure ingress protection (IP) rating, a properly certified hazardous area power supply and appropriate wiring practices to comply with building codes.

Grounding

The WNM metal case is connected to its DIN rail. It is recommended that the DIN rail be connected to earth ground. This is the same recommendation for grounding of any metal case instrument. This is a safety good practice and also provides a path for stray RF signals to be shunted to earth ground.

The WNM RF coaxial cable shield, metal connector shells and power supply GND are connected to the WNM case.

WARNING:
When connecting any external cables (RF coax, communications shield, power supply GND) to WNM or any device or enclosure, use care that these cables are already properly isolated or grounded. If the cable is carrying a floating voltage, this may introduce LETHAL ELECTRIC SHOCK to personnel. It will also introduce an undesirable ground loop current. DO NOT USE THE WNM INTERNAL CIRCUIT TRACES AS A GROUND JUNCTION BLOCK TERMINAL. Instead use a properly grounded electrical path on such cables.

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The following WNM connectors are interconnected via a low impedance path. Exercise care to prevent introduction of ground loop signals/current when connecting WNM with cables and power supplies. If voltage is present on these connectors, then use suitable isolation devices.

> DB9: shell, mounting studs, and pin 5
> RS485/422: COM
> RJ45: shell
> RF SMA-RP: coax shield
> Power Supply: minus (-)

WNM Accessories
For your WNM applications antennas, surge protectors and RF coaxial cable use Type N connectors. A short adapter cable connects the WNM RF connector (SMA-RP) to the RF coaxial cable with Type N male connectors. If it is desired to extend cables, use Type N female-to-female barrel bulkhead connectors between long cable lengths. There is no change to the radio or to antenna tuning if coax cable overall length is changed. Always use low loss 50 Ohm coax suitable for frequency range (900 MHz or 2.4 GHz). Increasing coaxial cable length and using low efficiency (usually smaller diameter) 50 Ohm coax will increase RF losses resulting in reduced RF communications distance and reduced receive sensitivity. Do not use 75 Ohm coaxial cable, the transmitted RF signal strength and received signal strength will both be degraded.

For best installation, always comply with the instructions included with each antenna.

Antennas
Antennas for each WNM on network must be the same frequency band. It is OK to use any combination of omnidirectional antennas and Yagi antennas on the same network. Antenna mounting bracket includes 'U' bolts or pipe clamp to affix antenna to top of metal pole. Antenna accepts Type N male RF connector/coaxial cable.

The recommended installation location for the antenna is a physically highest point such as atop a mast/pole at the top of a building or tower. In any case, the antenna should ideally have a straight line of site from its antenna to the distant antenna(s) at other locations. At a minimum, the antenna needs to be located above and away from any fixed and temporary obstructions (including possible large trucks passing). The antenna should be above any other building rooftops in the RF signal path to the other antenna(s). The higher the installed location of the antenna, then the fewer opportunities for the RF signal to reflect from nearby

surfaces to degrade the overall RF signal strength.

If multiple antennas are co-located at the same location, it is preferred that antennas be located above or below the other antennas by as much vertical distance as practical. This will minimize the interference cross-coupling of antenna signals and also retain received signal strength.

Vertical polarization is preferred in most applications. Horizontal polarization may be used in special installations to reduce interference from nearby vertically polarized antennas. All antennas are secured to a vertical pipe using 'U' shaped brackets or clamp bands.

Antennas are available in different gains. An antenna with increased gain is generally recommended to offset the losses of RF coaxial cable and to increase effective radiated power for improved communications range. Note the local and national government guidelines limit the effective radiated RF energy. Moore Industries will assist in calculating the correct radio power, antenna gains and RF cable losses for your particular installation.

For more information on antenna selection please see Appendix A.

Surge Suppression

There is always a possibility that a lightning strike will introduce high voltage and high current onto the coaxial cable. The purpose of the coaxial cable surge suppressor and its earthing wire is to divert this high energy from entering the building where equipment is housed.

