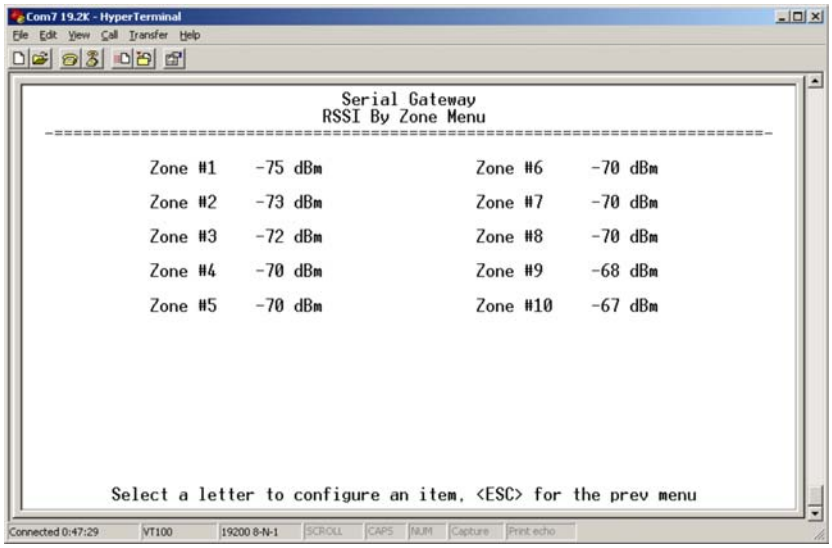


Figure 3-44. RSSI by Zone Menu

TIP: Under normal circumstances, the signal levels in each zone should be within a few decibels of each other. If you see one that is significantly lower or higher, it may be a sign of radio frequency interference from another signal source on the 900 MHz band. See *"Network Performance Notes"* on Page 96 for further information.

Event Log Menu

The transceiver's microprocessor monitors many operational parameters and logs them. Events are classified into four levels of importance, which are described in Table 3-5. Some of these events will result from a condition that prevents the normal of the unit—these are "critical" events. These will cause the unit to enter an "alarmed" state and the PWR LED to blink until the condition is corrected. All events are stored in the Event Log that can hold up to 8,000 entries.

Table 3-5. Event Classifications

Level	Description/Impact
Informational	Normal operating activities
Minor	Does not affect unit operation
Major	Degraded unit performance but still capable of operation
Critical	Prevents the unit from operating

Time and Date

The events stored in the Event Log are time-stamped using the time and date of the locally connected device. Remote units obtain this information from the Access Point when they associate with it. The Access Point obtains the time and date from a Time Server. This server can generally be provided by a standard Windows PC server SNTP application. In the absence of the SNTP services, the user must manually enter it at the

Access Point. (See *"Device Information"* on Page 42 for SNTP server identification.) The manually set time and date clock is dependent on the unit's primary power. A loss of power will reset the clock to January 1, 2002 but will not affect previously stored error events.

```
**************************************CC**************************************
0                              Device Name Here                               *
1                                Event Log Menu                               *
2  -=========================================================================-  *
3                                                                              *
4      A) Current Alarms                                                       *
5                                                                              *
6      B) View Event Log                                                       *
7                                                                              *
8      C) Clear Event Log                                                      *
9                                                                              *
0      D) Send Event Log                                                       *
1                                                                              *
2      E) Event Log Host Address      0.0.0.0                                  *
3                                                                              *
4      F) Event Log Filename          eventlog.txt                             *
5                                                                              *
6      G) TFTP Timeout                10 sec                                   *
7                                                                              *
8      H) Syslog Server Address       127.0.0.1                                *
9                                                                              *
0                                                                              *
1                                                                              *
2                                                                              *
3             Select a letter to configure an item, 'Q' to exit menu           *
4                                                                              *
**************************************CC**************************************
```

Figure 3-45. Event Log Menu

- **Current Alarms** *(Telnet/Terminal only)*—View list of root causes that have placed the Device Status in the alarmed state. (See *"Alarm Conditions"* on Page 128)
- **View Log**—View a list of events stored in the current log. Some of these events are stored in volatile memory and will be erased with a loss of power. The events are numbered for easier identification and navigation.
- **Clear Log**—Purges the log of all events

  TIP: Save your Event Log before choosing to clear it in order to retain potentially valuable troubleshooting information. (See *"Upgrading the Firmware"* on Page 102 for an overview on how to transfer files from the transceiver to a computer on the network using TFTP.)

- **Send Log** *(Telnet/Terminal only)*—Initiate TFTP transfer of the unit's event Event Log in a plain text (ASCII) file to a TFTP server at the remote location.
- **TFTP Host Address** *(Telnet/Terminal only)*—IP address of the computer on which the TFTP server resides. This same IP address is used in other screens/functions (reprogramming, logging, etc.). Changing it here also changes it for other screens/functions. [**Any valid IP address; 127.0.0.1**]

- **Filename** *(Telnet/Terminal only)*—Name to be given to the Event Log file sent to the TFTP server for archiving. [**Any 40-char alphanumeric string; Blank**]

  NOTE: You may want to change the filename to reflect the type of log you intend to archive and/or its date.
- **TFTP Time-out** *(Telnet/Terminal only)*—Time in seconds the TFTP server will wait for a packet ACK (acknowledgment) from the transceiver before suspending the file transfer. [**10 to 120 seconds; 10**]
- **Syslog Server**—IP address to which alarms are sent using the syslog message format. [**Any valid IP address; 0.0.0.0**]

View Current Alarms

Most events, classified as "critical" will make the PWR LED blink, and will inhibit normal operation of the transceiver. The LED will remain blinking until the corrective action has been completed.

An alarm condition is different from a log event in the sense that an alarm is persistent in nature. That is, an alarm condition remains as an alarm until it has been cleared by correcting the cause (see Table 4-6 on Page 130 for corrective action).

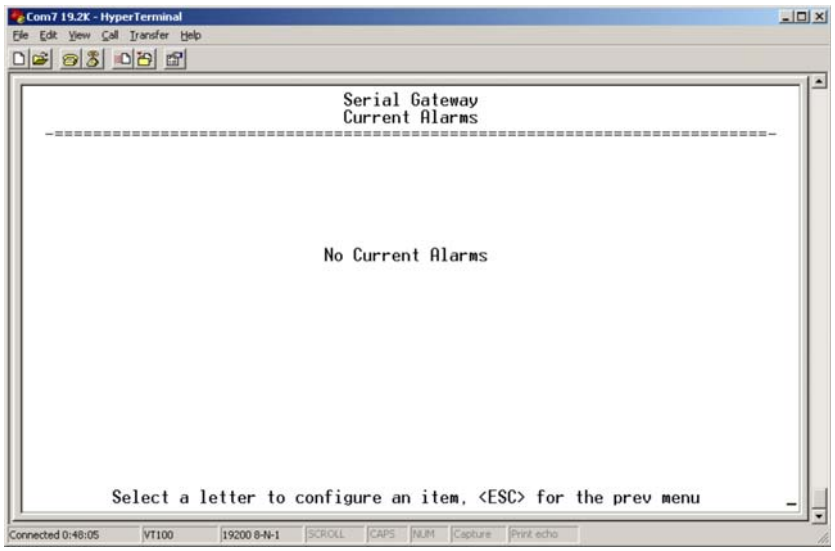


Figure 3-46. Current Alarms Screen

View Event Log

See Table 4-4 on Page 128 for event classifications.

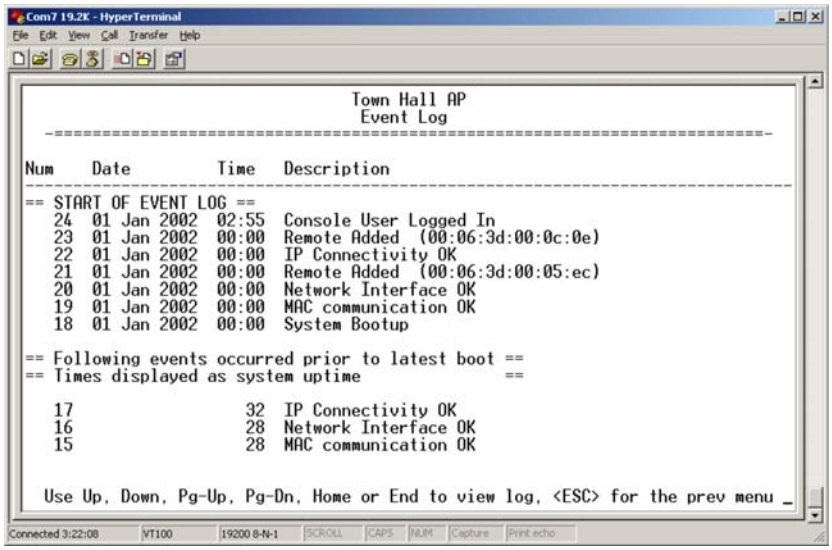


Figure 3-47. Sample Event Log Screen

Packet Statistics Menu

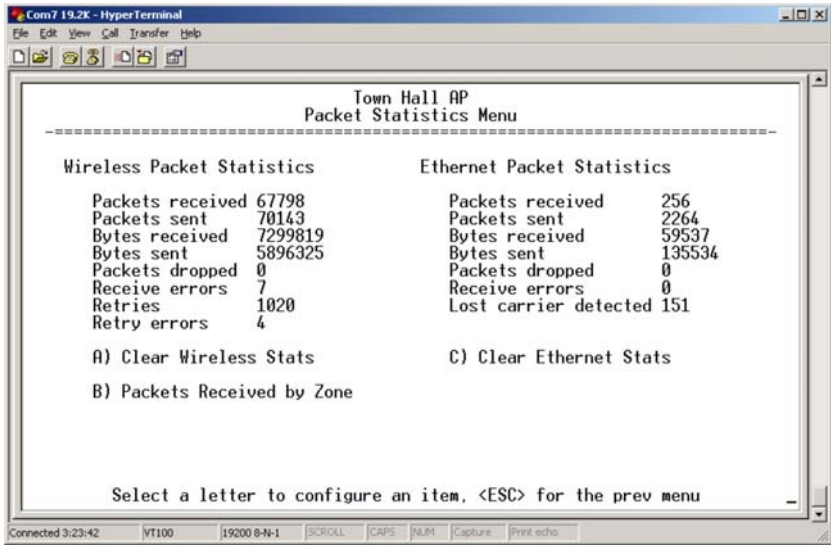


Figure 3-48. Sample Packet Statistics Menu

Wireless Packet Statistics

- **Packets received**—Over-the-air data packets received by this unit
- **Packets sent**—Over-the-air data packets sent by this Remote.
- **Bytes received**—Over-the-air data bytes received by this Remote.
- **Bytes sent**—Over-the-air data bytes sent by this Remote.
- **Packets dropped**—To-be-transmitted packets dropped as a result of a lack of buffers in the RF outbound queue.
- **Receive errors**—Packets that do not pass CRC. This may be due to transmissions corrupted by RF interference.

- **Retries**—Number of requests to re-send a data packet before it is acknowledged. If the packet was not acknowledged, this counter is not incremented.
- **Retry errors**—Packets discarded after exceeding seven retries over-the-air.
- **Clear Wireless stats**—Resets the statistics counter.

Ethernet Packet Statistics

- **Packets received**—Packets received by the transceiver through the Ethernet port.
- **Packets sent**—Packets transmitted by the transceiver through the Ethernet port.
- **Bytes received**—Data bytes received by this Remote through its LAN port.
- **Bytes sent**—Data bytes sent by this Remote.
- **Packets dropped**—Received packets dropped as a result of a lack of buffers.
- **Receive errors**—Packets that do not pass CRC. This may be due to collisions in the Ethernet LAN.
- **Lost carrier detected**—A count of the number of packets that the unit attempted to send out the Ethernet port when the carrier signal of the Ethernet was not present. (No carrier present could be due to a loose connection, bad or wrong cable, or equipment failure at the other end of the Ethernet cable.)
- **Clear Ethernet stats**—Resets the statistics counter.

Packets Received by Zone

This screen, shown in Figure 3-49, presents a breakdown of wireless packet statistics by-zone. All zones should report similar numbers. If one or more zones report lower numbers than the others (2% reduction), the specific zone is probably experiencing interference. An improvement can be realized by blocking this zone (see **Main Menu>>Radio Configuration>>Skip Zone Option**).

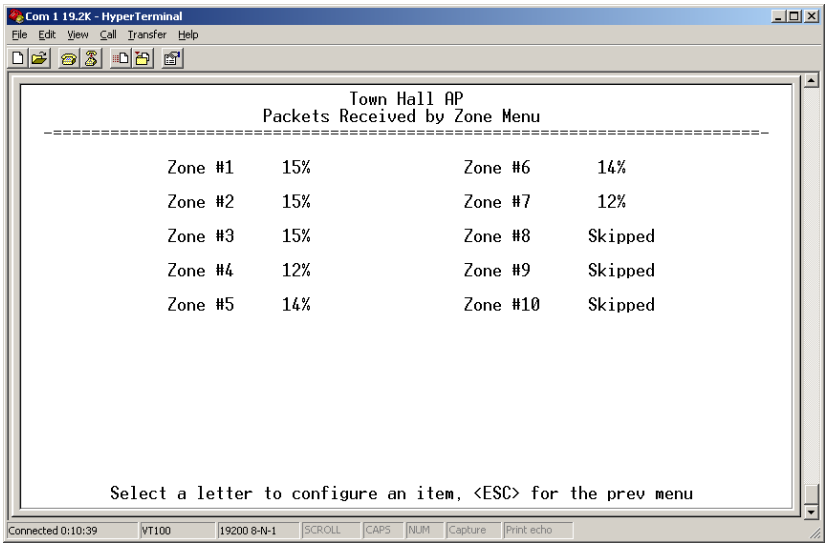


Figure 3-49. Packets Received By Zone Menu

Wireless Network Status

(Remotes Only)

The Wireless Network Status screen provides information on a key operating process of the transceiver—the association of the Remote with the Access Point. The following is a description of how this process takes place and as monitored on the *Figure 3-50. Wireless Network Status Screen"* on page 92.

