



MMT9000

Installation Guide

APCD-WM001-1.0

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Because some states/jurisdictions do not allow the exclusion or limitation of liability for consequential or incidental damages, the above limitation may not apply to you.

In no event will WaveRider's liability exceed the amount paid for the product.

Regulatory Notices

This equipment has been tested and found to comply with the limits for a Class B Intentional Radiator, pursuant to Part 15 of the FCC Regulations. These limits are intended to provide protection against harmful interference when the equipment is operated in a residential environment.

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. However, there is no guarantee that interference will not occur in a particular installation.

Notice to User

Any changes or modifications to equipment that are not expressly approved by WaveRider may void the user's authority to operate the equipment.

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Preface

Conventions

The following conventions are used throughout this document:

WARNING!



Whenever you see this icon and heading, the associated text addresses or discusses a critical safety or regulatory issue.



CAUTION: Whenever you see this icon and heading, the associated text discusses an issue, which, if not followed, could result in damage to, or improper use of, the equipment or software.



TIP: Whenever you see this icon and heading, the associated text provides a tip for facilitating the installation, testing, or operation of the equipment or software.

Regulatory Notices

This device has been designed to operate with only the antenna types listed in this manual. This device has been tested using unshielded Ethernet CAT-5 cable.

There can be no modifications made to the MMT9000 or its antennas without the express permission of WaveRider. Failure to comply may void the user's authority to operate this equipment in accordance with FCC regulations.

Federal Communications Commission

The MMT9000 has been designed and manufactured to comply with FCC Part 15.

Operators must be familiar with the requirements of the FCC Part 15 Regulations prior to operating any link using this equipment. For installations outside the United States, contact local authorities for applicable regulations.

The FCC ID for the MMT9000 equipment is OOX-MMT9000.

The transmitter of this device complies with Part 15.247 of the FCC Rules.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Interference Environment

Operation is subject to the following conditions:

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

Operational Requirements

In accordance with the FCC Part 15 regulations:

1. The maximum average power output of the intentional radiator shall not exceed one (1) watt (30 dBm) for all spread spectrum systems operating in the 902 to 928MHz band.
2. Stations operating in the 902 to 928MHz band may use transmitting antennas of directional gain greater than 6dBi, provided the average output power from the intentional radiator is reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.
3. The operator of a spread spectrum system and the user of the radio device are each responsible for ensuring that the system is operated in the manner outlined in [Interference Environment](#) on page ix.

The MMT9000 with its certified antenna complies with these requirements.

Warnings and Advisories

General Advisory

Installers, operators and maintenance personnel must be familiar with the related safety requirements before they attempt to install or operate the MMT9000.

It is the responsibility of the operator to ensure that the public is not exposed to excessive Radio Frequency (RF) levels. The applicable regulations can be obtained from local authorities.

WARNING!



To comply with FCC RF exposure limits, the MMT9000 mobile antennas must be mounted to provide a separation distance of 20cm (8 inches) or more from all persons. The MMT9000 panel antenna must be mounted to provide a separation distance of 30cm (12 inches) or more from all persons. The distance is measured from the nearest point of the antenna to the human body.

WARNING!



The MMT9000 is only to be installed by qualified professional installers, who are familiar FCC regulations and with installing radio transmission equipment, especially in vehicles. The installer must be familiar with all installation procedures and restrictions contained herein.

Important Safeguards

WARNING!



CAUTION: To reduce risk of electrical shock, do not remove covers, since there are no user-serviceable parts inside. Refer servicing to qualified personnel.

1. Read all these instructions before installing and operating the MMT9000.
2. Retain these instructions for future reference.
3. Heed all warnings on the MMT9000 and in these instructions.
4. Follow all instructions.
5. Disconnect MMT9000 from its power source before cleaning. Clean only with a damp cloth.
6. Use only attachments recommended by WaveRider.
7. The metal housing protects the MMT9000 from overheating to ensure reliable operations. Do not cover the MMT9000. Although the MMT9000 has been rated for a wide range of temperatures, it will perform better and longer if proper ventilation is provided.

8. Operate the MMT9000 only from a 13.8 VDC (+/-25%) power supply, such as a standard vehicle power system. Using other voltages, such as 24 VDC or AC power, can result in damage to the MMT9000.
9. Use the fuse assembly provided to protect the MMT9000 from power surges in the vehicle power system as well as protecting the power system from short circuits in the MMT9000 or its power cable.
10. Route the Power-supply cable, Ethernet cable and Antenna cable so that they are not likely to be walked on or pinched by items placed upon or against them, paying particular attention to cord and cables at their plugs, convenience receptacles and the points where the cords exit the equipment.
11. Provide strain relief for cables near their connections. This is typically done by leaving a loop in the cable near the connection.
12. Do not locate the MMT9000 in the vicinity of power lines or other electric light or power circuits, or where it can fall onto such power lines or circuits.
13. For added protection during a lightning storm, or when it is left unattended and unused for long periods of time, unplug the MMT9000. This will power down the MMT9000.
14. Never push foreign objects of any kind through openings (e.g. Ethernet jack) in this wireless product as they may short-out parts that could result in a fire or electric shock and damage the unit.
15. The MMT9000 is a rugged unit that can tolerate a wide range of environments if installed correctly, but it is not rated as being submersible nor immune to all liquids from all directions. If the MMT9000 may experience rain, then mount the unit so that the rain does not fall on or drip directly onto the connector endplate.
16. Do not attempt to service this wireless product yourself. Refer all servicing to qualified service personnel.
17. Unplug the unit and refer servicing to qualified service personnel under the following conditions:
 - When the power supply cord or plug is damaged.
 - If the MMT9000 does not operate normally for an extended period of time when following the operating instructions. Note that it is possible that Internet traffic can be slow even under normal operations due to network congestion and radio interference and fading and not as result of problems with the MMT9000.
 - When the MMT9000 exhibits distinct changes in performance. This may indicate a need for service.
18. When replacement parts are required, be sure the service technician has used replacement parts specified by WaveRider or with the same characteristics as the original part. Improper substitutions may result in fire, electric shock or other hazards.
19. Upon completion of any service or repairs to this wireless product, ask the service technician to perform safety checks to determine that the wireless product is in proper operating condition.

20. Install the MMT9000 in compliance with local and national electrical codes where applicable. The following are the national codes. The installer is responsible for knowing the appropriate local codes.

- In the United States, use the National Electrical Code (NEC);
- In Canada, use the Canadian Electrical Code, Part 1, CSA C22.1;
- In other countries, use International Electrotechnical Commission (IEC) 364, part 1 through 7.

Revision History

Date	Revision	Description
July 2005	1.0	Initial Release Version

Customer Support

An extensive knowledge base is available at www.waverider.com.

WaveRider offers a complete training program. Please contact your sales representative for training information.

WaveRider also offers priority telephone and email support. Please contact your sales representative for details.

1

Introduction

The WaveRider MobileWAN family of wireless systems enables mobile, field deployable wireless access networking and operates in the 900 MHz ISM band. The MobileWAN consists of a base station and a mix of multiple fixed subscriber terminals and mobile subscriber terminals. The MobileWAN system comes fully configured as a basic system to provide high-speed data services. With optional components, the WaveRider MobileWAN has the capability to provide enhanced telephone service via an IP PBX, as well as security video and short message text services. The system connects to all standard IP and telephony networks using standard interface protocols.