WARNING:

The coaxial cable surge suppressor is a 'building code' requirement to minimize the chance of a lightning strike from entering the inside of a building. This is a personnel and equipment safety issue. A properly installed RF coaxial cable surge protector with proper earthing is a very low cost protection for both personnel and equipment. As with any lightning event, use proper additional safety precautions for safety.

Please follow electrical and local building codes during installation. It is normally good practice for the out-of-doors process controls and protected equipment to be in a suitable enclosure with the surge suppressor properly mounted and grounded as the coaxial cable enters the wall of the enclosure. However always consult local and national codes and practices. However, if the process control and protected equipment are inside a building, then a second surge suppressor should be installed at the coaxial cable entrance to the building to prevent the high energy from entering the building.

Power Supply

Power supply should be 10 V to 24 Vdc, regulated. For RFI suppression, install a ferrite bead on power supply cable adjacent to WNM power supply connector. Power supply cable length should not to exceed 3 meters (9 feet) length.

NOTE:

Power must be provided from NEC Class 2 Circuit or a Limited Power Source.

Other items

Items such as antenna structures (poles, towers, custom brackets to secure to buildings), ground rods, ground clamps, cable ties and enclosure glands are normally not included from the factory. These are routinely purchased locally to match your custom installation. Check with your local building and safety codes for guidance/restrictions suited for your particular facility.

Operation & Diagnostics

Establish confidence in your communications system. Verify it is providing you comparable communications performance to hard cabled Intra-bench setup tests.

If there are problems please note all LED status indicators and contact Moore Industries technical support.

Radio LED Status Indicators

The Ethernet and Serial radios have readily visible front panel LED (Light Emitting Diode) indicators as to the status of the radio.

With no power applied, all LED indicators are dark.

Upon application of DC power to the radio, the 'POWER' LED illuminates and remains steady green color. The radio starts an internal initialization sequence for several seconds. During this time the RF Transmit and RF Receive should blink.

LED	Description
Power	Dark = No Power. Green LED (solid) = Input power supply is applied.
R/F Transmit	Yellow led indicates brief RF transmission.
Link/RF Receive	Green led = RF reception
Ethernet*	(Ethernet radios only) Green led = Ethernet cable is connected to a device. Momentary dark flash = Ethernet activity
232/485	Yellow led = RS232 signal levels are configured. Dark = RS485 signal levels
Signal Strength	3 Green leds identify that the radio is linked and the signal strength from weak to strong. 1 being weakest and 3 strongest. If RF strength is " in-between" then the RF strength is lower than the uppermost blinking led. Remote or Repeater Radios Only : If the radio is not linked, the signal strength leds will illuminate one at a time and repeat.

*Ethernet led is not present on Legacy "Serial Only" Models

**Figure 7.** *WNM Front Panel LED Layouts*

LEGACY
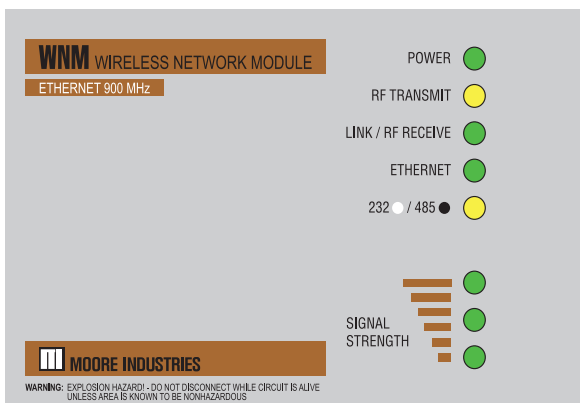
CURRENT
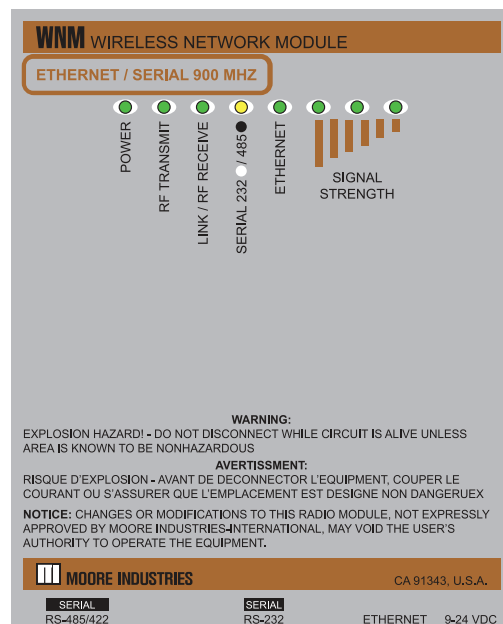
Diagnostic Tools
(WNM Ethernet only)
Additional diagnostic tools are provided for the Ethernet version of the WNM by the PC Configuration program. For set up of the program please see Installing the WNM Configuration Program section.