The Transceiver's Association Process

After the Remote is powered up and finishes its boot cycle, it begins scanning the 900 MHz band for beacon signals being sent out from AP units. If the Remote sees a beacon with a *Network Name* that is the same as its own, the Remote will stop its scanning and temporarily synchronize its frequency-hopping pattern to match the one encoded on the AP's beacon signal. The Remote waits for three identical beacon signals from the AP and then it toggles into a fully synchronized "associated" state. If the Remote does not receive three identical beacons from the Access Point unit within a predetermined time period, it returns to a scanning mode and continues to search for an AP with a matching network name in its beacon.

Under normal circumstances, the association process should be completed within 20 seconds after boot-up. This time can vary depending on the beacon period setting at the AP. See **Beacon Period** description in Section 3.5.1, *Radio Configuration Menu* (beginning on Page 52).

Remote units are always monitoring the beacon signal. If an associated Remote loses the AP's beacon for more than 20 seconds, the association process starts again.

The Wireless Network Status Screen (Remote only)

```
**************************************CC**************************************
0                              Device Name Here                               *
1                          Wireless Network Status Menu                       *
2  -=============================================================================-  *
3                                                                             *
4         Device Status              Operational                              *
5                                                                             *
6         Connection Status          Associated                               *
7                                                                             *
8         Current Netname            mds-wlan                                 *
9                                                                             *
0         Current AP Serial Number   1354444                                  *
1                                                                             *
2         Current AP Eth Address     00:c0:69:00:01:03                        *
3                                                                             *
4         Connection Date            01 Jan 2005                              *
5                                                                             *
6         Connection Time            02:37                                    *
7                                                                             *
8      A) Beacon List                                                         *
9                                                                             *
0                                                                             *
1                                                                             *
2                                                                             *
3             Select a letter to configure an item, 'Q' to exit menu          *
4                                                                             *
**************************************CC**************************************
```

Figure 3-50. Wireless Network Status Screen

- **Connection Status**—Current state of the wireless network communication.
  - *Scanning*—The unit is looking for an Access Point beacon signal.

- *Exp(ecting) Sync(hronization)*—The unit has found a valid beacon signal for its network.
- *Hop Sync*—The unit has changed its frequency hopping pattern to match that of the Access Point.
- *Connected* —The unit has established a radio (RF) connection with the Access Point, but has not obtained cyber-security clearance to pass data.
- *Associated* —This unit has successfully synchronized and associated with an Access Point. This is the normal status.
- *Alarmed*—The unit is has detected one or more alarms that have not been cleared.

- **Current AP Mac Address**—Wireless address of Access Point with which the Remote is associated.
- **Current AP IP Address**—IP address of Access Point with which the Remote is associated.
- **Association Date**—Date of last successful association with an Access Point.
- **Association Time**—Time of day association was established on the association date.
- **Latest AP Firmware Version**—
- **AP Auto Upgrade**—
- **AP Reboot when Upgraded**—

Remote Listing Menu *(Access Points Only)*

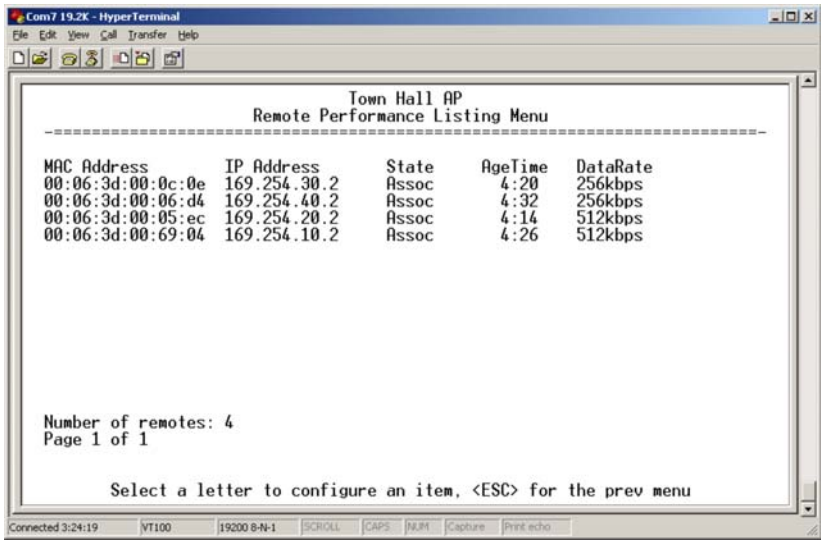


Figure 3-51. Remote Listing Menu
(List of transceivers associated with this AP)

- **MAC Address**—Hardware address of the Remote transceiver.
- **IP Address**—IP Address of the Remote transceiver.
- **State**—Current association state of the Remote transceiver.
- **AgeTime**—Time, in minutes, remaining before the device (address)

will be deleted from the table.

Each transceiver maintains a table with the addresses of the devices it communicates with. The age-time countdown is restarted to 5 minutes every time a message to/from that device is detected. If no traffic is exchanged with that device, it then “ages out” of the table. When traffic is detected it is included again in the table. This optimizes memory space utilization.

- **DataRate**—Supported data rate by this unit.

Endpoint Listing Menu

(Access Points Only)

This list shows all of the non-Mercury 900 Ethernet devices that are known to the transceiver and is equivalent to the ARP table of IP devices.

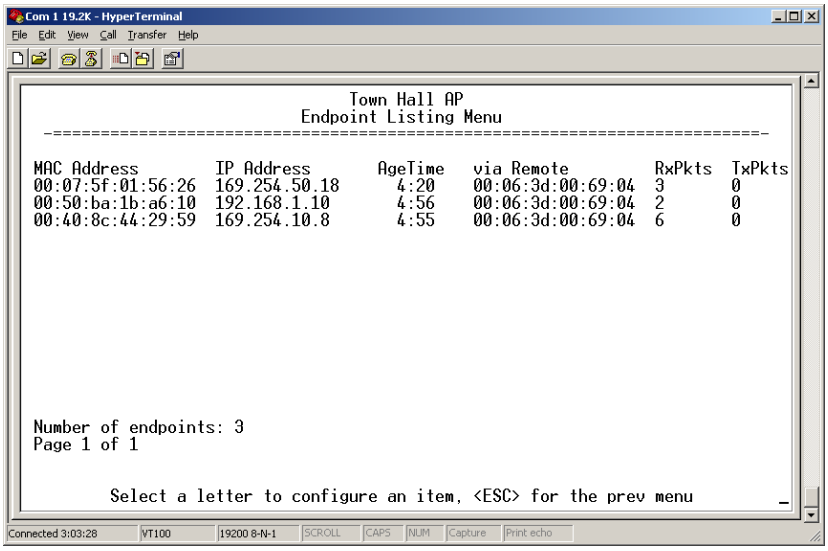


Figure 3-52. Endpoint Listing Menu

(Lists all equipment attached to REMOTE transceivers in the network)

- **MAC Address**—Hardware address of endpoint device.
- **IP Address**—IP Address of endpoint device.
- **AgeTime**—Time, in minutes, remaining before the device (address) will be deleted from the table.

  Each AP maintains a table with the addresses of the remote radios it communicates with. The age-time countdown is restarted to 5 minutes every time a message to/from that remote is detected. If no traffic is exchanged with that remote, it then “ages out” of the table. When traffic is detected it is included again in the table. This optimizes memory space utilization.
- **via Remote**—Hardware address of the radio connected to this device.
- **RxPkts**—Over-the-air data packets received by the transceiver. and

passed on to the endpoint device.

- **TxPkt**—Number of packets received from the endpoint device and passed over-the-air.

Remote Performance Listing Menu

(Access Points Only)

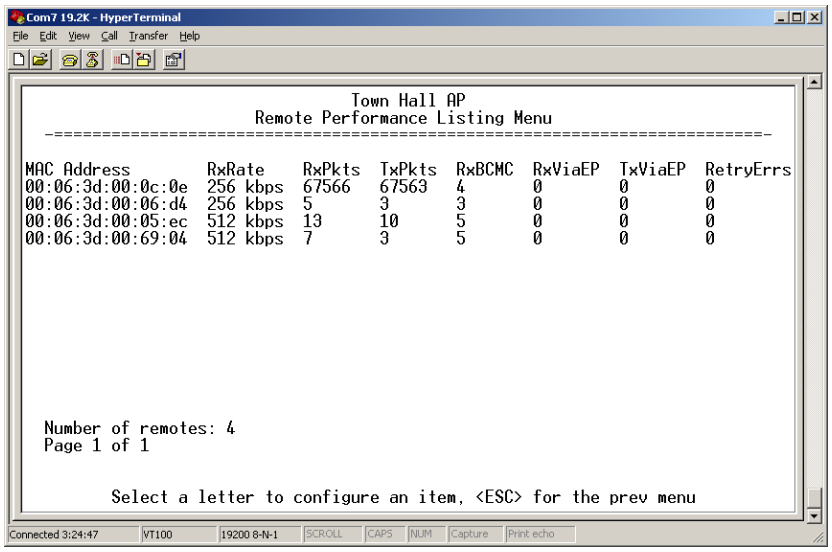


Figure 3-53. Remote Performance Listing Menu for AP

This screen provides a unit-by-unit summary of all Remote units currently associated with this Access Point. The parameters are displayed in a column format with each line corresponding to one Remote.

- **RxRate**—Over-the-air data rate the radio is currently using. All transceivers do not need to use the same rate.
- **RxPkts**—Over-the-air data packets received from this unit.
- **TxPkts**—Over-the-air data packets sent to this unit.
- **RxBCMC**—Total number of Broadcast and/or Multicast packets received over-the-air.
- **RxViaEP**—Packets received by the transceiver through the Ethernet port.
- **TxViaEP**—Packets sent by the transceiver through the Ethernet port.
- **RetryEr**—Packets discarded after exceeding five retries over-the-air.

Serial Data Statistics Menu

This screen provides a summary of port activity for both serial data ports. These values will be reset to zero after a reboot cycle.

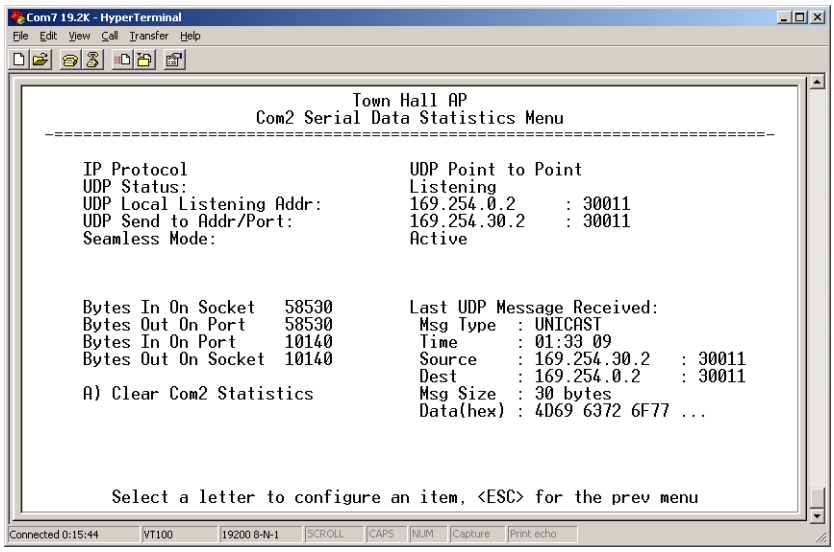


Figure 3-54. Serial Data Statistics Screen

- **Bytes in on port—**Number of bytes received by the transceiver through the serial interface
- **Bytes out on port—**Number of bytes transmitted by the transceiver through the serial interface
- **Bytes in on socket—**Number of bytes received by the transceiver through the IP socket
- **Bytes out on socket—**Number of bytes transmitted by the transceiver through the IP socket

  In general, the number of bytes **Out on Socket** should follow the number of bytes **In On Port** as all bytes received on the serial port should be transmitted out to the IP interface. The same should be true in the opposite direction, bytes **Out On Port** should follow bytes **In On Socket.**
- **Clear Com1 Statistics**—Resets counter to zero.

3.8.2 Network Performance Notes

Principles of Network Operation

The following is a list of points that are useful for dealing with the networking aspects of the transceiver.

1. The transceiver acts as a bridge.

- If any radio in your network is connected to a large LAN, such as may be found in a large office complex, there may be undesired multicast/broadcast traffic over the air. As a bridge, the radios transmit this type of frame.
- The radio goes through a listening and learning period at start-up before it will send any packets over either of its ports. This is about 10 seconds after the CPU's operating system has finished its boot cycle.
- The bridge code in the transceiver operates and makes decisions about packet forwarding just like any other bridge. The bridge code builds a list of source MAC addresses that it has seen on each of its ports.
  There are a few general rules that are followed when a packet is received on any port:
  - If the destination address is a multicast or broadcast address, forward the packet to all remotes.
  - If the destination address is not known, forward the packet to all remotes.
  - If the destination address is known, forward the packet to the port that the destination is known to be on (usually the RF port).
  - The bridge code uses Spanning Tree Protocol (STP) to prevent loops from being created when connecting bridges in parallel. For example, connecting two remotes to the same wired LAN could create a loop if STP was not used. Every bridge running STP sends out Bridge Protocol Data Units (BPDUs) at regular intervals so that the spanning tree can be built and maintained. BPDUs are 60-byte multicast Ethernet frames.