The basic components of the MobileWAN system include:

1. MBT9000 - MobileWAN Base Terminal
2. MFT9000 - MobileWAN Fixed Terminal
3. MMT9000 - MobileWAN Mobile Terminal

Figure 1 MMT9000 MobileWAN Mobile Terminal



The MMT9000 is the first component of the MobileWAN family to be released. The MMT9000 is a rugged vehicle data-radio that provides Ethernet access to the IP-based internet. The MMT9000 has been designed to be easily installed into a vehicle and be powered from a vehicle's 12 VDC¹ power system.

1.1 MMT9000 Features

The MMT9000 is well suited for mobile applications in the following industries:

- remote works sites,
- private communications networks,
- municipal governments,
- public works,
- large construction projects,
- homeland security,
- public safety (non life threatening),
- industrial solutions, and
- special events.

The MMT9000 is capable of delivering high-speed data, voice, and video. It can work with VPNs and other security middle ware.

The MMT9000 is a mobile wireless modem that connects to the user's computer through an Ethernet connection. It is intended to be installed in a vehicle and provides an interface to the customer's computer or local area network on one side and wireless access to the LMS4000 network on the other.

The MMT9000, which acts as a network bridge, receives data from the Base Station (MBT9000, CCU3000 or NCL1900)² over the 900 MHz radio link, and forwards this data to the user's computer through the Ethernet port. In the other direction, the MMT9000 forwards data received from the user's computer over the radio link to the Base Station.

The MMT9000 has a compact form factor designed for use in a vehicle, including emergency vehicles. The MMT9000 has outstanding RF performance in a hostile mobile environment. Temperature, vibration, shock, exposure to moisture and ease of installation have all been considered in the modem packaging. Set-up and configuration is rapid and simple.

-
1. We refer to the MMT9000 as being powered by 12 VDC. This is by convention and refers to the 12 VDC power system on most vehicles. The actual input power specification is 13.8 VDC +/- 25%.
 2. We will use the generic term "Base Station" throughout this document to stand for any of the WaveRider 900 MHz base station products, the CCU3000, NCL1900 or MBT9000

Features of the MMT9000 include:

- **Nomadic Base Station Discovery** (factory default) - The MMT9000 searches all available channels or channels from a user-defined list. The MMT9000 selects which Base Station or access point to establish a connection based on airlink quality and authorization acceptance. With this and DHCP Client enabled (factory defaults), the installer does not need to enter ANY configuration parameters into the MMT9000 in order to install it.
- **DHCP Client** (factory default)- The MMT9000 can obtain its IP address, subnet mask and IP gateway information from a DHCP server, reducing the amount of configuration required for installation. This allows the network operator to reassign IP addresses to MMT9000s without having to access the mobile terminal itself.
- **Auto Remote Configuration** - The MMT9000 will accept parameters from a RADIUS server to set other configurable parameters in the modem. These parameters include: password, all SNMP parameters, RF Frequency (including enabling auto-discovery), and number of hosts.
- **Monitoring Tools** - The MMT9000 has a Windows GUI, LEDs and a SETUP Menu to make monitoring the airlink very accessible to the user. The MMT9000 supports the local link IP address, 169.254.10.250, on its Ethernet port at all times. Using the local-link address, the user can use the password "setup" at any time to call up the setup menu that allows any user to check the RF link quality to verify connectivity.
- **Mobile and Fixed Antennas** - The MMT9000 is certified to work with a variety of antennas, including whip antennas that can be permanently mounted on a vehicle or magnetically mounted and a high-gain panel antenna that can be mounted on a mobile command center or permanently installed as required.
- **Interoperable with LMS4000 System** - The MMT9000 can connect to the MBT9000, CCU3000 or NCL1900 as Base Stations. It can also share the network with a mixture of MMT9000s, MFT9000s, and residential EUMs. Thus the MMT9000 can use a network designed exclusively for its use and/or existing LMS4000 networks.

Detailed specifications for the MMT9000 can be found on the WaveRider website.

1.2 Document Scope

This installation guide provides general guidelines for the installation and configuration of the MMT9000, its performance, and any required regulatory information, including approved installation notices. The Setup menu is described, which can be used to align the MMT9000 antennas.

The concepts for the MobileWAN family of components are the same as the fixed wireless LMS4000 family. Related information can be found in the suite of available LMS4000 manuals, which includes the following:

- *LMS4000 900 MHz Radio Networking Concepts* (APCD-LM053)
- *LMS4000 Data Networking Concepts* (APCD-LM050)
- *LMS4000 Managing the Network* (APCD-LM052)
- *LMS4000 CLI Reference Manual* (APCD-LM051)

- *LMS4000 SNMP Reference Manual* (APCD-LM049)
- *Acronyms and Glossary* (APCD-LM056)

These manuals provide information not included in this Installation Guide, including information on:

- Planning, installing and managing the network.
- Diagnostic tools for the network and modems.
- Details on the Command Line Interface and methods of accessing the modems.
- Manual configuration of the modem via the CLI.
- Glossary of network terms.

These manuals can be found on WaveRider's Web site (<http://www.waverider.com>).

NOTE: The installer may be required to manually configure the MMT9000. In this case, the installer should be familiar with *LMS4000 CLI Reference Manual* (APCD-LM051).

Other documents on the WaveRider web site are useful to assist in installing and operating the MMT9000.

WaveRider recommends that you be familiar with the following sections before proceeding with the instructions in this guide:

- [Software License Agreement](#) on page iii
- [Warranty](#) on page iv
- [Conventions](#) on page viii
- [Warnings and Advisories](#) on page ix
- [Important Safeguards](#) on page x

NOTE: The information contained in this manual is subject to change without notice. The reader should consult the WaveRider web site for updates.

1.3 MMT9000 - MobileWAN Mobile Terminal

Figure 2 shows the components that make up the MMT9000 MobileWAN Mobile Terminal.

Key elements of the MMT9000 are described on the following pages:

- [MMT9000 Modem - External Indicators and Connectors](#) on page 5
- [MMT9000 Suite of Antennas](#) on page 7
- [MMT9000 Nomadic Operation](#) on page 9

MMT9000 Modem



12 VDC Power Cable



Fuse Assembly



Figure 2 MMT9000 Components

1.3.1 MMT9000 Modem - External Indicators and Connectors

All interfaces on the MMT9000 are on one side of the radio for ease of installation. The following interfaces are:

- Ethernet port - 10BaseT RJ45 receptacle to connect the modem to the end-user's computer. Details on the Ethernet port are found in [Appendix B on page 29](#).



CAUTION: Any DC voltage applied to the Ethernet port may damage the MMT9000, the Ethernet cable, and/or network gear. The MMT9000 is not a Power-over-Ethernet device.

- SMA-F Antenna Port - for connecting one of the approved mobile or fixed antennas to the MMT9000. See [section 1.3.2](#), MMT9000 Suite of Antennas for details on the antennas.
- DC Power Connector - a watertight, locking 4 pin receptacle receives the connector from vehicle power system cable. The MMT9000 comes with an 18-ft. cable for connecting to the vehicle power system as well as a fuse assembly. The pin out and connection details are discussed in [Connecting to Vehicle Power System](#) on page 14.



CAUTION: Use standard vehicle power system (13.8 VDC +/- 25%) only. Any other voltage can result in damage to the modem.

- Chassis Ground Lug - this should be connected to the vehicle chassis or ground system.

The MMT9000 also has 3 LEDs. [Figure 3](#) shows the layout of the MMT9000 Connectors and LEDs, while [Table 1](#) and [Table 2](#) explain what each LED means.