Verifying Communication
The WNM radio network performance may be verified that the radios are configured and communicating with each other. This uses the Diagnostic pull down menus. To access the 'Diagnostic' pull down menu, you want to first exit from the 'Configure' menu.

Use the WNM Configuration program to view the various network radio link paths. To see this graphically, the network may be presented as radios plus their respective links. Each link is color coded. Navigate to the Diagnostic menu, highlight the 'Network' pulldown menu, and select your specific network connected to the WNM communications port.
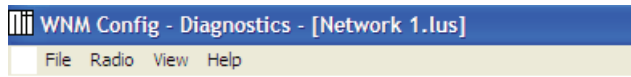
Note The color of the arrow in-between radio sites. Solid lines in green color indicate good communications. Broken lines (dashed with red color) identify broken pathways.

Signal Strength
From the above screen, use your mouse to navigate to any of the radios. Double click on the desired radio.
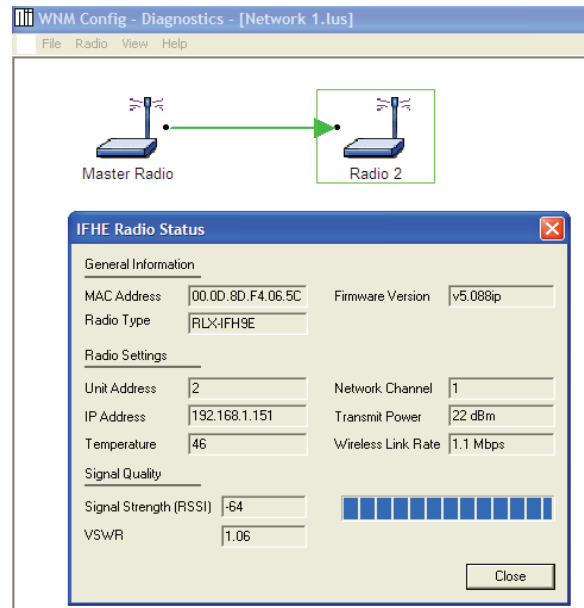
The graphic above illustrates that 'Radio 2' is selected. This activates a pop up screen, that identifies important parameters for 'Radio 2' . These include general information, radio settings, and signal strength between the Master Radio and 'Radio 2'. The VSWR parameter is not availible in the Current version models.

This may be repeated for any additional radio on the network.

Spectrum Analyzer (WNM *Legacy* 900MHz model)
The WNM Ethernet radios provide an additional diagnostic tool suitable for a site survey and to investigate the possible source of a new interference signal. The Spectrum Analyzer is actually a subroutine within each **Legacy** Ethernet 900 MHZ version radio. This in no longer a supported diagnostic tool on the Current Models.

Note:
The Spectrum Analyzer should be used only during scheduled maintenance times since the analyzer uses considerable 'process time' that would usually be used to communicate routine network data transfers. To use the Spectrum Analyzer on any specific radio you must connect an Ethernet cable from your PC (running the Spectrum Analyzer) directly into the radio under test.