2. Distance affects throughput. Because of timers and other components of the protocol, there is a maximum distance limit of 40 miles for reliable operation. After this, although data still flows, the throughput will start to drop and latency will increase, due to additional retries between the radios. Repeater stations may be used to extend this range.

3. Throughput calculations must take into account all overhead.

The following is an example of the overhead at each layer for a 100-bytes of data over UDP:

- Data: 100 bytes
- UDP header: 8 bytes
- IP header: 20 bytes
- Ethernet header: 14 bytes
- 802.11 header 24 bytes
- LLC and SNAP header: 8 bytes
- MDS PHY header and FCS: 16 bytes

Total over-the-air frame size=190 bytes

If the frame is directed (for example: not multicast/broadcast), the 802.11 ACK frame must be accounted for:

- 14 bytes—802.11 ACK
- 30 bytes—Over-the-air ACK frame (including 16 MDS PHY bytes)

If the 802.11 encapsulated Ethernet frame (NOT the UDP or Ethernet frame) exceeds the RTS threshold, then the overhead for RTS/CTS frames must also be accounted for.

- 20 bytes—802.11 RTS.
- 14 bytes—802.11 CTS.
- 66 bytes—Total Over-the-air bytes for RTS/CTS with MDS PHY headers.

If the frame is TCP, then there is a 32-byte TCP header instead of the 8-byte UDP header.

- ARP requests, ARP replies and BPDU's will affect throughput.
- ARP requests are 60-byte Ethernet frames. 142 bytes over-the-air.
- ARP replies are 60-byte Ethernet frames. 142 bytes over-the-air.
- BPDUs are 60-byte Ethernet frames. 142 bytes over-the-air.

Note that the overhead to put a single Ethernet frame over-the-air is 82 bytes. If RTS/CTS is invoked, it is 148 bytes. Therefore, the overhead for a minimal Ethernet frame (60 bytes) is 128% and, as such, gives the transceiver a poor small-packet performance.

4. Station-to-Station traffic reduces throughput

- When sending frames from an endpoint connected to one transceiver to *another* endpoint with a different transceiver, the throughput will be halved at best. This is because all frames must go through the AP and thus are transmitted twice over the same radio system. Therefore, in the previous 100-byte UDP example, the number of over-the-air bytes will be 380 bytes (190 bytes x 2) if the frame has to go station-to-station.

5. Interference has a direct correlation to throughput.

- Interference could be caused by any unnecessary traffic on the network from unrelated activities, or Radio Frequency Interference in the wireless spectrum.

Tips for Optimizing Network Performance

Here are some suggestion on things to try that may maximize throughput:

1. *AP Only:* Increment the **Dwell Time** to the maximum of 262.1 ms. This lowers the overhead since it will stay longer on a channel. The down side is that if a particular channel is interfered with it will take longer to hop to another channel.
   (**Main Menu>>Radio Configuration>>Dwell Time**)

2. *AP Only:* Change the **Beacon Period** to **Normal** (508 ms). This will also reduce the overhead of beacons sent out. On the down side, association time may be a little longer.
   (**Main Menu>>Radio Configuration>>Beacon Period**)

3. Change the **Fragmentation Threshold** to the maximum of 1600. Longer packets will be sent over the air reducing overhead. On the other hand, if a packet is corrupted it will take longer to be retransmitted.
   (**Main Menu>>Radio Configuration>>Fragmentation Threshold**)

4. Increase the **RTS Threshold** to 1600. RTS mechanism is used to reserve a time slot if packets exceed this number. On the other hand, a hidden-node might interfere more often than if RTS was not used.
   (**Main Menu>>Radio Configuration>>RTS Threshold**)

   Decreasing the **RTS Threshold,** to the 100 to 200 range, may improve throughput on a busy network. It will add small packets, but reduce collisions (and resulting re-tries) of large packets.
   (**Main Menu>>Radio Configuration>>RTS Threshold**)

5. Activate compression on the Radio Configuration Menu (**Compression enabled**).

6. Use the **Performance Information Menu** to check the packets received by zone. (Remotes Only: **Main Menu>>Performance Information>>Packet Statistics>>Packets Received by Zone**)

   Readings should be close in value. A significantly lower value (2% reduction) probably indicates interference. Performance can be improved by blocking the affected zones at the Access Point. (**Main Menu>>Radio Configuration>>Skip Zone Option**)

7. Use the **Performance Information Menu** to check for errors, retries and dropped packets. Do the same with Ethernet traffic.

   With weak signals, interference, or hidden nodes, the optimal performance may be lower due to collisions and retries.

Data Latency—TCP versus UDP Mode

The latency of data passing through a network will depend on user data message length, the overall level of traffic on the network, and the quality of the radio path.

Under ideal conditions—low traffic and good RF signal path—the latency for units operating in the TCP mode, will typically be around 5 ms in each direction. However, when UDP multicast traffic is transported, the outbound packet latency (from AP to remote) is dependent on the beacon period.

UDP multicast packet latency can be minimized by setting the **Beacon Period** to **Fast** (52 ms). Changing beacon rate to **Fast** will result in an average latency of 31 ms, assuming outbound packets wait for a beacon transmission 50% of the time (26ms) plus the normal packet latency (5 ms).

Data Compression

Enabling this option uses an LZO compression algorithm for over-the-air data. Varying levels of data reduction are achieved depending on the nature of the data. Text files are typically the most compressible, whereas binary files are the least compressible. On average, a 30% increase in throughput can be achieved with compression enabled.

Compression is used on data packets of 100 bytes or more, including Ethernet, IP, and TCP/UDP headers.

Packets-per-Second (PPS)

The radio has a limit of 70 PPS. Consider this restriction when planning your network, especially when smaller packets are expected to make up the majority of the traffic as is the case with VoIP (Voice over IP).

3.9 MAINTENANCE

In the course of operating a wireless network, you will likely want to take advantage of product improvements, and to read and archive the configuration of your individual transceivers using the *Maintenance Menu*. This section provides detail information on how to take advantage of these services.

The maintenance tasks for the transceiver are:

- **Reprogramming**— Managing and selecting the unit's operating system firmware resources. *(See "Reprogramming Menu"* on Page 101*)*

- **Configuration Scripts**—Saving and importing data files containing unit operating parameters/settings. *(See "Configuration Scripts Menu"* on Page 106*)*
- **Authorization Key**—Alter the unit's overall capabilities by enabling the built-in resources. (*See "Authorization Keys Menu"* on Page 114*)*
- **Auto-Upgrade/Remote-Reboot**—Configure when remotes retrieve new firmware versions from the associated AP, and whether or not they reboot to the new firmware after receiving the new firmware. (See *"Auto-Upgrade/Remote-Reboot Menu"* on Page 115)
- **Radio Test**—A diagnostic tool for testing RF operation. (See *"Radio Test Menu"* on Page 116)
- **Ping Utility**—Diagnostic tool to test network connectivity. (See *"Ping Utility Menu"* on Page 117)

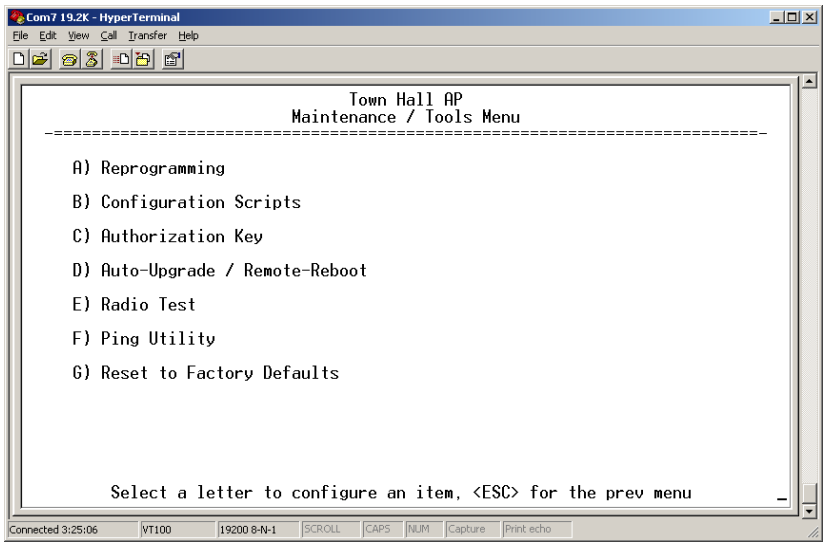


Figure 3-55. Maintenance Menu

3.9.1 Reprogramming Menu

The transceiver has two copies of the firmware (microprocessor code) used for the operating system and applications. One copy is "active" and the second one is standing by, ready to be used. You can load new firmware into the inactive position and place it in service whenever you desire.

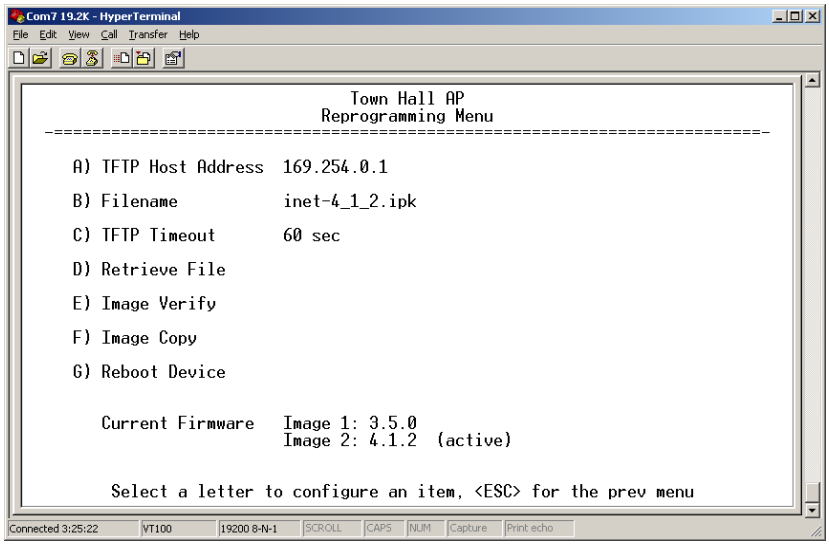


Figure 3-56. Reprogramming Menu
(Shown with "Image Copy" Selected)

- **TFTP Host Address**—IP address of the host computer from which to get the file. [**Any valid IP address**] This same IP address is used in other screens/functions (reprogramming, logging, etc.). Changing it here also changes it for other screens/functions.
- **Filename**—Name of file to be received by the TFTP server. [**Any 40-character alphanumeric string**] Verify that this corresponds to the TFTP directory location. May require sub-directory, for example: **\firmware\mercury\mercury-4_4_0.ipk**.
- **TFTP Timeout**—Time in seconds the TFTP server will wait for a packet ACK (acknowledgment) from the *transceiver* before suspending the file transfer. [**2 to 60 seconds; 10**]
- **Retrieve File**—Initiate the file transfer from the file from TFTP server. Placed into inactive firmware position in the *transceiver*'s non-volatile memory [**Y, N**]
- **Image Verify**—Initiate the verification of the integrity of firmware file held in unit.
- **Image Copy**—Initiate the copying of the active firmware into the inactive image.
- **Reboot Device**—Initiate rebooting the transceiver. This will interrupt data traffic through this unit, and the network if performed on an Access Point. Intended to be used to toggle between firmware images.

NOTE: See *"Upgrading the Firmware"* on Page 102 for details on setting up the TFTP server.

Upgrading the Firmware

From time-to-time MDS offers upgrades to the transceiver firmware. One version of the firmware provides core software resources for all

transceiver models. Loading new firmware into the unit will not alter any privileges provided by Authorization Keys and does *not* require the transceiver be taken off-line until you want to operate the unit from the newly installed firmware image.

You must use the embedded Management System for all firmware activities, including uploading from a TFTP server.

File transfers can be initiated through any of the three Management System gateways:

- **Terminal-Emulator**—Use a terminal emulator program on your PC, such as HyperTerminal, connected directly to the transceiver's COM1 port via a serial cable.
- **Telnet**—Text-based access to the Management System through a network connection.
- **Web Browser**—Connect to the transceiver using a Web browser on a local PC connected directly to the radio's LAN port or associated network.

Firmware images are provided free-of-charge on the MDS Web site at:
www.microwavedata.com/service/technical/support

Installing New Firmware by TFTP

To install firmware by TFTP, you will need:

- A PC with a TFTP server running.
- The IP address of the PC running the TFTP server.

If you do not know your computer's address on a Windows PC, you can use the **RUN** function from the **Start** menu and enter **winipcfg** or **ipconfig** to determine your local PC's IP address. The IP address of the radio can be found under the Management Systems' **Configuration** menu.
(*See "Network Configuration Menu"* on Page 44.)

A TFTP server is available on the MDS Web site at:
www.microwavedata.com/service/technical/support/downloads.asp

There are several alternatives to connecting the transceiver for firmware upgrade. Figure 3-57 and Figure 3-58 show two variations. It is essential all of the equipment be on the same subnet.