Figure 3 MMT9000 Modem - External Indicators and Connectors

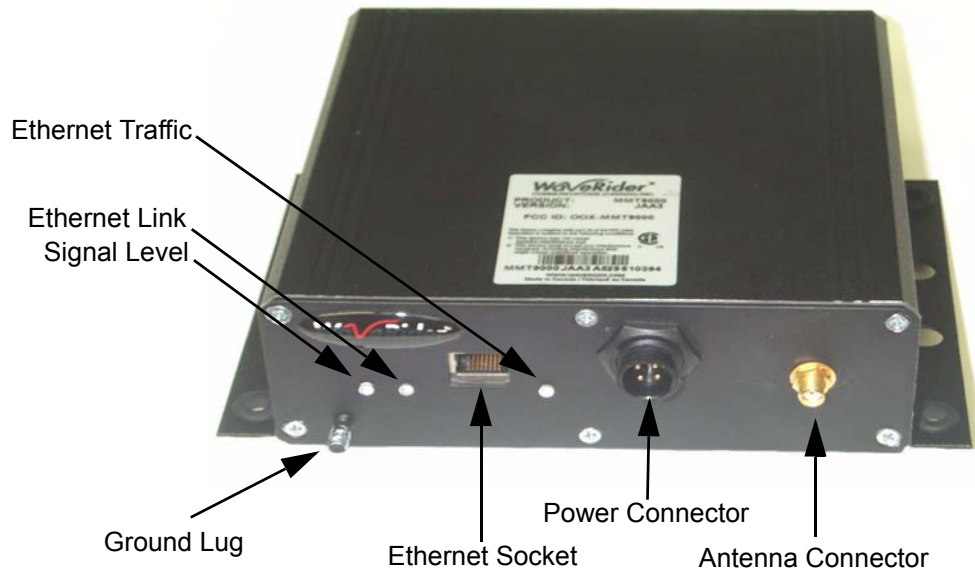


Table 1 Ethernet Status LEDs

LED State	Ethernet Status
Ethernet Link	If the Link LED is ON, the Ethernet physical connection is configured and working properly. If the Link LED is OFF, then the Ethernet physical connection is not working properly, which could be because the wrong type of cable was used or there is a problem with the host or device Ethernet interface. If connecting directly to the end-user PC, use the crossover Ethernet cable provided. If connecting to a router or switch, use a straight-through cable.
Ethernet Traffic	The Ethernet Traffic LED flashes whenever the link is transferring data.

Table 2 Signal Level LED Status

Signal Level State	Status
Flashing	The MMT9000 has adequate signal level to support the radio link. As the signal level increases, the flash rate increases. If possible, turn or move the antenna slowly until the Signal Level LED flashes as fast as possible (i.e. turn panel antenna, reposition magnetic mounted antennas).
Off	The MMT9000 does not have adequate signal level (<-86 dBm). Move and/or turn the antenna until it begins flashing. If a permanently mounted mobile antenna is being used, then the vehicle needs to move.

1.3.2 MMT9000 Suite of Antennas

Only the following antennas are approved by FCC to be used with the MMT9000. All of these antennas and their mounting assemblies can be purchased from WaveRider.

The end user must position the antenna correctly to receive an adequate signal level. This is especially true of the panel antenna which is a directional antenna. The Radio LED on the MMT9000, described in [section 1.3.1](#), MMT9000 Modem - External Indicators and Connectors, or the Setup menu, described in [Setup Menu](#) on page 21, can be used to help with the alignment..

WARNING!



To comply with FCC RF exposure limits, the MMT9000 mobile antennas must be mounted to provide a separation distance of 20cm (8 inches) or more from all persons. The MMT9000 panel antenna must be mounted to provide a separation distance of 30cm (12 inches) or more from all persons. The distance is measured from the nearest point of the antenna to the human body.

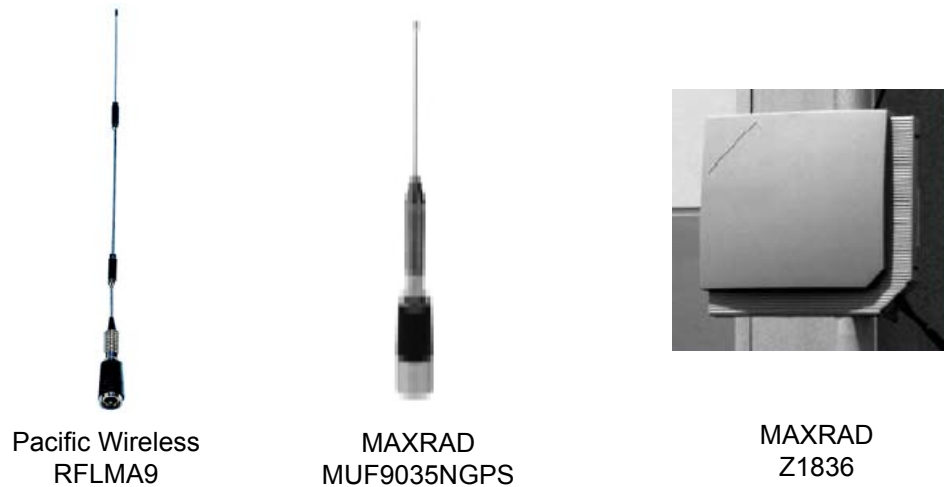
MMT9000 Mobile Antennas

The MMT9000 is designed for use with variety of mobile whip antennas. The following mobile antennas has been certified to be used with MMT9000:

Table 3 MMT9000 Mobile Antennas

Maker	Model	Gain	Mount
Pacific Wireless	RFLMA9	7 dBi	RFLMM-110
MAXRAD	MUF9035NGP(S)	5 dBi	BGMML or BMAML
MAXRAD	MUF9025NGP(S)	5 dBi	BGMML or BMAML
MAXRAD	MUF9003NGP(S)	3 dBi	BGMML or BMAML
MAXRAD	MUF9035NGP(S)	3 dBi	BGMML or BMAML
MAXRAD	MUF9000NGP(S)	Unity	BGMML or BMAML

NOTE: The mobile antennas must be mounted on a metal surface at least 1 Meter diameter for best performance.

Figure 4 MMT9000 Suite of Antennas

The following are the mounting options for these mobile antennas:

Table 4 MT9000 Mobile Antenna Mounts

Maker	Model	Type	Cable Length / Type Provided
Pacific Wireless	RFLMM-110	RFLinx Magnetic Mount	10-ft. RG-58/U (*1)
MAXRAD	BGMML	Magnetic Mount	12-ft. LMR195
MAXRAD	BMAML	Permanent Mount	12-ft. LMR195

*1 - Installer will need to replace existing connector with SMA-M connector to mate with MMT9000.

MMT9000 Fixed Antenna

The MMT9000 has an FCC-approved, fixed outdoor panel antenna, the Maxrad Z1836. It is provided with 25-ft. LMR200 RF cable. Since the panel antenna has a 65 degree beam width and better than 17 dB front-to-back ratio, it can be positioned to suppress interference from other wireless devices.

WARNING!



To comply with FCC RF exposure limits, the MMT9000 panel antenna use at least 6 feet of LMR200 cable.

1.3.3 MMT9000 Nomadic Operation

A key feature of the MMT9000 is its Nomadic Operations. This feature allows the MMT9000 to quickly search for the best Base Station. Should the signal from the Base Station become too poor, the MMT9000 re-searches for the next Base Station. In this way, the MMT9000 is never out of touch with a Base Station for more than a few seconds, provided that it is moving around within the coverage areas of several base stations.

To implement Nomadic Operations, the MMT9000 constantly monitors the signal from the Base Station. When the packet error rate goes above 15% for 15 seconds, the MMT9000 searches through a list of frequencies and registers with the “best” Base Station that will allow it to register.