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If the Spectrum Analyzer identifies a particular 'non-network' RF signal as being usually strong from another network, this would indicate a desire to reposition antennas, reposition the 'other network' antenna, or to reassign the channels between (among) networks.

To see this graphical Spectrum Analyzer presentation, navigate to the Utilities menu and select 'WNM-E Spectrum Analyzer'.
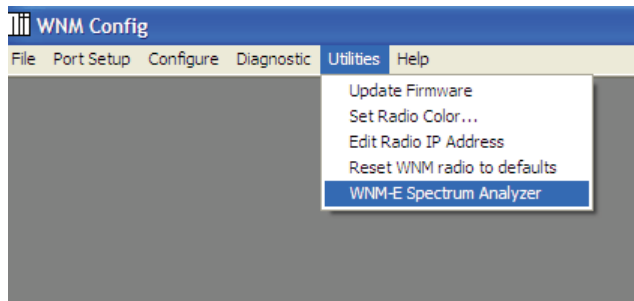

Next, use your mouse to navigate to the 'Select Radio' button and click. This will require a few seconds as the WNM Configuration program scans for all of the Ethernet radios on this network. Select the desired radio from the network and press the 'OK' button. This process will likely be repeated for each radio site to be investigated. The pull down menu selections is similar to:

Next, press the 'Open' button to activate the Spectrum Analyzer. The Spectrum Analyzer subroutine requests a User name and Password. Please enter the default User name of "admin" and Password of "admin" for these two requests. Then press the 'OK' button.
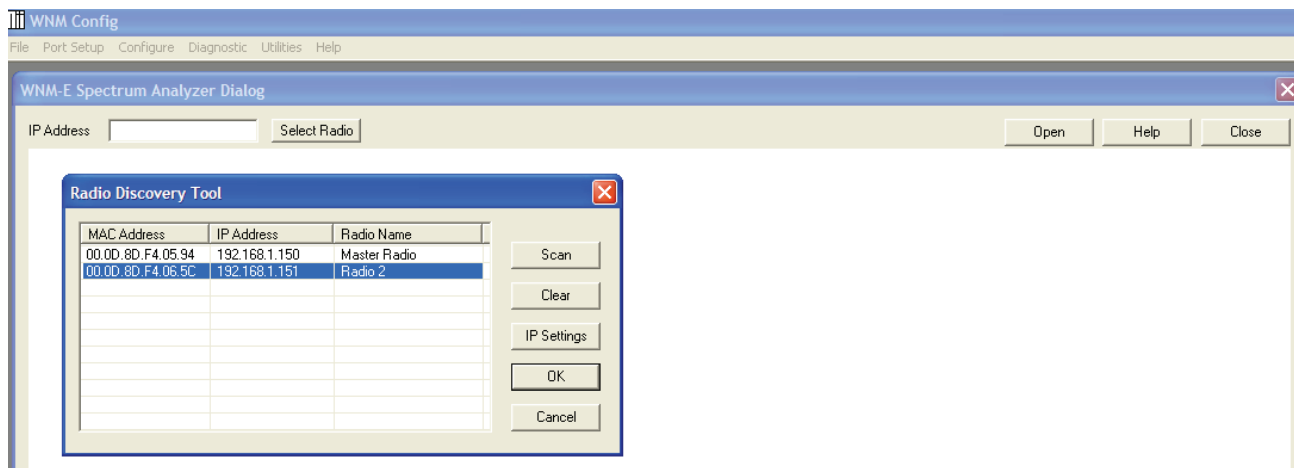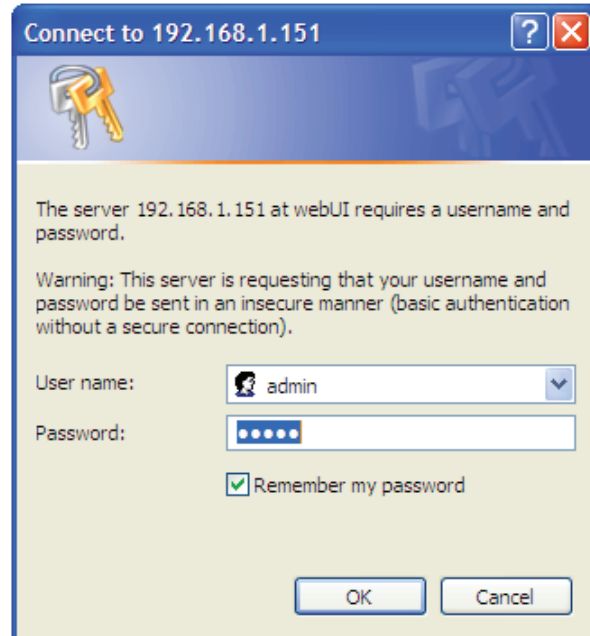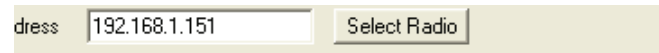
This activates the Spectrum Analyzer. The screen display indicates received signal activity. Note that we are using spread spectrum so not all RF signal channels are in use at all times for our particular network. However, there are other radio services and other electrical equipment that also share this band and may use RF signal bursts on a more continuous basis than our own network. This Spectrum Analyzer may be used to assist in an RF site survey to determine other RF spectrum transmitter signals in the vicinity