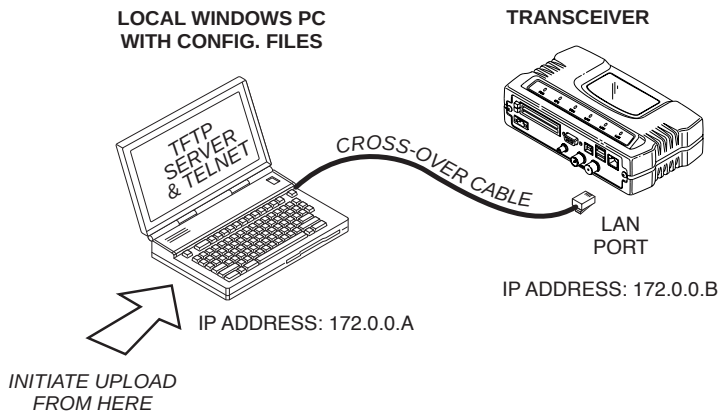


Figure 3-57. Firmware Upgrade Setup—Option 1
(TFTP Server and Firmware File on Same CPU)

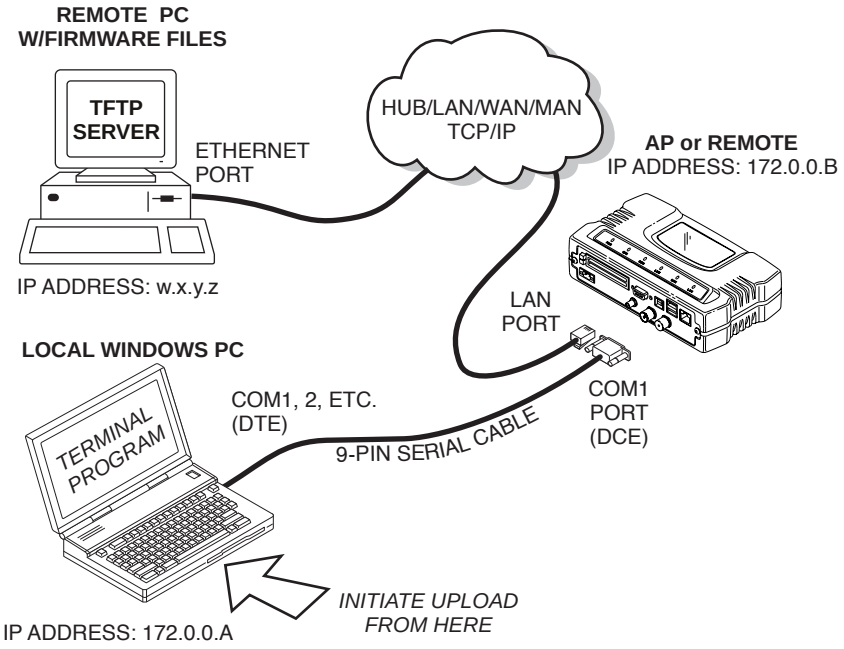


Figure 3-58. Firmware Upgrade Setup—Option 2
(TFTP Server and Firmware File on Remote Server)

NOTE: The LAN and COM1 ports share a common data channel when loading firmware over-the-air. Transferring the radio firmware image file (≈ 3 Mb), may take several minutes depending on traffic between the TFTP server and the transceiver.

Regardless of your connection to the transceiver, loading firmware/configuration files into the unit's flash-RAM is much slower than loading software onto a PC hard drive or RAM.

Upgrade Procedure

To load a new firmware file (**filename.ipk**) into the transceiver, use the following procedure:

1. Launch a TFTP server on a PC connected either directly or via a LAN to the Ethernet port (LAN) of the radio. Point the server towards the directory containing the firmware image file.

2. Connect to the Management System by whichever means is convenient: Browser or Telnet via the LAN, or Terminal emulator via the COM1 port.

3. Go to the MS Reprogramming Menu.
(**Main Menu>>Maintenance Menu>>Reprogramming Menu**)

4. Fill in the information for the:

   - **TFTP Host Address**—IP Address of server (host computer) running TFTP server.
   - **Retrieve File**—Name of file **(filename.ipk)** to be pulled from the TFTP server holding the firmware file.

5. Pull the firmware file through the TFTP server into the transceiver.
(**Main Menu>>Maintenance Menu>>Reprogramming Menu>>Retrieve File**)

   Status messages on the transfer are posted on the Management System screen.

NOTE: The new firmware image file that replaces the "Inactive Image" file will be automatically verified.

---

6. Reboot the transceiver.
Main Menu>>Maintenance Menu>>Reprogramming Menu>>Reboot Device

---

NOTE: When upgrading to firmware 6.0.0 or later, the unit creates internal files following the first reboot. This one-time process delays the response of the HTTP interface for 5-10 minutes. If DC power is cycled (turned off and back on) during this process, the files will have to be created again. It is recommended that you wait until this 5-10 minute process is complete before verifying operation of HTTP, HTTPS, or SSH.

---

7. Test the transceiver for normal operation.

End of Procedure

Error Messages During File Transfers

It is possible to encounter errors during a file transfer. In most cases errors can be quickly corrected by referring to Table 3-6.

Table 3-6. Common Errors During TFTP Transfer

Error Message	Likely Cause/Corrective Action
Invalid File Type	Indicates that the file is not a valid firmware file. Locate proper file and re-load.
File not found	Invalid or non-existent filename on TFTP server
Invalid file path	Invalid or non-existent file path to TFTP server
Timeout	TFTP transfer time expired. Increase the timeout value.
Flash Error	Flash memory error. Contact factory for assistance.
Bad CRC	Cyclic Redundancy Check reporting a corrupted file. Attempt to re-load, or use a different file.
Version String Mismatch	Invalid file detected. Attempt to re-load, or use a different file.
Sending LCP Requests	The PPP server is querying for any clients that may need to connect.
Port not Enabled	The serial port is disabled.

3.9.2 Configuration Scripts Menu

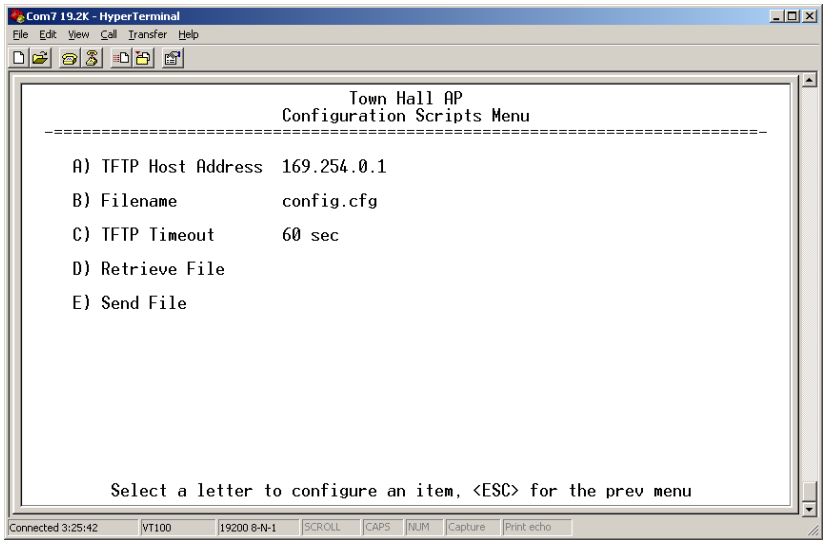


Figure 3-59. Configuration Files Menu

- **TFTP Host Address**—IP address of the computer on which the TFTP server resides. [**Any valid IP address**]

- **Filename**—Name of file containing this unit's configuration profile that will be transferred to the TFTP server. The configuration information will be in a plain-text ASCII format. [**Any 40-character alphanumeric string**] May require sub-directory, for example: **config\mercury-config.txt.** (See *"Using Configuration Scripts"* on Page 107)

  NOTE: The filename field is used in identifying the desired incoming file and as the name of file being exported to the TFTP server. Before exporting the unit's configuration, you may want to name it something that reflect the unit's services or identification.
- **TFTP Timeout**—Time in seconds the TFTP server will wait for a packet ACK (acknowledgment) from the *transceiver* before suspending the file transfer. [**10 to 120 seconds; 10**]
- **Retrieve File**—Initiate the file transfer of the configuration file from TFTP server into the transceiver.
- **Send File**—Initiate the file transfer from the transceiver's current configuration file to TFTP server.

NOTE: See *Upgrading the Firmware* on Page 102 for details on setting up the TFTP server.

A Brief Description of Configuration Files

If you plan to have more than a few radios in your network, use the configuration file feature to configure similar units from a common set of parameters. There are over 50 user-controllable settings that can be used to optimize the network and saved into a Configuration File. However, only four essential parameters need to be reviewed and altered to use the file with another transceiver.

A Configuration File (data file) will make it easy to apply your unique settings to any radio(s) you wish. Configuration files will also provide you with a tool to restore parameters to a "known good" set, in the event that a parameter is improperly set and performance is affected. (See *"Using Configuration Scripts"* on Page 107 for detailed instructions and a sample configuration file.)

Using Configuration Scripts

Configuration Scripts can be created and downloaded from the transceiver that contain a wealth of information on the unit. This file can serve many purposes, not the least of which is to keep a permanent "snapshot" of the unit's configuration at a point in time. These files can also be used to view the setup of a unit without needing to connect to it. Examining archival files can be a useful source of information during troubleshooting.

In the next few sections you will learn about the contents of the file and, how to use it as a template for configuring multiple transceivers with the

same profile. Ultimately, standardized files can be uploaded into the transceiver to speed up the installation process.

Configuration Files can also be uploaded into a transceiver to restore the settings of a unit using a previously-saved configuration of the unit. This is particularly convenient after finishing a test using some experimental settings.

Sample of an Exported Configuration File

The following is a sample of a typical configuration file as produced by a transceiver containing over 150 parameters; many of which are user editable. The presentation has been slightly altered to allow notes to appear below associated parameter lines. Some of the values used in the calibration of the unit's built-in test equipment have been deleted to reduce space. This presentation is offered as a guide to the type of information contained in the file. See *"Editing Configuration Files"* on Page 113 for further information.

NOTE: The parameter names and the data values from the Exported Configuration File are shown in bolded text. Any description will be found below in an indented paragraph. Descriptions for parameters that are functionally identical to both COM1 are not repeated.

Beginning of Configuration File

; MDS mercury

; Created 00-03-2002 6:59:41

IP Address: 192.168.1.1

The IPv4 address of this unit. This field is unnecessary if DHCP is enabled.

NOTE: Changing the IP value via the network will cause a loss of communication with other devices unaware of the new address.

IP Netmask: 255.255.255.0

The IPv4 local subnet mask. This field is unnecessary if DHCP is enabled.

IP Gateway: 0.0.0.0

The IPv4 address of the network gateway device, typically a router. This field is unnecessary if DHCP is enabled.

Ethernet Address: 00:06:3D:00:00:5D

The physical Ethernet MAC (Media Access Controller) address of the device. This value is set by the factory and cannot be changed.

Wireless Address: 00:06:3D:00:00:5C

The physical wireless MAC (Media Access Controller) address of

the device. This value is set by the factory and cannot be changed.

Model Number: 900

The model number of this unit. This value is set by the factory and cannot be changed.

Serial Number: 1026295

The serial number of this unit. This value is set by the factory and cannot be changed.

Unit Name: Library Admin Office

A name for this unit. It appears at the top of every menu screen.

Owner: Hilltop College IT

The name of the owner of this unit.

Contact: IT Dept. X232

The contact person regarding this unit.

Description: Link to Campus Server

A brief general description of this unit.

Location: Hollister Bldg. RM450

The location of this unit.

Com1 Port Config: 8N1

Configuration of character size, type of parity, and number of stop bits to be used.

Max Remotes Allowed: 50

The maximum number of remotes allowed to connect to this Access Point.

Device Mode: Access Point

Configures the unit to act as a Remote or an Access Point. The Access Point option is not allowed unless the unit is specifically ordered as such, or an Authorization Key has been purchased to allow it.

Dwell Time: 32.8

The amount of time the unit spends at any given frequency in its hopping pattern. This field is only changeable by an Access Point. Remotes read the Masters value upon association.

Hop Pattern: 1

RSSH Calibration: 235

RSSL Calibration: 190

Freq Calibration: 8402

Network Name: West Campus Net

The name of the network this unit belongs to. The unit will only communicate with devices having identical *Network Names*.

Date Format: Generic

Specifies the format of the date.

- Generic = dd Mmm yyyy
- European = dd-mm-yyyy
- US = mm-dd-yyyy

Console Baud: 19200

The baud rate of the serial menu console. Default value is 19200 bps.

Company Name: MDS

Version Name: 06-1234567

Product Name: mercury

Beacon Period: Normal

The amount of time in milliseconds between beacon transmissions by the AP.

Data Rate: 512 kbps

The selected over-the-air data rate. A lower data rate generally allows more distance between the unit and its Access Point.

RF Output Power Setpoint: 30

The desired amount of RF output power, measured in dBm.