The factory default is for the MMT9000 to search all 101 frequencies. To speed up the search, a list of frequencies to be used can be configured to force the MMT9000 to search only the relevant frequencies.

Care must be taken when designing an LMS network that will support nomadic units. If an MMT9000 moves between two Base Station that support the same IP subnet (i.e. are in switched mode on the same Ethernet broadcast domain) then service will continue nearly uninterrupted. However, if an MMT9000 moves between two Base Station supporting separate IP subnets (routed mode or separate domains), then the end-user’s PC(s) will have to have new IP addresses, by DHCP or mobile IP protocols.

The “break-on-line” feature can assist in triggering the end-user PC to get a new IP address. This feature disables the Ethernet port on the MMT9000 for a configurable period of time when a search for a new base station frequency is started. Disabling the Ethernet port for long enough forces most current operating systems on the user’s computer to request a new IP address, gateway and DNS servers via DHCP. For computers running Windows XP, WaveRider recommends a 7 second break time. Use the command “rad freq nomadic 7” to set the MMT9000 to nomadic mode with a 7 second break time.

The “break-on-line” feature only works if the PC is directly connected to the MMT9000 Ethernet port. If a hub or switch is placed between the PC and the MMT9000, the PC will not lose its Ethernet link, since that is provided by the hub or switch.

If the MMT9000 itself has its DHCP client enabled, then it will use DHCP to get a new IP address for the modem when it changes Base Stations.

2 Installation

The MMT9000 must be installed by a professional installer who is familiar with the FCC regulations that apply to the MMT9000. Familiarity with installing vehicle-mounted 2-way radio equipment is highly desirable. Best practices applicable to vehicle mounted radio systems should be followed for providing power and grounding to the modem as well as antenna placement on a vehicle.

2.1 Installation Checklist

A successful installation is divided into pre-installation, installation and post-installation stages, with each stage outlined in the following checklists.

The Pre-Installation Stage Checklist involves the Network Operator as well as the installer.

Table 5 Pre-Installation Stage Checklist

Step	Discussion
section 2.2.1, Network and MMT9000 Configuration	The network must be properly configured by the Network Operator to accept the new modem.
section 2.2.2, Verifying the MMT9000 Components	Ensure that all the needed parts are included.
section 2.2.3, End-Users PC	The end-user's PC requires an Ethernet Network Interface to accept the data from the MMT9000.

When everything is ready for the installation stage, then the installer performs the following steps:

Table 6 Installation Stage Checklist

Step	Discussion
section 2.3.1, Locating the MMT9000	For vehicle installation, the MMT9000 should be mounted in an appropriate location. The MMT9000 is rugged enough to be mounted in any partly protected location.
section 2.3.2, Connecting to Vehicle Power System	The MMT9000 is powered from the vehicle's 12 VDC power system.
section 2.3.3, Connecting the End-User's PC	Connect the modem to the end-user's PC.
section 2.3.4, Locating the MMT9000 Antenna	The MMT9000 mobile antennas mount to vehicle roofs or trunks. The external panel can be mounted on command centers, trailers, etc. Find the best location for mounting the MMT9000 antenna at least 20 cm away from where people will stand.
section 2.3.5, Testing the Data Link	Confirm that the link is functioning correctly.

Once the installation is complete and verified, the network operator can complete the Post-installation Stage, using the Automatic Remote Configuration feature or manually over the air. This is discussed in [section 2.4](#), Post-Installation

2.2 Pre-Installation Steps

2.2.1 Network and MMT9000 Configuration

There are a number of steps that must be undertaken by the network operator before installing an MMT9000. For more information, see the *LMS4000 Data Networking Concepts* (APCD-LM050), *LMS4000 900 MHz Radio Networking Concepts* (APCD-LM053), *LMS4000 Managing the Network* (APCD-LM052), and *LMS4000 CLI Reference Manual* (APCD-LM051) on the WaveRider web-site.

1. **Base Station Authorization:** Ensure that the MMT9000 is authorized at one or more Base Stations with the appropriate Grade of Service.
2. **IP Addresses:** Configure a DHCP server to accept the new MMT9000's request(s) for an IP address, if the modem has DHCP enabled (factory default). If not using DHCP, then the MMT9000 must be manually configured with the following settings:
 - IP address
 - Subnet mask
 - Gateway IP address
3. **Frequency Assignment:** If the Nomadic Base Station Discovery feature (factory default) is used, then the MMT9000 will search for the Base Station upon power up.

This is the recommended approach. If for some reason this is not acceptable, then the MMT9000 must be configured with its radio frequency.

The easiest installation uses the MMT9000 factory defaults, so that the modem will get all its IP address information from DHCP and its RF Frequency from the Nomadic Base Station Discovery feature.

Other useful information for the installer includes:

- The IP address of a site that accepts pings as well as the name of a site that accepts pings, for testing the data link.
- Whether modem is being connected directly to end-user PC or via an Ethernet switch or IP router. In the latter cases, the installer must provide a straight-through Ethernet cable to connect the modem to the switch/router.

2.2.2 Verifying the MMT9000 Components

See [MMT9000 - MobileWAN Mobile Terminal](#) on page 4 for more information on the MMT9000 kit. Verify that the MMT9000 kit is complete with:

- MMT9000 modem
- Power cable assembly
- Fuse assembly

In addition to the modem itself, verify that the antenna selected for the installation is complete, including:

- Antenna
- Antenna Mounting hardware, be it a magnetic or vehicle mount for the mobile antennas or clamping hardware for the panel antenna

Equipment that is needed but not provided since it will be unique to each installation, includes:

- Ethernet cable - this will be a straight-through or cross-over cable depending on whether the end-user's PC is connected to a switch or directly to the MMT9000.
- Mounting bolts, washers and nuts - for attaching the MMT9000 rail to an equipment tray, directly to the vehicle or to some other attachment point.

2.2.3 End-Users PC

Ensure that the end-user PC is equipped with an Ethernet interface.

2.3 Installation Steps

2.3.1 Locating the MMT9000

The MMT9000 has been designed and tested for a rugged mobile environment. It is designed to meet IP53 rating (dust protected, light rain), so an additional enclosure to house the modem is not required. The MMT9000 can be installed in the trunk area or in the passenger compartment of the vehicle. Do not install in the engine compartment.

The location of the MMT9000 in a vehicle should be close as possible to the mobile antenna to reduce cable insertion loss.

Figure 5 Possible Locations for MMT9000



Trunk Shelf



Console Floor

Other possible locations for the MMT9000 are. under the driver or passenger seat, trunk side panel or trunk floor



CAUTION: If the MMT9000 is likely to be exposed to rain or spray, orient the MMT9000 so that the connector endplate is more protected. This can be achieved by having the connectors facing down or facing away from the exposed side. All connectors except the Ethernet connector are waterproof. If the Ethernet connector is subjected to too much spray, it can leak and/or short out until dry. Ensure the boot of the Ethernet cable is snug against the chassis.

2.3.2 Connecting to Vehicle Power System

The MMT9000 is designed to work directly from the vehicle +12VDC electrical system or from a +12VDC power distribution panel.

Included in the MMT9000 kit is an 18-ft., 4-wire, 18-gauge cable with an 2-amp inline fuse kit (see [Figure 2 on page 5](#)). The connector to the modem is a twist-lock assembly. The following table shows the wire color and its purpose:

Table 7 MMT9000 Wiring to Vehicle Power System

Wire Color	Description
Black	0 VDC (Battery Negative side)
Red	+12 VDC
White	Ignition Sense: +12VDC turns unit on. Tie to Red if not using ignition sensing
Green	Chassis ground, same ground as antenna base.