of this radio site. The screen displays the presence, of such signals as well as relative signal strength. This screen is updated every few seconds. You may want to take a screen shot of the graphics for a comparative interpretation of the RF spectrum. It is desirable that the signal strength of the WNM network be 10dB (or higher) greater than other RF signals to obtain optimum transmissions.
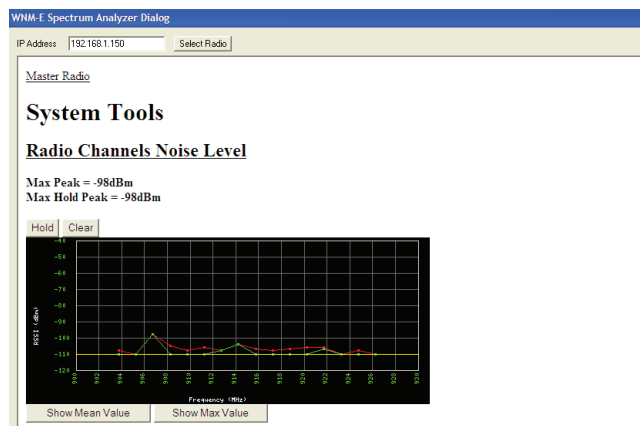
The above displays the spectrum at this radio site with the aid of numeric fields and color coding. We use spread spectrum technology, so it will operate successfully, even with an occasional missed packet.

We should now inspect both the 'Mean values' and also the 'Max Values'. Both are of importance. The graphics are interpreted as follows:

IP Address: This particular radio site.

Max Peak: Highest level of received signal at this instant in dBm.

Max Hold: Highest level of historically received signal in dBm. Since 'Hold' button activated.

Hold: Activates the red color graphic. Shows historical peak signal received.

Clear: Deactivates the red color graphic and disables historical peak (Max Peak = Max Hold)

Show Mean Value: Mathematical average of received signals per frequency over reporting period.

Show Max Value: Highest recorded signals per frequency over reporting period.

RSSI: Receiver Signal Strength Indication in dBm.

Upon conclusion of Spectrum Analyzer activities, 'Close' the Spectrum Analyzer. This will permit normal network communications activities through the radio.

Password
There is both encryption and password protection. It is your own responsibility to record and track these entries. From the factory, the Spectrum Analyzer uses a default name of: 'admin' and a password of: 'admin'.