Power Cal Table DAC1: 98

21 additional values follow; do not alter

Active Boot Image: 0

Tx Coefficient1: 0

31 additional values follow; do not alter

Rx Coefficient1: 0

14 additional values follow; do not alter

Skipped Hop Zone1: Active

Skipped Hop Zone2: Skip

Skipped Hop Zone3: Active

Skipped Hop Zone4: Active

Skipped Hop Zone5: Active

Skipped Hop Zone6: Active

Skipped Hop Zone7: Active

Skipped Hop Zone8: Active

Skipped Hop Zone9: Active

Skipped Hop Zone10: Active

Firmware TFTP Host IP: 63.249.227.105

Address of the TFTP Host from which firmware images are downloaded

Firmware TFTP Filename: mercury-4_4_0.ipk

Eventlog TFTP Host IP: 192.168.1.3

Address of TFTP Host to which to send the event log

Eventlog TFTP Filename:

Config Script TFTP Host IP: 192.168.1.33

Address of TFTP Host to which to send the event log

Config Script TFTP Filename: mercury_config.txt

Fragmentation Threshold: 1600

Maximum packet size allowed before fragmentation occurs

RTS Threshold: 500

Number of bytes for the RTS/CTS handshake boundary

RSSI Threshold: 0

RSSI value at that the connection is deemed “degraded”

SNR Threshold: 0

SNR value at that the connection is deemed “degraded”

SNMP Read Community: public

Community string for read access using SNMPv1

SNMP Write Community: private

Community string for write access using SNMPv1

SNMP Trap Community: public

Community string sent with traps using SNMPv1

SNMP Trap Manager #1: 0.0.0.0

IP Address of a SNMP manager to which traps will be sent

SNMP Trap Manager #2: 0.0.0.0

SNMP Trap Manager #3: 0.0.0.0

SNMP Trap Manager #4: 0.0.0.0

SNMP Trap Manager #5: 0.0.0.0

Auth trap enable: disabled

Setting to enable SNMP authentication traps

Trap Version: v1 Traps

Selects which SNMP trap format

Package 1 Version: 1.1.0

Indicates the version of firmware in Image 1

Package 2 Version: 1.1.0

TFTP Timeout: 20

Com1 Serial Data Enable: disabled

Setting to enable COM1 data mode

Com1 Serial Data Mode: UDP

IP Protocol for COM1 data mode

Com1 Serial Data Baud Rate: 9600

Baud rate for COM1 data mode

Com1 Serial Data Tx IP Address: 0.0.0.0

COM1 data will be sent to this IP address

Com1 Serial Data Tx IP Port: 0

COM1 data will be sent to this IP port

Com1 Serial Data Rx IP Port: 0

COM1 data will be received on this IP port

Com1 Serial Data Rx IP Address: 0.0.0.0

COM1 data will be received on this IP address

SNTP Server IP: 0.0.0.0

The IPv4 address of NTP/SNTP Time Server

Com1 Serial Data Seamless Mode: enabled

Setting to enable seamless mode for COM1 data mode

Com1 Serial Data Delimiter Chars: 4

Minimum number of characters which will be considered a gap in seamless mode for COM1

Com1 Serial Data Buffer Size: 20

Number of output characters which will be buffered in seamless mode for COM1

RF Frequency Hopping Format: USA/CANADA

(Read Only) The frequency-hopping rules the radio is configured to operate under

SNMP Enable: disabled

Enable/Disable SNMP Agent

Hop Protocol: 1

Frequency hopping protocol version

DHCP Server Enable: disabled

Enable/Disable DHCP Server Daemon

DHCP Netmask: 255.255.255.0

The IP Address to be used as the DHCP Netmask

DHCP Start Address: 192.168.0.11

The IP Address to be used as the starting address

DHCP End Address: 192.168.0.22

The IP Address to be used as the ending address

Approved Remotes List Enable: disabled

Setting to enable the Approved Remotes List

Encryption Enable: disabled

Setting to enable over-the-air data encryption

HTTP Enable: enabled

Setting to enable the HTTP interface

Telnet Enable: enabled

Setting to enable the Telnet interface

HTTP MD5 Authentication: disabled

Setting to enable MD5 Digest Authentication

Automatic Key Rotation: disabled

Setting to enable Automatic Key Rotation

Approved APs List Enable: disabled

Setting to enable the Approved Access Points List

Watch-Link-Status Flag @ AP: disabled

A flag that controls whether the Remotes care about the AP's Ethernet Link Status

Network Name Hash Enable: disabled

A flag that controls whether MD5 hashing is applied to the network name

End of Configuration File

Editing Configuration Files

Once a Remote unit's operation is fine-tuned, use the *Configuration Scripts Menu* on Page 106 to save a copy of the configuration in a PC. Once the file is saved in the PC it can be used as a source to generate modified copies adjusted to match other devices. The configuration files can be modified using a text editor or an automated process. (Not provided by MDS).

We recommend that you review and update the following parameters for each individual unit. Other parameters may also be changed.

Table 3-7. Common User-Alterable Parameters

Field	Comment	Range
IP Address	Unique for each individual radio	Any legal IP address
IP Gateway	May change for different groups or locations	Any legal IP address
Unit Name	Should reflect a specific device. This information will appear in Management System headings	Any 20-character alphanumeric string
Location	Used only as reference for network administration	Any 40-character alphanumeric string

Table 3-7. Common User-Alterable Parameters *(Continued)*

Field	Comment	Range
System Mode	The application of the parameter in this field is dependent on the authorized options stored in the unit's permanent memory. The mode must be compatible with any previously installed Authorization Keys.	"Access Point" "Dual Remote" "Serial Remote" "Ethernet Remote" NOTE: These are case-sensitive.
Network Name	Used to identify different groups or locations	Any 15-character alphanumeric string

Each resulting file should be saved with a different name. We recommend using directories and file names that reflect the location of the unit to facilitate its identification.

Editing Rules

- You may include only parameters you want to change.
- Change only the parameter values.
- Capitalization counts in some field parameters. (Example: System Mode)
- Comment Fields
    a. Edit, or delete anything on each line to the right of the comment delineator, the semicolon (;).
    b. Comments can be of any length, but must be on the same line as the parameter, or on a new line that begins with a semicolon character.
    c. Comments after parameters in files exported from a transceiver do not need to be present in your customized files.

3.9.3 Authorization Keys Menu

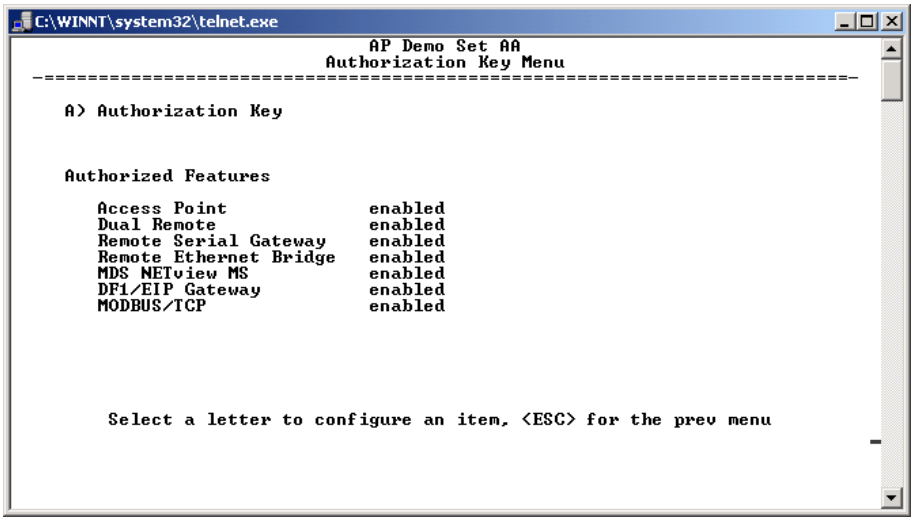


Figure 3-60. Authorization Key Menu

- **Authorization Key**—Initiate the entering of an Authorization Key into the transceiver's non-volatile memory.
- **Authorized Features**—List of authorized features available for use [**enabled, disabled**].

  Some models will show an additional selection called **Encryption** under Authorized Features.

3.9.4 Auto-Upgrade/Remote-Reboot Menu

NOTE: This menu is only available when MDS NETview MS key is enabled.

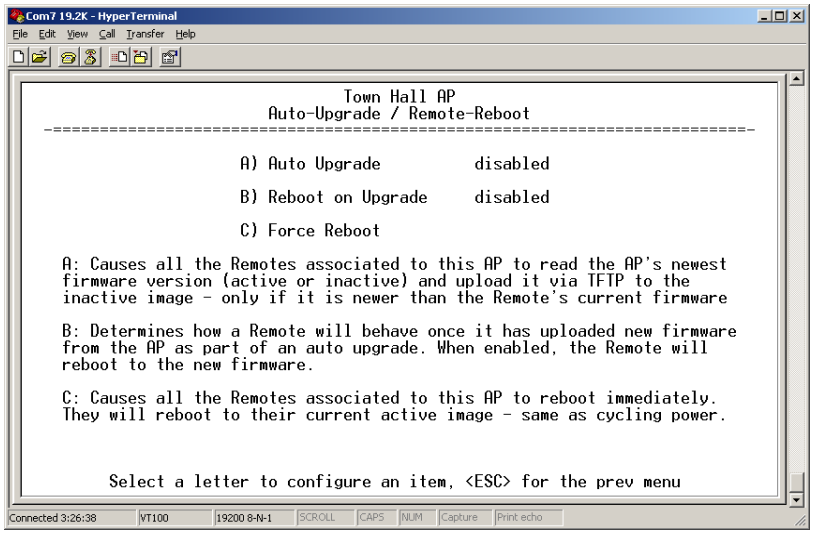


Figure 3-61. Auto-Upgrade / Remote Reboot Menu

- **Auto Upgrade**—Causes all of the Remotes associated to this AP to read the AP's newest firmware version (active or inactive) and upload it via TFTP to the inactive image, but only if it is newer than the Remote's current firmware.
- **Reboot on Upgrade**—Determines how a Remote will behave once it has uploaded new firmware from the AP as part of an auto-upgrade. When enabled, the Remote will reboot to the new firmware.
- **Force Reboot**—Causes all of the Remotes associated to this AP to reboot immediately. They will reboot to their current active image—the same as if the power were re-cycled.

NOTE: To use the Auto Upgrade/Reboot feature, both the AP and Remotes must already be running version 4.4.0 or newer firmware.

Exception: If the AP has already been upgraded to version 4.4.0 and the Remote is still at 3.5.0 or older, you can upgrade the Remote by using the AP as a file server. This method allows for only one remote to be upgraded at a time. Instructions for this method are given below.

Firmware Upgrade (with AP Acting as a File Server)

An AP running firmware version 4.4.0 (or newer) may be used as a file server to upgrade Remotes running older firmware (3.5.0 or earlier). Follow the steps below to perform the upgrade:

1. At the Reprogramming Menu (Page 102), Enter the AP's IP Address in the TFTP Server field.

2. Enter **upgrade_from_ap.ipk** in the Filename field.

NOTE: The filename is case sensitive.

3. Perform the firmware download.

3.9.5 Radio Test Menu

This area provides several useful tools for installers and maintainers. You can manually key the radio transmitter to make measurements of antenna performance. (See *"Antenna Aiming"* on Page 135 for details.)

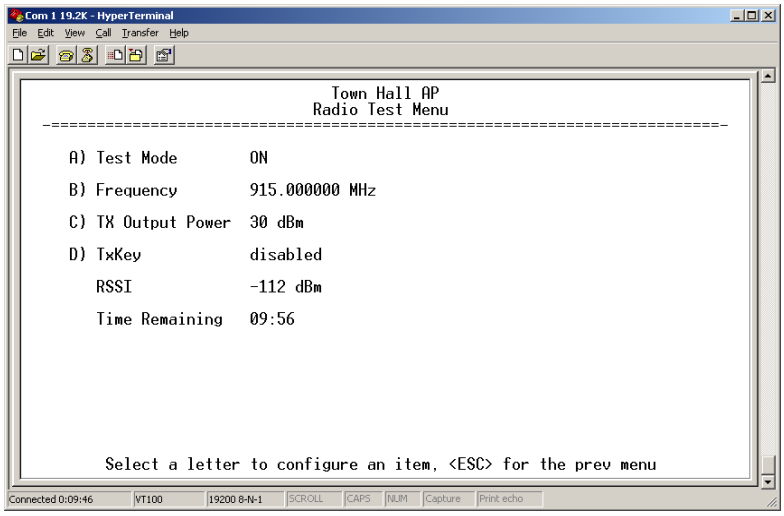


Figure 3-62. Radio Test Menu
Shown with Test Mode set to ON

NOTE : Use of the Test Mode will disrupt traffic through the radio. If the unit is an Access Point, it will disrupt traffic through the *entire* network.

Test Mode function is automatically limited to 10 minutes and *should only be used for brief measurement of transmit power*. It may also be manually reset to continue with the testing or turned off.

- **Test Mode**—Controls access to the transceiver's suite of tools. [**ON, OFF; OFF**]
- **Frequency**—Set radio operating frequency during the testing period to a single frequency. [**915.0000 MHz**]
- **TX Output Power**—Temporarily overrides the power level setting in the Radio Configuration Menu. [**20**]
- **TxKey**—Manually key the radio transmitter for power measurements. [**Enable, Disable; Disable**]
- **RSSI**—Incoming received signal strength on frequency entered in the frequency parameter on this screen (–dBm). This RSSI measurement is updated more frequently than the RSSI by Zone display of the Performance Information menu.