The MMT9000 also has a ground lug on the connector endplate which should be connected to the vehicle ground system.

The MMT9000 can be installed in other locations than just a vehicle, so long as the input power is 13.8 VDC +/- 25% and there is a ground system.

2.3.3 Connecting the End-User's PC

The Ethernet interface on the MMT9000 is a 10BaseT Ethernet RJ-45 receptacle. If connecting directly to the end-user's PC, a crossover cable is required. If connecting to an Ethernet hub or switch, a straight-through Ethernet cable is used.

The Ethernet cable must be able to withstand the same environment as the MMT9000, so cable rated as CAT5 outdoor or better is recommended

An Ethernet surge suppressor should be connected as close as possible to the MMT9000 Ethernet interface. This suppressor must be connected to the chassis ground.

As noted, there are many ways to connect the MMT9000 to the end-user's PC, using Ethernet switches, IP routers, etc. The discussion below is for the simplest, most direct method of connection.

1. Connect the end-user's PC by attaching a crossover Ethernet cable between the Ethernet port on the end-user's computer and the Ethernet port on the modem.
2. Apply power and wait 10 seconds for the MMT9000 to come up.
3. Check the Ethernet LEDs on the Ethernet interface of the modem and/or end-user's PC to ensure the Ethernet connection between the MMT9000 and the end-user's PC is active. Refer to [Table 1 on page 6](#) for an explanation of the Ethernet LEDs normally provided on Ethernet interface cards.

4. When attempting to send data to, or receive data from, the Internet, check the Ethernet Traffic LED to ensure data transmission is taking place. This LED flashes as data traffic passes between the end-user's PC and the MMT9000

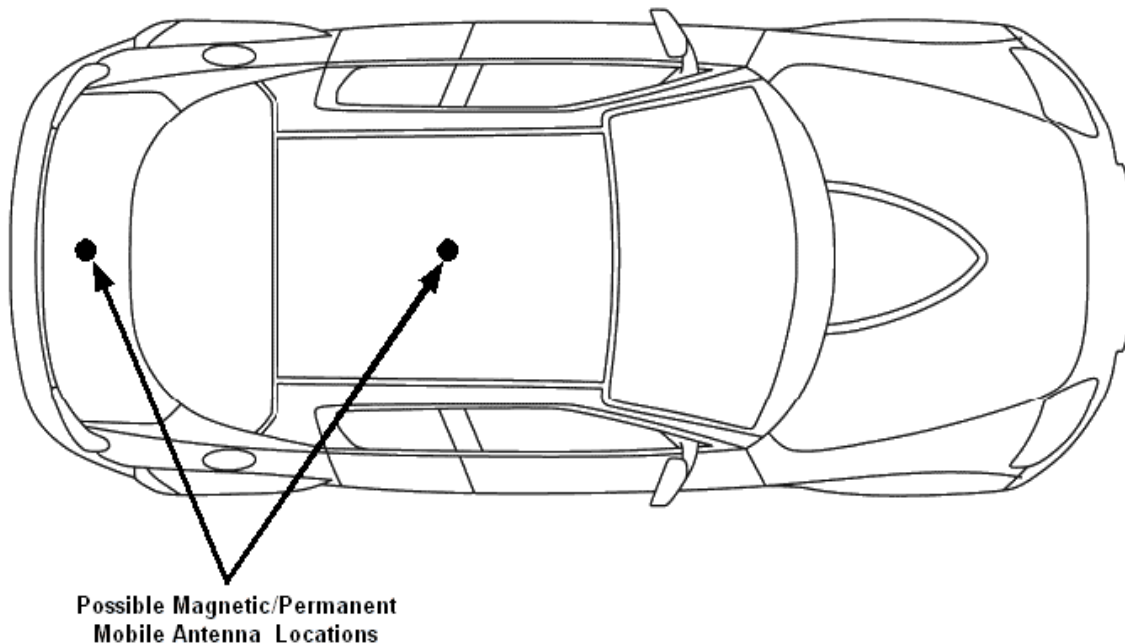
2.3.4 Locating the MMT9000 Antenna

Mobile Antenna

The mobile antennas for the MMT9000 should be mounted on the top of the vehicle or in the middle of the trunk lid. These locations provide good unobstructed locations that are at least 20 cm away from people. WaveRider also recommends that the MMT9000 antenna be mounted away from other radio system antennas to reduce possible interference between systems.

These guidelines apply to both fixed and magnetic mount mobile antennas. The magnetic mount antennas are intended to be put into position when the vehicle has stopped. The magnet may not hold when the vehicle is moving

Figure 6 Possible Locations for MMT9000 Mobile Antenna



Panel Antenna

The MMT9000 panel antenna is intended for outdoor installation, either in a permanent or semi-permanent (e.g. on the top of a mobile command centre vehicle that is usually left in place for many hours or days). The major difference is that the antenna in a semi-permanent location must be re-adjusted for each new location.

2.3.5 Testing the Data Link

Omni-directional Mobile Antennas are designed to capture radio signals from any direction. Repositioning the antenna (or vehicle) may be needed if the signal levels are not adequate in a given location. Generally, it is better to have the antenna as high as possible. Also the further away from surfaces that can reflect the radio waves the better, so parking away from buildings is usually better.

When using the panel antenna at a new location, be sure to orient the antenna so that it is pointing at the best signal.

Use the Radio LED to help in positioning or orienting the antenna. The Radio LED will flash more quickly if the signal improves. If the Radio LED does not flash at all, then there is no radio signal in that position or orientation.

Alternatively, the Setup Menu as described in [section 3](#), Setup Menu provides the figures of merit for the signal. The goal for a good installation is to have the Signal Strength FOM in the range of 5-8 and the Signal Quality FOM to be in the range 4-5. However, there are many good installations with lower figures of merit. Using the LEDs or Setup Menu, you can determine if the location has adequate figures of merit. MMT9000. In most cases, a signal strength of 5 with a signal quality of 4 is a better signal than a signal strength of 6 and signal quality of 2.

The following are simple tests that the installer or end-user can perform to ensure that the link is functioning correctly. These tests may be used for each new location, especially if the link does not appear to be working as expected. If any test fails, then the subsequent tests are likely to fail as well until the problem is resolved

NOTE: Turn off all cordless phones in the customer's premises, and any other equipment that uses the 900MHz ISM band. Once the installation is complete, turn this equipment back on and monitor for interference or degraded signal quality.

1. **Ping the MMT9000:** Configure the end-user's PC to have an IP address on subnet 169.254.x.x and ping the MMT9000 at IP address "169.254.10.250" (see [Ping the MMT9000](#) on page 17 for more details if needed).
2. **Assess the Link:** Use the Setup Menu as described in [Setup Menu](#) on page 21 to assess the Radio Link Status and to get the Troubleshooting information to baseline the installation. This test verifies that the end-user's PC is communicating with the MMT9000 and provides insight into the state of the RF link. This test is recommended since it provides details on the state of the modem and what Base Station(s) it has located.
3. **Verify DHCP:** If the network assigns end-user PC's IP addresses by DHCP, then reconfigure the end-user PC to use DHCP to automatically obtain its IP address. Verify the end-user PC has received an IP address, by using the DOS command "ipconfig" and seeing that an IP address is assigned along with Gateway and DNS server addresses. This confirms that the End user PC is contacting the DHCP server correctly. See [Verify DHCP](#) on page 18 if more details are required.
4. **Ping the Gateway:** Assuming the end-user PC has an IP address and a Gateway address as shown by the "ipconfig" command, ping the gateway to determine if it can

be reached. See [Ping the Gateway](#) on page 18 if more details are required. This step assume your gateway will respond to pings.