Customer Support

Moore Industries is recognized as the industry leader in delivering top quality to its customers in products and services. We perform stringent quality assurance checks on every unit we ship. If any Moore Industries product fails to perform up to rated specifications, call us for help. Our highly skilled staff of trained technicians and engineers pride themselves on their ability to provide timely, accurate, and practical answers to your process instrumentation questions.

Factory phone numbers are listed on the back cover of this manual.

If problems involve a particular module, there are several pieces of information that can be gathered *before you call the factory* that will help our staff get the answers you need *in the shortest time possible*. For fastest service, gather the complete model and serial number(s) of the problem unit(s) and the job number of the original sale.

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Appendix A-Antenna Selection

Antennas have the following properties. This is important in the selection and installation for your particular application.

a) All antennas are always frequency sensitive. That is, an antenna optimized for the 900 MHz band will not operate properly on the 2.4 GHz band, and vice versa. An antenna on the incorrect band will actually reduce its own transmitter RF output power, cause the radio to radiate increased transmitted RF noise that may interfere with other electronic devices, increase receiver signal noise, decrease receiver signal sensitivity, and likely violate country RF emissions standards.

b) Antenna length is a function of natural frequency. A 900 MHz band antenna is longer than the identical 2.4 GHz band antenna with the same gain. However, physical dimensions are not always a true indicator of antenna frequency and antenna gain. This is due to factory manufacturing and tuning methods which alter the natural antenna length and characteristics. Always identify an antenna by its model number.

c) Antenna gain may be increased by increasing the length of the antenna, by adding elements to the antenna, by adding a reflector, and other methods. Antenna construction needs to be performed by specific formulas and laws of physics else degraded antenna and radio performance will occur. The factory recommended antennas already are manufactured to maintain correct impedance, polarization, and directionality for the desired frequency band.

d) All WNM radios, coax, RF surge accessories and antennas use 50 Ohm impedance. No tuning of antenna, coax, RF accessories, or radio is necessary if 50 Ohm impedance in the RF pathway is maintained throughout.

e) Antennas with increased gain may be used to offset some of the RF signal loss within long coax cables. However, do not exceed the overall emitted RF power permitted for your country/location/application by using an antenna with excessive gain. Good practice requires the RF signal strength not exceed that which is necessary for minimum reliable communications.

f) Antennas are intended to be mounted above all obstructions of any type. This is to assure the antenna 'sees' only clear space nearby in all directions, plus 'sees' clear space all of the way to the distant (destination) antenna. This includes the RF signal clearing tall buildings, parked vehicles, power lines, other antennas, and natural obstructions such as vegetation and terrain. Any interfering items that the antenna and RF pathway 'sees' (or reflections from) will degrade the desired antenna performance and RF signal transfer. Plan your antenna placement and RF pathway to always be a 'direct line-of-sight' between (among) the antennas.

g) Antennas collect radio signals from everywhere. If multiple antennas are to be co-located, then design your installation so one antenna is physically above the other by 2 meters (6 feet) minimum separation. Greater separation vertically and horizontally is better. This will minimize 'RF pickup' from the other antenna(s).

h) Antenna polarization. Omnidirectional antennas are vertically polarized, the same as on the whip antenna of an automobile. This is the most common polarization for process control communication. All other antennas on a radio network should also be installed to be vertically polarized. Exception – Should a known radio site be interfering and antenna placement does not correct the problem, then change your radio network antennas (or the other radio network) to horizontal polarization to minimize radio signal coupling. Note that commercial horizontal polarized omnidirectional antennas are very rare.

i) Antennas supplied by Moore Industries are suited for mounting atop metal poles. Such poles are readily available from any supply house. Assure the metal pole is grounded. Also assure the metal pole is not carrying electrical currents (e.g. ground for another circuit) since such ground currents will increase the receiver noise.

j) Antennas have exposed metal parts. Always follow antenna installation, wiring, grounding and all safety instructions / advisories. Lethal voltages may occur on antenna, wiring and on pathways to other electronic devices connected to the coaxial cable if an antenna accidentally falls upon nearby electrical power lines or onto other antennas.