3.9.6 Ping Utility Menu

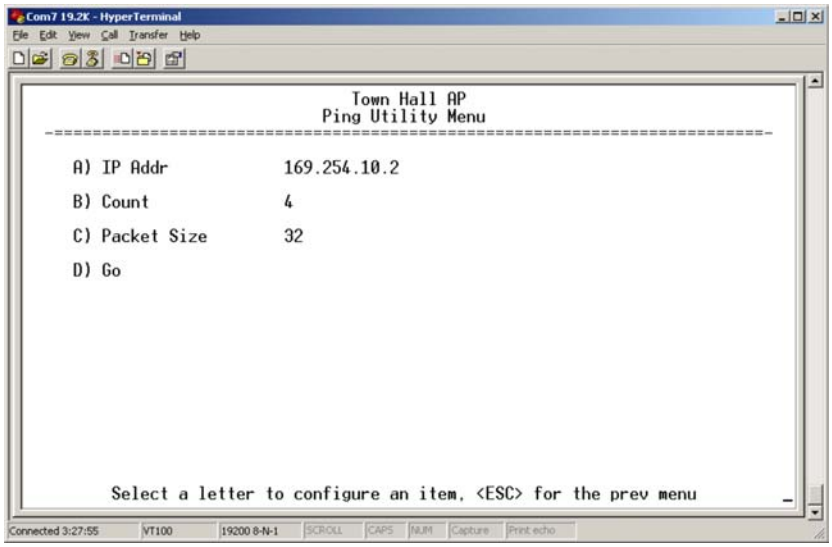


Figure 3-63. Ping Utility Menu

- **IP Addr**—Address to send a PING. [**Any valid IP address**]
- **Count**—Number of PING packets to be sent.
- **Packet Size**—Size of each PING data packet (bytes).
- **Go**—Send PING packets to address shown on screen.

  Screen will be replaced with detailed report of PING activity. Press any key after viewing the results to return to this menu.

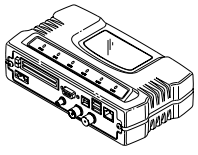
3.9.7 Reset to Factory Defaults

To reset all transceiver parameters back to the factory defaults, including the password, you must enter a special code (authorization key) provided by the factory in place of the user name at the time of login.

This procedure is useful when several parameters have been modified, and there is no track of changes. It causes the transceiver to return to a known state.

Password Reset

As part of the reset action the transceiver's password is reverted to the default value of **admin**. As a security measure, this event causes all radio parameters to return to the factory default settings, including zone skipping (as applicable), baud rate settings, network name, security phrase, etc.



4 TROUBLESHOOTING & RADIO MEASUREMENTS

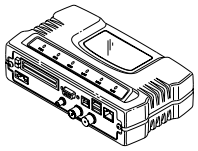
Contents

4.1 TROUBLESHOOTING.....123

4.1.1 Interpreting the Front Panel LEDs 123
4.1.2 Troubleshooting Using the Embedded Management System ...124
4.1.3 Using Logged Operation Events 128
4.1.4 Alarm Conditions 128
4.1.5 Correcting Alarm Conditions 130
4.1.6 Logged Events 131

4.2 RADIO (RF) MEASUREMENTS..... 133

4.2.1 Antenna System SWR and Transmitter Power Output 134
4.2.2 Antenna Aiming 135



4.1 TROUBLESHOOTING

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

When communication problems are found, it is good practice to begin by checking the simple things. Applying basic troubleshooting techniques in a logical progression can identify many problems.

Multiple Communication Layers

It is important to remember the operation of the network is built upon a radio communications link. On top of that are two data levels— wireless MAC, and the data layer. It is essential that the wireless aspect of the Access Point and the Remotes units to be associated are operating properly before data-layer traffic will function.

Unit Configuration

There are over 50 user-configurable parameters in the Management System. Do not overlook the possibility that human error may be the cause of the problem. With so many possible parameters to look at and change, a parameter may be incorrectly set, and then what was changed is forgotten.

To help avoid these problems, we recommend creating an archive of the transceiver's profile when your installation is complete in a Configuration File. This file can be reloaded into the transceiver to restore the unit to the factory defaults or your unique profile. For details on creating and archiving Configuration Files, see *"Using Configuration Scripts"* on Page 107.

Factory Assistance

If problems cannot be resolved using the guidance provided here, review the MDS web site's technical support area for recent software/firmware updates, general troubleshooting help, and service information. Additional help is available through our Technical Support Department. (See "TECHNICAL ASSISTANCE" on the inside of the rear cover.)

4.1.1 Interpreting the Front Panel LEDs

An important set of troubleshooting tools are the LED status indicators on the front panel of case. You should check them first whenever a problem is suspected. Table 2-2 on Page 27 describes the function of each status LED. Table 4-1 below provides suggestions for resolving

common system difficulties using the LEDs, and Table 4-2 provides other simple techniques.

Table 4-1. Troubleshooting Using LEDs—Symptom-Based

Symptom	Problem/Recommended System Checks
PWR LED does not turn on	a. Voltage too low—Check for the proper supply voltage at the power connector. (10–30 Vdc) b. Indefinite Problem—Cycle the power and wait (≈ 30 seconds) for the unit to reboot. Then, recheck for normal operation.
LINK LED does not turn on	a. Network Name of Remote not identical to desired Access Point—Verify that the system has a unique Network Name. b. Not yet associated with an Access Point with the same Network Name. Check the "Status" of the unit's process of associating with the Access Point. Use the Management System. c. Poor Antenna System—Check the antenna, feedline and connectors. Reflected power should be less than 10% of the forward power reading (SWR 2:1 or lower).
PWR LED is blinking	a. Blinking indicates an alarm condition exists. b. View Current Alarms and Event Log and correct the problem if possible. (See *"Using Logged Operation Events"* on Page 128) c. Blinking will continue until the source of the alarm is corrected, for example, a valid IP address is entered, etc.
LAN LED does not turn on	a. Verify the Ethernet cable is connect at both ends. b. Verify that the appropriate type of Ethernet cable is used: straight-through, or crossover.
LAN LED lights, but turns off after some time	Verify traffic in LAN. Typically, the radio should not be placed in high traffic enterprise LANs, as the it will not be able to pass this level of traffic. If needed, use routers to filter traffic.

4.1.2 Troubleshooting Using the Embedded Management System

If you have reviewed and tried the things mentioned in Table 4-1 and still have not resolved the problem, there are some additional tools and techniques that can be used. The embedded Management System is a good source of information that may be used remotely to provide preliminary diagnostic information, or may even provide a path to correcting the problem.

Table 4-2. Basic Troubleshooting Using the Management System

Symptom	Problem/Recommended System Checks
Remote does not associate; stays in HOPSYNC	a. Verify the AP has sufficiently large number in the “Max Remotes” parameter of the Network Configuration Menu. b. Verify the correct MAC address is listed in the “Approved Remotes List” or “Approved Access Points List” of the Security Configuration menu.
Serial data is slow with UDP multicast traffic	Change Beacon Period to FAST. (Radio Configuration Menu)
Cannot access the MS through COM1	a. Connect to unit via Telnet or Web browser b. Disable the serial mode for COM1 (Serial Gateway Configuration>>Com1 Serial Data Port>>Status>>Disabled) or, if you know the unit’s data configuration: a. Connect to COM 1 via a terminal set to VT100 and the port’s data baud rate. b. Type **+++** c. Change the terminal’s baud rate to match the transceiver’s Console Baud Rate. d. Type **+++**
Display on terminal/Telnet screen garbled	Verify the terminal/terminal emulator or Telnet application is set to VT100
Cannot pass IP data to WAN.	a. Verify your IP settings. b. Use the PING command to test communication with the transceivers in the local radio system. c. If successful with local PING, attempt to PING an IP unit attached to a transceiver. d. If successful with the LAN PINGs, try connecting to a known unit in the WAN.
Wireless Retries too high.	Possible Radio Frequency Interference— a. If omnidirectional antennas are used, consider changing to directional antennas. This will often limit interference to and from other stations. b. Try skipping some zones where persistent interference is known or suspected. c. The installation of a filter in the antenna feedline may be necessary. Consult the factory for further assistance.
Password forgotten.	a. Connect to the transceiver using a terminal through the COM1 Port. b. Obtain a password-resetting Authorization Key from your factory representative. c. Enter the Authorization Key at the login prompt as a password.
Packet Repeat Mode troubles (extra characters in data, data not delivered)	Verify that all radios in the network have their Packet Redundancy Mode set to the same selection (Single Packet vs. Packet Repeat Mode).

The following is a summary of how several screens in the Management System can be used as diagnostic tools. For information on how to connect to the Management System See *"STEP 3—CONNECT PC TO THE TRANSCEIVER"* on Page 22.

Starting Information Screen

*(*See *Starting Information Screen* on Page 40*)*

The Management System's "homepage" provides some valuable bits of data. One of the most important is the "Device Status" field. This item will tell you if the unit is showing signs of life.

If the *Device Status* field says "associated," then look in the network areas beginning with network data statistics. If it displays some other message, such as *Scanning*, *Hop Sync* or *Alarmed*, you will need to determine why it is in this state.

The Scanning state indicates a Remote unit is looking for an Access Point beacon signal to lock onto. It should move to the Hop Sync and finally to the Associated state within less than a minute. If this Remote unit is not providing reliable service, look at the *Event Logs* for signs of lost association with the Access Point or low signal alarms. Table 4-3 provides a description of the Device Status messages.

Table 4-3. Device Status[1]

Scanning	The unit is looking for an Access Point beacon signal. If this is a Remote radio, *Associated* means that this unit is associated with an Access Point
Hop Sync	The unit has found a valid beacon signal for its network and has changed its frequency hopping pattern to match that of the AP.
Connected	The unit has established a radio (RF) connection with the Access Point, but has not obtained cyber-security clearance to pass data.
Associated	This unit has successfully synchronized and is "associated" with an Access Point. This is the normal operating state.
Alarmed	The unit is has detected one or more alarms that have not been cleared.

1. Available in the *Startup Information Screen* or the *Wireless Status Screen* at the Remotes.

If the Remote is in an "Alarmed" state, the unit may still be operational and associated. Look for the association state in the *Wireless Network Status* screen to determine if the unit is associated. If it is, then look at the *Error Log* for possible clues.

If the unit is in an "Alarmed" state and not able to associate with an Access Point unit, then there may be problem with the wireless network layer. Call in a radio technician to deal with wireless issues. Refer the technician to the *RADIO (RF) MEASUREMENTS* on Page 133 for information on antenna system checks.

Packet Statistics Menu

(See Packet Statistics Menu on Page 90)

This screen provides detailed information on data exchanges between the unit being viewed and the network through the wireless and the Ethernet (data) layers. These include:

Wireless Packet Statistics

- Packets received
- Packets sent
- Bytes received
- Bytes sent
- Packets dropped
- Receive errors
- Retries
- Retry errors

Ethernet Packet Statistics

- Packets received
- Packets sent
- Bytes received
- Bytes sent
- Lost carrier detected
- Packets dropped
- Receive errors
- Retries
- Retry errors

The most significant fields are the *Packets Dropped*, *Retries*, *Retry Errors*, *Receive Errors* and *Lost Carrier Detected*. If the data values are more than 10% of their sent and received counterparts, or the *Lost Carrier Detected* value is greater than a few dozen, there may be trouble with radio-frequency interference or a radio link of marginal strength. Review the *RSSI by Zone Screen's* values (Page 86) for zones that are more than 2 dB (decibels) below the average level, and for signal level values that are likely to provide marginal service. For example, an average level is less than –85 dBm during normal conditions with a data rate of 256 kbps.

If the RSSI levels in each zone are within a few dB of each other, but less than –85 dBm, then a check should be made of the aiming of the antenna system and for a satisfactory SWR. Refer to *RADIO (RF) MEASUREMENTS* on Page 133 for information on antenna system checks.

NOTE: For a data rate of 1 Mbps the average signal level should be –77 dBm or stronger with no interference.

Serial Port Statistics Menu

(See Serial Data Statistics Menu on Page 96)

This screen provides top-level information on data exchanges between the unit's serial ports and the network through the wireless and the Ethernet (data) layers. These include:

- Bytes In On Port *xxx*
- Bytes Out On Port *xxx*
- Bytes In On Socket *xxx*
- Bytes Out On Socket *xxx*

You can use this screen as a indicator of port activity at the data and IP levels.

Diagnostic Tools

(See MAINTENANCE on Page 100)

The radio's Maintenance menu contains two tools that are especially useful to network technicians—the Radio Test Menu and the Ping Utility. The Radio Test selection allows for testing RF operation, while the Ping Utility can be used to verify reachability to pieces of equipment connected to the radio network. This includes transceivers and user-supplied Ethernet devices.

4.1.3 Using Logged Operation Events

(See Event Log Menu on Page 87)

The transceiver's microprocessor monitors many operational parameters and logs them as various classes of "events". If the event is one that affects performance, it is an "alarmed". There are also normal or routine events such as those marking the rebooting of the system, implementation of parameter changes and external access to the Management System. Informational events are stored in temporary (RAM) memory that will be lost in the absence of primary power, and Alarms will be stored in permanent memory (Flash memory) until cleared by user request. Table 3-5 summarizes these classifications.

Table 4-4. Event Classifications

Level	Description/Impact	Storage
Informational	Normal operating activities	Flash Memory
Minor	Does not affect unit operation	RAM
Major	Degraded unit performance but still capable of operation	RAM
Critical	Prevents the unit from operating	RAM

These various events are stored in the transceiver's "Event Log" and can be a valuable aid in troubleshooting unit problems or detecting attempts at breaching network security.

4.1.4 Alarm Conditions

(See View Current Alarms on Page 89)

Most events, classified as "critical" will make the PWR LED blink, and will inhibit normal operation of the transceiver. The LED blinks until the corrective action is completed.