5. **Ping Internet by IP address:** If everything is good so far, try pinging a known Internet address. If successful, then you know that the end-user PC can access the general Internet. See [Ping Internet by IP address](#) on page 19 if more details are required.
6. **Ping Internet by Name:** Ping a known named Internet address (e.g. “ping www.google.com” or some equivalent). Even if the site refuses ping commands, you should get the IP address for the named site. If so, this shows that DNS is working correctly. See [Ping Internet by Name](#) on page 20 if more details are required.
7. **Link Speed Test:** Go to a known web-site that offers link speed testing, such as “http://bandwidthplace.com/speedtest”. Follow their instructions and determine the link speed. There are many factors affecting the link speed between the end-user’s PC and the test site, including the assigned grade-of-service for the modem, the loading on the Base Station sector and the loading over the rest of the Internet. So this test is not the best test for ensuring that the modem to Base Station link is operating at its correct speed. But it should indicate that the PC is able to communicate with a site on the Internet.

If any of these tests fail, then the installer may need to check the modem, the antenna and its alignment, the cabling, the PC’s configuration and the RF link. If all of these appear good, then the installer should contact the Network Operator for further troubleshooting advice.

The following sections provide more detail for some of the steps for Testing the Data Link.

Ping the MMT9000

Note that the MMT9000 may be on a different sub-net than the end-user’s PC, so pinging the IP address assigned to the MMT9000 will go through the Base Station. Therefore, we ping the MMT9000 using the local link IP address as the 1st test.

1. Ensure the end-user’s PC is configured with an IP address of 169.254.10.251, netmask = 16 (or 255.255.0.0). See [Setup Menu](#) on page 21 for more information.
2. Ping the MMT9000’s local-link IP address 169.254.10.250, from the end-user’s PC, as follows:
 - Open a DOS window in the end-user’s PC.
 - At the command prompt, type `ping 169.254.10.250` and press **Enter**.
3. If there is no response, check the following:
 - The end-user’s computer IP address settings.
 - The Ethernet link light on the PC.
 - The Ethernet crossover cable between the MMT9000 and the end-user’s PC, to ensure that the pins have not been damaged.
4. If there is a response, but with errors, check the Ethernet crossover cable.

This is what a successful ping from the end-user’s PC to the MMT9000 looks like:

```
C:\>ping 169.254.10.250
```

```
Pinging 169.254.10.250 with 32 bytes of data:
```

```

Reply from 169.254.10.250: bytes=32 time<10ms TTL=64
Reply from 169.254.10.250: bytes=32 time<10ms TTL=64
Reply from 169.254.10.250: bytes=32 time<10ms TTL=64
Reply from 169.254.10.250: bytes=32 time<10ms TTL=64

```

```

Ping statistics for 169.254.10.250:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

```

This is what an unsuccessful ping from the end-user's PC to the MMT9000 looks like:

```

C:\>ping 169.254.10.250

Pinging 169.254.10.250 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 169.254.10.250:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

```

Verify DHCP

This step is for networks that use DHCP to provide IP addresses to the end-user's computer. Assuming the Setup command shows that the modem has registered with a Base Station and is receiving a signal, then reconfigure the end-user PC to use the correct IP address. This is usually done using DHCP to automatically obtain the IP address.

On Windows 2000, XP and similar systems, the IP Address is set using the Control Panel > Network and Dialup Connection > Local Area Connections > right mouse click to select Properties > Internet Protocol (TCP/IP) > Properties. To enable DHCP, click on the "Obtain an IP Address Automatically" button.

Once properly configured, verify the end-user has received an IP address. For a Windows 2000 or XP PC, in a DOS Window, type "ipconfig" and see that there is an IP address assigned along with a Gateway Address and DNS server addresses This confirms that the End user PC is contacting the DHCP server correctly. Record the IP Address of the gateway and the DNS servers.

Ping the Gateway

Ensure the end-user's PC is configured properly. Then ping the gateway address from a PC DOS window. The gateway address was recorded during the Verify DHCP address if using DHCP. Otherwise the installer will know the gateway address since it is needed to configure the end-user's PC.

Ping using short packets first (default size) to confirm the connection. Then use long packets (1472 byte packets) to confirm the RF performance. Errors observed on pings with long packets indicate a high error rate on the channel, caused by low signal levels or interference.

The following describes how to ping the gateway:

1. Open a DOS window.
2. At the command prompt, type `ping <aaa.bbb.ccc.ddd> -t -l 1472`, where `<aaa.bbb.ccc.ddd>` is the Gateway radio IP address and press **Enter**.
3. Press **Ctrl+c** to end the test.

NOTE: If this test fails with the long packets, but pinging the Gateway with the default packet size succeeds, then the connection is working but is not operating at maximum capacity, possibly due to poor antenna placement or orientation, poor signal levels, and/or interference.

The following example assumes the Gateway has an IP address of 172.16.4.1. Replace that address with the correct gateway address from the 'ipconfig' command:

```
C:\>ping 172.16.4.1 -t -l 1472

Pinging 172.16.4.1 with 1472 bytes of data:

Reply from 172.16.4.1: bytes=1472 time=40ms TTL=64
Reply from 172.16.4.1: bytes=1472 time=81ms TTL=64
Reply from 172.16.4.1: bytes=1472 time=80ms TTL=64
Reply from 172.16.4.1: bytes=1472 time=40ms TTL=64
Reply from 172.16.4.1: bytes=1472 time=60ms TTL=64
Reply from 172.16.4.1: bytes=1472 time=80ms TTL=64
Reply from 172.16.4.1: bytes=1472 time=40ms TTL=64
Reply from 172.16.4.1: bytes=1472 time=110ms TTL=64

Ping statistics for 172.16.4.1:
    Packets: Sent = 8, Received = 8, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 40ms, Maximum = 110ms, Average = 66ms
Ctrl-C
^C
C:\>
```

Ping Internet by IP address

Use the following test to determine whether the end-user's PC can communicate with the Internet. If you do not know an IP address, try the DNS servers. Otherwise, skip this step.

```
C:\>ping 216.239.39.104

Pinging 216.239.39.104 with 32 bytes of data:

Reply from 216.239.39.104: bytes=32 time=90ms TTL=113
Reply from 216.239.39.104: bytes=32 time=80ms TTL=113
Reply from 216.239.39.104: bytes=32 time=80ms TTL=113
Reply from 216.239.39.104: bytes=32 time=70ms TTL=113
```

```
Ping statistics for 216.239.39.104:
  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
  Minimum = 70ms, Maximum = 90ms, Average = 80ms
```

Ping Internet by Name

Use the following test to verify that the DNS server IP address is correctly configured in the end-user's PC and is operating properly:

```
C:\> ping www.google.com

Pinging www.google.akadns.net [216.239.39.104] with 32 bytes of data:

Reply from 216.239.39.104: bytes=32 time=72ms TTL=241
Reply from 216.239.39.104: bytes=32 time=69ms TTL=241
Reply from 216.239.39.104: bytes=32 time=76ms TTL=241
Reply from 216.239.39.104: bytes=32 time=68ms TTL=241

Ping statistics for 216.239.39.104:
  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
  Minimum = 68ms, Maximum = 76ms, Average = 71ms
```

2.4 Post-Installation

Once a good link between the Base Station and the MMT9000 has been established, the configuration can be completed automatically using the Automatic Remote Configuration feature with a RADIUS Server and database in which the MMT9000 information has been entered.