Antenna Types

There are a moderate number of antenna types. Each has its advantage depending upon particular application. Here are the popular types for process control.

1. **Isotropic**. This is a theoretical antenna. It is not real antenna. It is for identifying a reference point for comparisons of all other antennas. Its antenna pattern is a perfect sphere. It radiates RF energy in all directions, including up and down. This is not perfect for practical reasons because usually we do not want an antenna that radiates directly upwards into space and also directly downwards into the ground. The gain of an isotropic antenna is always 0 dBi, a fixed reference value. All other antennas are real and have a higher gain a positive number above 0dBi. If comparing with a dBd (dipole antenna reference), then 0 dBd = 2.15 dBi.

2. **Non-Directional (omnidirectional).** This antenna style is most common when one site needs to communicate with multiple sites in various directions. Antenna consists usually of a single vertical rod installed pointing upwards (installed pointing downwards if mounted at the ceiling level of a building to communicate within the building). The omnidirectional antenna may have radials at its base. If so, be sure to install the radials during installation to maintain antenna 50 Ohm impedance and RF pattern. If no radials, the antenna has special internal stacking of elements and is referred to as a collinear antenna. A collinear antenna has special internal design to eliminate the need for the ground radials. Omni antennas with increased RF gain are progressively taller to accommodate added internal elements.

3. **Directional**. This antenna style is most common for the remote sites

    a) **Yagi.** Sometimes referred to as a 'beam' antenna. Similar in appearance to television type rooftop antennas. However, process control application Yagi antennas use elements mounted vertically instead television's horizontal elements. Consists of one driven dipole (RF connector to this element), one reflector behind the dipole, then a few (to many) director elements in front of the driven element. The driven elements are towards the other site antenna. Polarization is vertical, all elements in a vertical plane. The greater the number of director elements, the greater the gain and the narrower of the RF signal. The reflector side of the antenna has negative RF gain. That is, the Yagi antenna rejects radio signal from the rear direction of the antenna. This rejection is both transmit and receive. This is important to reject and to prevent interference in a particular direction on a site. Yagi antennas may have visible individual elements. At 2.4 GHz the elements are frequently enclosed in ABS plastic tubes for weatherproofing and cosmetic reasons.

    b) **Parabolic.** Small dipole antenna with a large reflector dish or open mesh screen. Has the highest RF gain and this may be required for ultra-distance applications. Has very narrow RF signal width, thus requires careful alignment of dish. Do not use when strong winds may buffet (move) the dish. The dish antenna is not common.

    c) **Panel antennas.** These are cosmetically appealing packaged antennas. These antennas appear frequently as flat panel with pair to match surround walls. These are common in office areas. These antennas are directional.

RETURN PROCEDURES

To return equipment to Moore Industries for repair, follow these four steps:

1. Call Moore Industries and request a Returned Material Authorization (RMA) number.

   Warranty Repair –
   If you are unsure if your unit is still under warranty, we can use the unit's serial number to verify the warranty status for you over the phone. Be sure to include the RMA number on all documentation.

   Non-Warranty Repair –
   If your unit is out of warranty, be prepared to give us a Purchase Order number when you call. In most cases, we will be able to quote you the repair costs at that time. The repair price you are quoted will be a "Not To Exceed" price, which means that the actual repair costs may be less than the quote. Be sure to include the RMA number on all documentation.

2. Provide us with the following documentation:
   a) A note listing the symptoms that indicate the unit needs repair
   b) Complete shipping information for return of the equipment after repair
   c) The name and phone number of the person to contact if questions arise at the factory

3. Use sufficient packing material and carefully pack the equipment in a sturdy shipping container.

4. Ship the equipment to the Moore Industries location nearest you.

The returned equipment will be inspected and tested at the factory. A Moore Industries representative will contact the person designated on your documentation if more information is needed. The repaired equipment, or its replacement, will be returned to you in accordance with the shipping instructions furnished in your documentation.

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