Table 4-5. Alarm Conditions (Alphabetical Order)

Alarm Condition Reported	Event Log Entry	SNMP Trap
EVENT_50_LIMIT	Crossed 50% of Eth Port Rate Limit	rateLimit50(20)
EVENT_75_LIMIT	Crossed 75% of Eth Port Rate Limit	rateLimit75(21)
EVENT_100_LIMIT	Crossed 100% of Eth Port Rate Limit	rateLimit100(22)
EVENT_ADC	ADC output Railed	adcInput(3)
EVENT_AP_NN_CHANGED	Network Name changed at the AP	apNetNameChanged(74)
EVENT_BRIDGE	Network Interface /Error	networkInterface(17)
EVENT_NO_CHAN_CNT	Mismatch in Channel count at AP/REM	ChanCnt(71)
EVENT_NO_CHAN	Using Channel hopping but no channels selected	NoChan(23)
EVENT_COMPRESS	Compression setting changed	compressionChanged(76)
EVENT_ENDPOINT	Endpoint Added/Removed (AP only)	eventEndpoint(67)
EVENT_ETH_LINK_AP*	AP Ethernet Link Disconnected	apEthLinkLost(19)
EVENT_FLASH_TEST	Flash Test Failed	-
EVENT_FPGA	FPGA communication Failed	fpgaCommunication(2)
EVENT_FREQ_CAL	Frequency Not Calibrated	frequencyCal(7)
EVENT_INIT_ERR	Initialization Error	initializationError(18)
EVENT_IPADDR*	IP Address Invalid	ipAddressNotSet(4)
EVENT_IP_CONN(OK)		ipConnectivityOK(75)
EVENT_IPMASK*	IP Mask Invalid	ipNetmaskNotSet(5)
EVENT_LAN_PORT		lanPortStatus(78)
EVENT_MAC	MAC communication Failed	macCommunication(1)
EVENT_MACADDR	MAC Address Invalid	noMacAddress(6)
EVENT_NETNAME*	Netname Invalid	invalidNetname(12)
EVENT_PLL_LOCK	PLL Not locked	pllLock(10)
EVENT_POWER_CAL	Power Calibrated/Not Calibrated	powerCal(8)
EVENT_POWER_HIGH	RF Power Control Saturated High	rfPowerHigh(13)
EVENT_POWER_LOW	RF Power Control Saturated Low	rfPowerLow(14)

Table 4-5. Alarm Conditions (Alphabetical Order) *(Continued)*

Alarm Condition Reported	Event Log Entry	SNMP Trap
EVENT_REMOTE	Remote Added/ Removed (AP only)	eventRemote(66)
EVENT_REPETITIVE	The previous event is occurring repetitively	
EVENT_ROUTE_ADD	Manual entry added to Routing table	routeAdded(68)
EVENT_ROUTE_DEL	Manual entry deleted from Routing table	routeDeleted(69)
EVENT_RSSI*	RSSI Exceeds threshold	rssi(11)
EVENT_RSSI_CAL	RSSI Not Calibrated	rssiCal(9)
EVENT_SDB_ERR	Internal Remote/Endpoint database error (AP only)	sdbError(80)
EVENT_SINREM_SWITCH	Eth/Serial mode switch in a Single Remote	sinRemSwitch(70)
EVENT_SYSTEM_ERROR*	System Error Cleared; Please Reboot	systemError(16)
EVENT_TFTP_CONN	TFTP connectivity achieved	tftpConnection(73)
EVENT_TFTP_ERR	Attempted TFTP connection failed	tftpConnFailed(79)

* Condition may be corrected by user and alarm cleared.

4.1.5 Correcting Alarm Conditions

(See View Event Log on Page 90)

Table 4-6 provides insight on the causes of events that inhibit the unit from operating, and possible corrective actions. The Event Description column appears on the **Event Log** screen.

Table 4-6. Correcting Alarm Conditions—Alphabetical Order

Event Log Entry	Generating Condition	Clearing Condition or Action
ADC Failure	The ADC always reads the same value (either high or low limit)	Contact factory Technical Services for assistance
AP Ethernet Link	Monitor will check state of Ethernet link and set alarm if it finds the link down	Ethernet link is re-established
Bridge Down	When the Bridge fails to be initialized	Contact factory Technical Services for assistance
Flash Test Failed	Internal check indicates corruption of Flash memory	Contact factory Technical Services for assistance
FPGA Failure	Communication lost to the FPGA	Contact factory Technical Services for assistance

Table 4-6. Correcting Alarm Conditions—Alphabetical Order

Event Log Entry	Generating Condition	Clearing Condition or Action
General System Error	Internal checks suggest unit is not functioning properly	Reboot the transceiver
Initialization Error	Unit fails to complete boot cycle	Contact factory Technical Services for assistance
Invalid IP Address	The IP address is either 0.0.0.0 or 127.0.0.1	Program IP address to something other than 0.0.0.0 or 127.0.0.1
MAC Failure	The monitor task reads the LinkStatus from the MAC every second. If the MAC does not reply 10 consecutive times (regardless of what the result is) the CPU assumes the transceiver has lost communication to the MAC.	Contact factory Technical Services for assistance
Network Interface Error	Unit does not recognize the LAN interface	Contact factory Technical Services for assistance
Network Name Not Programmed	Network name is “Not Programmed”	Change Network Name to something other than “Not Programmed”
PLL Out-of-Lock	The FPGA reports a synthesizer out-of-lock condition when monitored by the CPU.	Contact factory Technical Services for assistance.
Power Control Railed High	Power control can no longer compensate and reaches the high rail	Contact factory Technical Services for assistance
Power Control Railed Low	Power control can no longer compensate and reaches the low rail	Contact factory Technical Services for assistance
RSSI Exceeds Threshold	The running-average RSSI level is weaker (more negative) than the user-defined value.	Check aiming of the directional antenna used at the Remote; or raise the threshold level to a stronger (less-negative) value.

4.1.6 Logged Events

(See View Event Log on Page 90)

The following events allow the transceiver to continue operation and do not make the PWR LED blink. Each is reported through an SNMP trap.

The left hand column, “Event Log Entry” is what will be shown in the Event Log.

Table 4-7. Non-Critical Events—Alphabetical Order

Event Log Entry	Severity	Description
Association Attempt Success/Failed	MAJOR	Self explanatory
Association Lost - AP Hop Parameter Changed	MINOR	Self explanatory
Association Lost - AP's Ethernet Link Down	MAJOR	Self explanatory
Association Lost - Local IP Address Changed	MAJOR	Self explanatory
Association Lost - Local Network Name Changed	MAJOR	Self explanatory
Association Lost/Established	MAJOR	Self explanatory
Auth Demo Mode Expired -- Rebooted Radio/Enabled	MAJOR	Self explanatory
Auth Key Entered - Key Valid/Key Invalid	MAJOR	Self explanatory
Bit Error Rate Below threshold/Above threshold	INFORM	Self explanatory
Console Access Locked for 5 Min	MAJOR	Self explanatory
Console User Logged Out/Logged In	MAJOR	Self explanatory
Country/SkipZone Mismatch	INFORM	Self explanatory
Current AP No Longer Approved	MAJOR	May occur during the Scanning process at a remote. Indicates that the received beacon came from an AP which is not in the “Approved AP” list. This may be caused by some remotes hearing multiple AP's. This event is expected behavior.
Decryption Error/Decryption OK		A decryption error is logged when an encryption phrase mismatch has occurred. A mismatch is declared after five consecutive errors over a 40-second window. When the error has cleared, **DECRYPT OK** will appear.
Desired AP IP Addr Mismatch	INFORM	Self explanatory
ETH Rate		Indicates heavy bursts of traffic on the unit's Ethernet port (LAN). This is expected behavior, resulting from the network configuration.
Ethernet Port Enabled/Disabled	INFORM	Self explanatory
Expected Sync Lost/Established	INFORM	Self explanatory
Hop Sync Lost/Established	INFORM	Self explanatory

Table 4-7. Non-Critical Events—Alphabetical Order *(Continued)*

Event Log Entry	Severity	Description
Hop Table Generated/Generation Failed	INFORM	Self explanatory
HTTP Access Locked for 5 Min	MAJOR	Self explanatory
HTTP User Logged Out/Logged In	MAJOR	httpLogin(49)
Log Cleared	INFORM	Self explanatory
MAC Param Changed		Caused by remotes running in auto data rate mode. Every time the link conditions cause a data rate change, the remote's MAC changes to the new rate and forwards a signal to the AP. This indicates link quality is changing and causing the data rate to adjust accordingly.
Max Beacon Wait Time Exceeded	MAJOR	Self explanatory
Received Beacon - AP is Blacklisted	INFORM	Self explanatory
Received Beacon - Netname Does Not Match	INFORM	Self explanatory
Received Beacon - Valid/Errored	INFORM	Self explanatory
Rem Ethernet Link Connected/Disconnected	MAJOR	Self explanatory
Reprogramming Complete	INFORM	Self explanatory
Reprogramming Failed	MAJOR	Self explanatory
Reprogramming Started	INFORM	Self explanatory
Scanning Started	INFORM	Self explanatory
SNR Within threshold/Below threshold	INFORM	Self explanatory
System Bootup (power on)	INFORM	Self explanatory
Telnet Access Locked for 5 Min	MAJOR	Self explanatory
Telnet User Logged Out/Logged In	MAJOR	Self explanatory
User Selected Reboot	MAJOR	Self explanatory

4.2 RADIO (RF) MEASUREMENTS

There are several measurements that are a good practice to perform during the initial installation. The will confirm proper operation of the unit and if they are recorded, serve as a benchmark in troubleshooting should difficulties appear in the future. These measurements are:

- Transmitter Power Output
- Antenna System SWR (Standing-Wave Ratio)
- Antenna Direction Optimization

These procedures may interrupt traffic through an established network and should only be performed by a skilled radio-technician in cooperation with the network manager.

4.2.1 Antenna System SWR and Transmitter Power Output

Introduction

A proper impedance match between the transceiver and the antenna system is important. It ensures the maximum signal transfer between the radio and antenna. The impedance match can be checked indirectly by measuring the SWR (standing-wave ratio) of the antenna system. If the results are normal, record them for comparison for use during future routine preventative maintenance. Abnormal readings indicate a possible trouble with the antenna or the transmission line that will need to be corrected.

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

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

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

Record the current transmitter power output level, and then set it to 30 dBm for the duration of the test to provide an adequate signal level for the directional wattmeter.

Procedure

1. Place a directional wattmeter between the ANTENNA connector and the antennas system.

2. Place the transceiver into the Radio Test Mode using the menu sequence below:
   (Main Menu>>Maintenance Menu>>Radio Test>>Test Mode>>Y>>ON)

NOTE: The Test Mode has a 10-minute timer, after which it will return the radio to normal operation. The Radio Test Mode can be terminated manually by selecting **OFF** on the menu or temporarily disconnecting the radio's DC power.

---

3. Set the transmit power to 30 dBm. (This setting does not affect the output level during normal operation—only during Test Mode.)
   (Main Menu>>Maintenance Menu>>Radio Test>>Test Mode>>Tx Power Output)

4. Key the transmitter.
   (Main Menu>>Maintenance Menu>>Radio Test>>Test Mode>>TxKey>>Enable)

   Use the PC's spacebar to key and unkey the transmitter ON and OFF. (Enable/Disable)

5. Measure the forward and reflected power into the antenna system and calculate the SWR and power output level. The output should agree with the programmed value.

   (Main Menu>>Radio Configuration>>RF Power Output)

6. Turn off Radio Test Mode at the Access Point and Remote.
   (Main Menu>>Maintenance Menu>>Radio Test>>Test Mode>>Disable)

End of procedure

4.2.2 Antenna Aiming

Introduction

The radio network integrity depends, in a large part, on stable radio signal levels being received at each end of a data link. In general, signal levels stronger than –80 dBm provide the basis for reliable communication that includes a 15 dB fade margin. As the distance between the Access Point and Remotes increases, the influence of terrain, foliage and man-made obstructions become more influential and the use of directional antennas at Remote locations becomes necessary. Directional antennas usually require some fine-tuning of their bearing to optimize the received signal strength. The transceiver has a built-in received signal strength indicator (RSSI) that can be used to tell you when the antenna is in a position that provides the optimum received signal.

RSSI measurements and Wireless Packet Statistics are based on multiple samples over a period of several seconds. The average of these measurements will be displayed by the Management System.

The measurement and antenna alignment process will usually take 10 or more minutes at each radio unit.

The path to the Management System menu item is shown in bold text below each step of the procedure.

Procedure

1. Verify the Remote transceiver is associated with an Access Point unit by observing the condition of the LINK LED (**LINK LED = On or Blinking**). This indicates that you have an adequate signal level for the measurements and it is safe to proceed.

2. View and record the *Wireless Packets Dropped* and *Received Error* rates.
   (Main Menu>>Performance Information>>Packet Statistics>>Wireless Packet Statistics)

   This information will be used later.

3. Clear the *Wireless Packets Statistics* history.

   (Main Menu>>Performance Information>>Packet Statistics>>Wireless Packet Statistics>>Clear Wireless Stats)\

4. Read the RSSI level at the Remote.
   (Main Menu>>Performance Information>>RSSI by Zone)

5. Optimize RSSI (less negative is better) by slowly adjusting the direction of the antenna.

   Watch the RSSI indication for several seconds after making each adjustment so that the RSSI accurately reflects any change in the link signal strength.

6. View the *Wireless Packets Dropped* and *Received Error* rates at the point of maximum RSSI level. They should be the same or lower than the previous reading.

   (Main Menu>>Performance Information>>Packet Statistics>>Wireless Packet Statistics)

   If the RSSI peak results in an increase in the *Wireless Packets Dropped* and *Received Error*, the antenna may be aimed at an undesired signal source. Try a different antenna orientation.