To use this feature, the network operator must update the RADIUS database for the new modem. This can be done before the modem is installed, in which case the modem will be automatically configured as soon as it has established a link.

The configurable items that can be included in the Automatic Remote Configuration include:

- password,
- all SNMP parameters,
- RF Frequency (including enabling Nomadic Base Station Discovery)
- number of customers.

If the Automatic Remote Configuration feature is not used, then the network operator can connect to the MMT9000 over the air and complete the configuration.

Details on configuring a RADIUS Server or manually configuring an individual MMT9000s are covered in the *LMS4000 Managing the Network* manual or other manuals, available on the WaveRider web-site.

3

Setup Menu

The MMT9000 is equipped with a simple setup menu through which you can align the antenna, monitor the RF link quality and view the key parameters of the modem.

3.1 Accessing the Setup Menu

The setup menu is accessed by connecting a Telnet session to the 'local link' IP address of the MMT9000, 169.254.10.250, with password = 'setup'. The connection must be through the Ethernet port, not over the air via the RF link.

The computer needs to have an IP address of 169.254.x.y with a 16 bit mask (255.255.0.0), where x and y can be any value from 0 to 255 except for 10.250, 0.0, or 255.255. It is recommended that the address 169.254.10.251 be used unless another address is more convenient. This address will be used throughout.

The following assumes the computer has a Windows 2000 or Windows XP operating system. Other operating systems can be used provided the computer has an IP address of 169.254.10.251 and can use 'ping' and 'telnet' programs.

On Windows 2000, XP and similar systems, the IP Address is set using the Control Panel > Network and Dialup Connection > Local Area Connections > right mouse click to select Properties > Internet Protocol (TCP/IP) > Properties.

Once the computer's IP address is set to 169.254.10.251, open a DOS command window and try to ping the MMT9000, using the command "ping 169.254.10.250". If the MMT9000 does not respond, verify the Ethernet cables are connected correctly, that power supply has power and that the computer has the correct address and net mask.

When the MMT9000 replies to the ping command, establish a telnet session with the command "telnet 169.254.10.250".

Once a telnet connection is established, a password is requested. Enter "setup", which will enter the setup menu.

3.2 Setup Menu

The Setup Menu structure consists of a menu with four selections.

Setup Menu

```
MMT9000 Setup Menu

Modem Serial Number : 610138
Station Identifier   : 61:01:38
Software Version    : 10.4
Search State        : Searching for best signal

Menu
====

(R)adio Link Status - Use this for pointing the antenna
(T)roubleshooting information - for network operator
(H)elp
e(X)it

type option and press enter >
```

The Setup menu identifies the modem, the software version and search state. In this case, the modem is configured for Nomadic Base Station Discovery and it is searching to find the best available Base Station.

There are 4 options:

- Radio Link Status - see [section 3.3](#), Radio Link Status Display
- Troubleshooting information - see [section 3.4](#), Troubleshooting Information Display
- Help - this provides an on-line explanation of the options and the information displayed with each.
- Exit - this terminates the telnet session.

3.3 Radio Link Status Display

The Radio Link Status display is the key setup display for aligning the antenna and verifying the link. The Radio Link Status display shows the search state of the modem, which is either:

- **searching for a Base Station** - A complete sweep of all frequencies takes about 30 seconds. The display shows which frequencies may be Base Stations. A search is started when any of the following occurs:
 - the modem boots up, either due to a hard (power) reset or software reset,
 - no Base Stations are found during the last frequency sweep, so that the modem cannot register with any Base Station found during the last sweep,
 - the modem has received no signal from the Base Station in the last two minutes. This indicates that the Base Station or radio link is down.

- **attempting to register with a Base Station** - When a frequency sweep has been completed, the modem attempts to register with the Base Stations in the order of best signal down to poorest. The modem may not register with a Base Station for a number of reasons, in which case the modem attempts the next Base Station in the frequency list. If the modem cannot register with any Base Station, contact the network operator. The reasons a modem may not be able to register with a Base Station include:
 - The modem is not authorized to register at that Base Station,
 - The signal detected is not a valid Base Station.

- **registered with a Base Station** - This state occurs when the modem has a frequency and has successfully registered with a Base Station. At this point, the modem can provide a link to the Internet through the Base Station.

An example of the Radio Link Status display is shown below.

Radio Link Status Display

```

Searching: found 9070 9086
Searching: found 9070 9086
Searching: found 9070 9086 9114
Searching: found 9070 9086 9114
Searching: found 9070 9086 9114 9142
Searching: found 9070 9086 9114 9142
Searching: found 9070 9086 9114 9142
Searching: found 9070 9086 9114 9142

Registered at 9114
          Signal Strength
          | Poor | Fair | Good
          | 1  2  3  4  5  6  7  8
4.0 *****
4.3 *****
5.0 *****
4.7 *****
6.7 *****
5.0 *****
3.7 *****
6.0 *****
8.7 *****
8.0 *****

          Signal Quality
          | Poor | Fair | Good
          | 1  2  3  4  5
1.5 *****
3.5 *****
3.0 *****
2.5 *****
2.0 *****
1.5 *****
4.0 *****
3.0 *****
3.5 *****
4.5 *****
    
```

The Signal Strength and Signal Quality graphs and values are Figures of Merit (FOM) and are interpreted using the tables below. The goal for aligning the antenna is a Signal Strength of 5 or better and a Signal Quality of 4 or 5, if possible.

Table 8 Signal Strength Figure of Merit

FOM	Meaning	Received Signal is at least	Received Signal is less than
1	Extremely poor		-92 dBm
2	Very Poor	-92 dBm	-89 dBm
3	Poor	-89 dBm	-86 dBm
4	Marginal	-86 dBm	-83 dBm
5	Okay	-83 dBm	-80 dBm
6	Good	-80 dBm	-77 dBm
7	Very Good	-77 dBm	-74 dBm
8	Excellent	-74 dBm	

Table 9 Signal Quality Figure of Merit

FOM	Meaning
0	Extremely Poor
1	Very poor
2	Poor
3	Adequate
4	Good
5	Very Good

Getting any Signal Strength reading at all indicates that packets are being received from the Base Station. The higher the signal strength and signal quality indicators, the lower the packet error rate and the higher the fade margin for the MMT9000. The goal should be a signal strength of 5 or higher and a signal quality of 4 or 5. Regardless of the levels, the MMT9000 should be aligned so that the indicators are the highest possible for the given site.

3.4 Troubleshooting Information Display

The troubleshooting information is provided to allow the network operator to troubleshoot the link.

The information provided below is a brief description of the statistics provided. A detailed understanding of this information is not required to install the MMT9000. If there are problems with the installation, then the installer may contact the network operator and report the information on this display so that the network operator can troubleshoot the installation.

The troubleshooting information display is shown below.

Troubleshooting information Display

MMT9000 Diagnostic Information
 ----- MAC Summary -----

Transmitted Payloads
 10k : 35 100.0%
 20k : 0 0.0%
 30k : 0 0.0%
 40k : 0 0.0%
 Fail Retry : 0 0.0%
 Fail Timeout : 1

Received Packets
 HCRC Error : 23993 3.0%
 Directed : 6948 0.8%
 Broadcast : 11178 1.4%
 No Match : 753093 94.7%

Received Packets with Payloads
 FCS Error : 0 0.0%
 Duplicate : 0 0.0%
 Too Busy - Discard : 0 0.0%
 Delivered : 73 100.0%

----- IP Summary -----
 MMT9000 configuration

Host Name : eum61-01-38
 Physical Address : 00:90:c8:61:01:38
 IP Address : 207.54.100.172
 Subnet Mask : 255.255.255.240
 Default Gateway : 207.54.100.166
 DHCP Server : 207.54.100.166
 Lease Obtained : 22-Jul-2005 22:58:36
 Lease Expires : 23-Jul-2005 22:58:35

----- Radio Summary -----

RF Power: 26 dBm
 Nomadic Mode - Locked on 60:0a:e0 at frequency 9114

Using default search list (all frequencies).
 Printing non-zero frequencies only

Frequency	RSS FOM	SQ FOM
9050	7.0	3.3
9086	7.0	2.3
9114	8.0	2.7

RSSI [dBm]	RX;	TX;	R1;	R2;	R3;	F;Retry%;	SQ;	RNA;	RNB
RSSI: -73	18;	0;	0;	0;	0;	0;	0;	8;	23; 23

The MAC Summary shows the breakdown for transmitted and received packets and payloads. All values are expressed as a count and percentage of total packets or payloads. A payload is a packet with real data.

- Transmitted Payloads: shows how many payloads were successfully transmitted the 1st time or needed to be sent a 2nd, 3rd or 4th time to get through, as well as how many packets failed to get through at all. Note that traffic must be sent from the end user PC in order to generate enough traffic to be meaningful. The rules of thumb are:
 - 1OK should be at least 90%, otherwise the link may not be good enough.
 - The 1OK packets should be 1000 or more to be a reasonable representation of the link.
- Received packets: shows the classification of all packets received from the Base Station, whether they contain payloads or not and whether they are directed to this modem or not. This data is for information only and does not indicate the quality of the link for the installer.
- Received packets with payloads: shows the disposal of the received packets with payloads for this modem, either directed to the modem or broadcast to all modems. Only the delivered payloads are successfully received. The rule of thumb here is that the delivered payloads should be better than 95%, otherwise the link is suspect.

Appendix A Factory Configuration

This appendix identifies the factory configuration settings for the MMT9000

Parameter	Default Configuration
Modem IP Address	From DHCP
Modem IP Netmask	From DHCP
Gateway IP Address	From DHCP
Local Link IP Address (Available on Ethernet Port only)	169.254.10.250
Local Link IP Netmask	16 255.255.0.0 ffff0000
Maximum Number of Customers*	5
Password*	By default, the MMT9000 has no password. Press Enter at the password prompt to enter a null password.
Port Filters	137 (both) 138 (both) 139 (both) 445 (both) 1512 (both)
Radio	Enabled
Radio Frequency*	Nomadic Base Station Discovery

Parameter	Default Configuration
Radio Power*	+26 dBm (High) - To be consistent with previous modems, +26 is used in the CLI to indicate maximum output power. The MMT9000 actually outputs about 27.3 dBm Peak power = 26.0.dBm average power. (NOTE: For configuring the modem, the power values entered are rounded to the nearest dB)
SNMP Name* (= Console Prompt)	Station ID
SNMP Contact*	WaveRider Communications Ltd.
SNMP Location*	www.waverider.com
SNMP Read Communities*	None entered
SNMP Write Communities*	None entered
SNMP Traps*	None entered
Statistics Log Interval	15 minutes

* These parameters can be set using Automatic Remote Configuration if the network is configured to use a RADIUS Server.

Appendix B Ethernet Cables and Connectors

The MMT9000 may use cross-over or straight through Ethernet cables, depending on the type of installation:

- **Cross-over Cable:** If a cable is connected directly between the MMT9000 and a PC, use a crossover Ethernet cable. A cross-over cable has one end wired according to T568A and the other end according to T568B. Both ends have RJ45 connectors.
- **Straight-Through Cable:** If MMT9000 is connected to an Ethernet switch or router use a straight-through Ethernet cable, which has both ends wired according to T568A (or both according to T568B) with RJ45 connectors.

The Ethernet cable used for the MMT9000 must have at least the RX and TX pairs wired as shown in [Table 10](#) with NO power on the other wires.

Table 10 Ethernet Interface Specifications

MMT9000 Physical Interface	RJ45 (Ethernet) socket
Wiring standard	TIA - T568A
Pin - Pair/Wire - Color	
Pin 1 - 3/a - Green/White	TX Data + (Output from MMT9000)
Pin 2 - 3/b - Solid Green	TX Data - (Output from MMT9000)
Pin 3 - 2/a - Orange/White	RX Data + (Input to MMT9000)
Pin 4 - 1/b - Solid Blue	Not Used.
Pin 5 - 1/a - Blue/White	Not Used.
Pin 6 - 2/b - Solid Orange	RX Data - (Input to MMT9000)
Pin 7 - 4/a - Brown/White	Not Used.
Pin 8 - 4/b - Solid Brown	Not Used.

The following table and figures show the definitions of wiring for T568A and T568B connectors, used to make cross-over and straight-through Ethernet cables as found in ANSI/TIA/EIA-568-B.2 "Balanced Twisted Pair Cabling Components".

Table 11 Wiring T568A and T568B ends for Ethernet Cables

#	Description	T568A	T568B
1	Connectors	RJ-45	RJ-45
2	Wiring standard	T568A	T568B
3	Pair/Wire - Color		(Pins in bold are different from T568A)
	3/a – Green/White	Pin 1	Pin 3
	3/b – Solid Green	Pin 2	Pin 6
	2/a - Orange/White	Pin 3	Pin 1
	1/b – Solid Blue	Pin 4	Pin 4
	1/a – Blue/White	Pin 5	Pin 5
	2/b – Solid Orange	Pin 6	Pin 2
	4/a – Brown/White	Pin 7	Pin 7
	4/b – Solid Brown	Pin 8	Pin 8

Straight-through Ethernet cables have T568A wiring at both ends (or T568B at both ends) while Cross-over cables have T568A at one end and T568B at the other end.

T568A Wiring Scheme

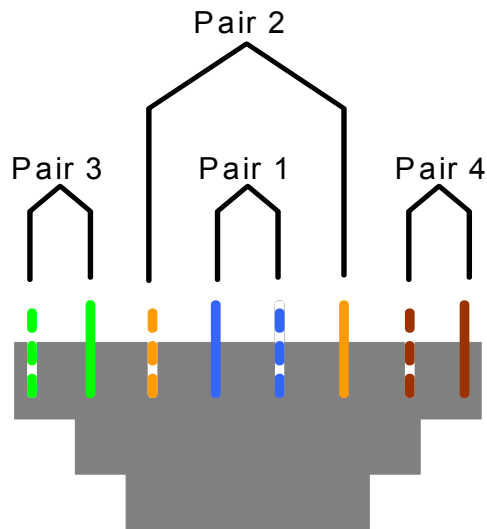


Figure 7 T568A Wiring

T568B Wiring Scheme

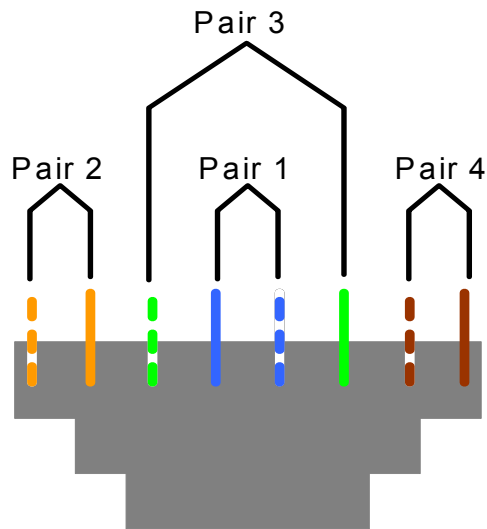


Figure 8 T568B Wiring