End of procedure

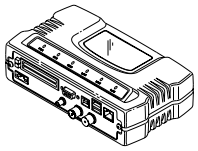
5 PLANNING A RADIO NETWORK

Contents

5.1 INSTALLATION PLANNING 139

5.1.1 General Requirements 139
5.1.2 Site Selection 141
5.1.3 Terrain and Signal Strength 141
5.1.4 Antenna & Feedline Selection 142
5.1.5 How Much Output Power Can be Used? 145
5.1.6 Conducting a Site Survey 145
5.1.7 A Word About Radio Interference 146

5.2 dBm-WATTS-VOLTS CONVERSION CHART 149



5.1 INSTALLATION PLANNING

This section provides tips for selecting an appropriate site, choosing an antenna system, and reducing the chance of harmful interference.

5.1.1 General Requirements

There are three main requirements for installing a transceiver—adequate and stable primary power, a good antenna system, and the correct interface between the transceiver and the data device. Figure 5-1 shows a typical Remote Gateway installation.

NOTE: The transceiver's network port supports 10BaseT and 100BaseT connections. Confirm that your hub/switch is capable of auto-switching data rates.

To prevent excessive Ethernet traffic from degrading performance, place the transceiver in a segment, or behind routers.

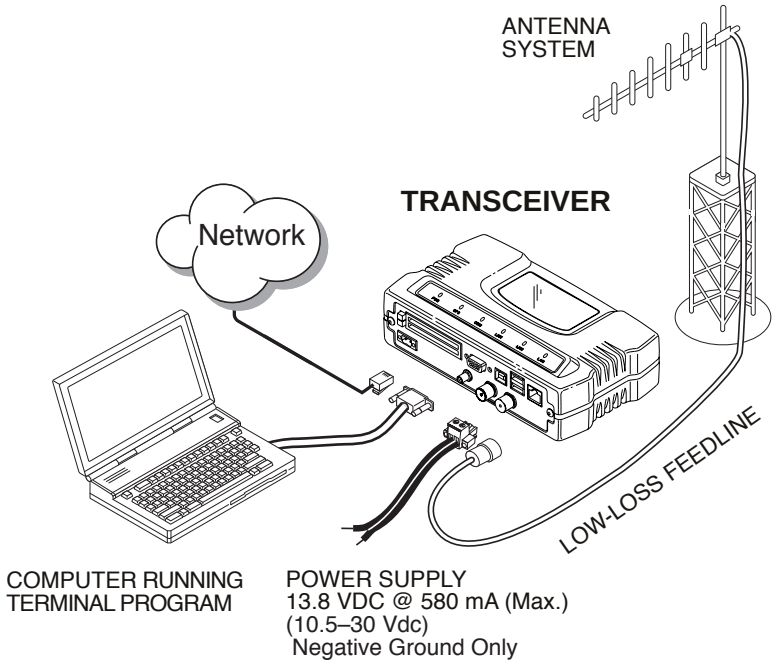


Figure 5-1. Typical Installation with a Tower-Mounted Antenna
(Connect user data equipment to any compatible LAN or COM Port)

Unit Dimensions

Figure 5-2 shows the dimensions of the transceiver case and its mounting holes, and Figure 5-3 on Page 140, the dimensions for mounting with factory-supplied brackets. If possible, choose a mounting location that provides easy access to the connectors on the end of the radio and an unobstructed view of the LED status indicators.

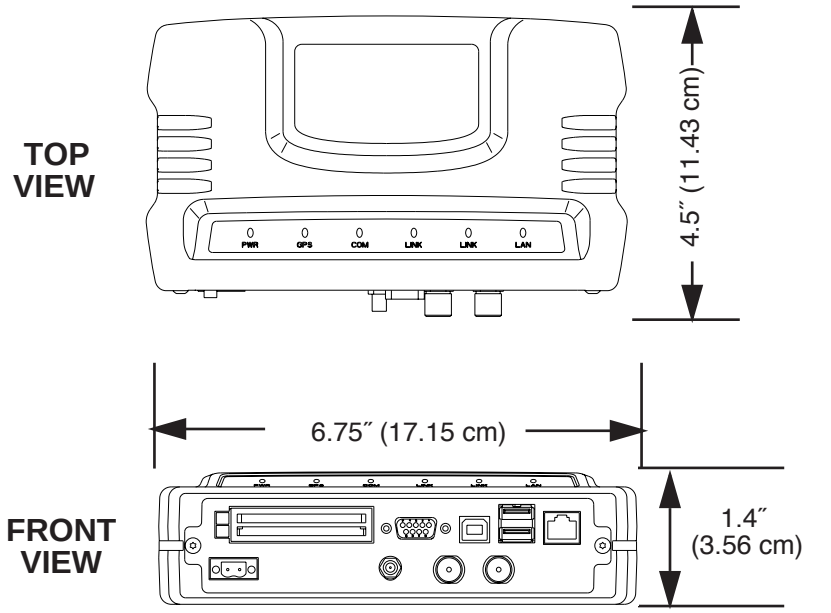


Figure 5-2. Transceiver Dimensions

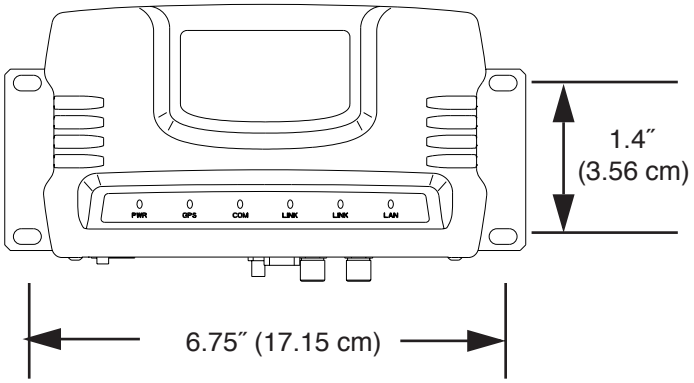


Figure 5-3. Mounting Bracket Dimensions (center to center)

5.1.2 Site Selection

Suitable sites should provide:

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

These requirements can be quickly determined in most cases. A possible exception is the last item—verifying that an unobstructed transmission path exists. Radio signals travel primarily by line-of-sight, and obstructions between the sending and receiving stations will affect system per-

formance. If you are not familiar with the effects of terrain and other obstructions on radio transmission, the discussion below will provide helpful background.

5.1.3 Terrain and Signal Strength

While the license-free 900 MHz band offers many advantages for data transmission services, signal propagation is affected by attenuation from obstructions such as terrain, foliage or buildings in the transmission path.

A line-of-sight transmission path between the central transceiver and its associated remote site(s) is highly desirable and provides the most reliable communications link.

Much depends on the minimum signal strength that can be tolerated in a given system. Although the exact figure will differ from one system to another, a Received Signal Strength Indication (RSSI) of –80 dBm for or stronger will provide acceptable performance in many systems. While the equipment will work at lower-strength signals, signals stronger than – 77 dBm provide a "fade margin" of 15 dB to account for variations in signal strength that may occur from time-to-time. RSSI can be measured with a terminal connected to the COM1 Port or with a HTTP browser to the LAN (Ethernet) connector. (See *"Antenna Aiming"* on Page 135 for details.)

5.1.4 Antenna & Feedline Selection

NOTE: The transceiver is a Professional Installation radio system and must be installed by trained professional installers, or factory trained technicians.

This text that follows is designed to aid the professional installer in the proper methods of maintaining compliance with FCC Part 15 limits and the +36 dBm or 4 watts peak E.I.R.P limit.

Antennas

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

In general, an omnidirectional antenna (Figure 5-4) is used at the Access Point station site. This provides equal coverage to all of the Remote Gateway sites.

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

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

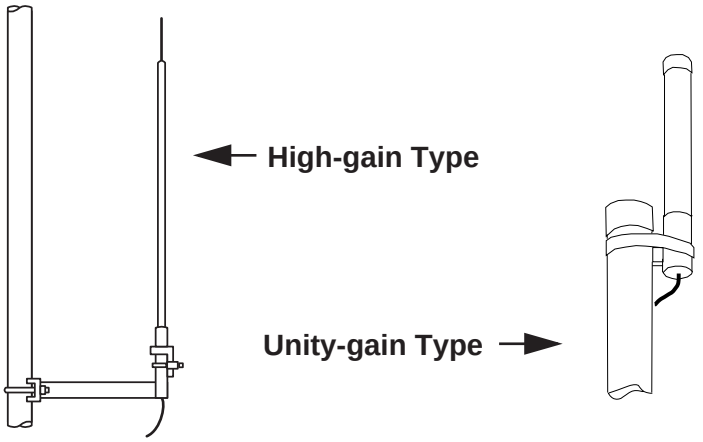


Figure 5-4. Typical Omnidirectional Antennas

At Remote Gateway sites and units in point-to-point LANs, a directional Yagi (Figure 5-5) antenna is generally recommended to minimize interference to and from other users. Antennas are available from a number of manufacturers.

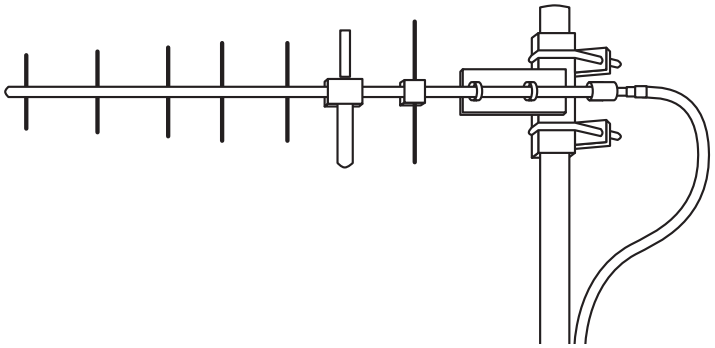


Figure 5-5. Typical Yagi Antenna (mounted to mast)

Feedlines

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

For cable runs of less than 20 feet (6 meters), or for short range transmission, an inexpensive type such as Type RG-8A/U may be acceptable. Otherwise, we recommend using a low-loss cable type suited for 900 MHz, such as Heliax®.

Table 5-1 lists several types of popular feedlines and indicates the signal losses (in dB) that result when using various lengths of cable at 900 MHz. The choice of cable will depend on the required length, cost considerations, and the amount of signal loss that can be tolerated.

Table 5-1. Length vs. Loss in Coaxial Cables at 900 MHz

Cable Type	10 Feet (3.05 m)	50 Feet (15.24 m)	100 Feet (30.48 m)	500 Feet (152.4 m)
RG-214	.76 dB	3.8 dB	7.6 dB	Unacceptable Loss
LMR-400	0.39 dB	1.95 dB	3.90 dB	Unacceptable Loss
1/2 inch HELIAX	0.23 dB	1.15 dB	2.29 dB	11.45 dB
7/8 inch HELIAX	0.13 dB	0.64 dB	1.28 dB	6.40 dB
1-1/4 inch HELIAX	0.10 dB	0.48 dB	0.95 dB	4.75 dB
1-5/8 inch HELIAX	0.08 dB	0.40 dB	0.80 dB	4.00 dB

The tables below outline the minimum lengths of RG-214 coaxial cable that must be used with common MDS omnidirectional antennas in order to maintain compliance with FCC maximum limit of +36 dBi. If other coaxial cable is used, the appropriate changes in loss figures must be made.

NOTE: The authority to operate the transceiver in the USA may be void if antennas other than those approved by the FCC are used. Contact your MDS representative for additional antenna information.

Table 5-2. Feedline Length vs. Antenna Gain*

(Required for Regulatory compliance)

Antenna Gain (dBd)	Antenna Gain (dBi)	Minimum Feedline Length (Loss in dB)	EIRP Level @ Min. Length	Maxrad Antenna Part No.
Unity (0 dB)	2.15 dBi	No minimum length	+32.15 dBm	Omni #MFB900
3 dBd	5.15 dBi	No minimum length	+35.15 dBm	Omni # MFB900
5 dBd	7.15 dBi	3.1 meters (1.2 dB)	+35.95 dBm	Omni # MFB900
6 dBd	8.15 dBi	9.1 meters (2.2 dB)	+35.95 dBm	Yagi # BMOY8903
10 dBd	12.15 dBi	24.7 meters (6.15 dB)	+35.25 dBm	Yagi # Z941

*Refer to Table 5-3 for allowable power settings of the transceiver for each antenna type.

NOTE: There is no minimum feedline length required when a 6 dBi gain or less antenna is used, as the EIRP will never exceed 36 dBm which is the maximum allowed, per FCC rules. The transceiver's RF output power may only be adjusted by the manufacturer or its sub-contracted Professional Installer.

The Transceiver's power output is factory set to maintain compliance with the FCC's Digital Transmission System (DTS) Part 15 rules. These rules limit power to a maximum of 8 dBm/3 kHz, thus the Transceiver is factory set to +30 dBm. When calculating maximum transceiver power output, use +30 dBm if the antenna gain is 6 dBi or less (36 dBm ERP). See *How Much Output Power Can be Used?* below for power control of higher gain antennas.

5.1.5 How Much Output Power Can be Used?

The transceiver is normally supplied from the factory set for a nominal +30 dBm RF power output setting; this is the maximum transmitter output power allowed under FCC rules. The power must be *decreased* from this level if the antenna system gain exceeds 6 dBi. The allowable level is dependent on the antenna gain, feedline loss, and the transmitter output power setting.

NOTE: In some countries, the maximum allowable RF output may be limited to less than the figures referenced here. Be sure to check for and comply with the requirements for your area.

5.1.6 Conducting a Site Survey

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

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

The test can be performed by first installing a radio and antenna at the proposed Access Point (AP) station site (one-per-system). Then visit the Remote site(s) with another transceiver (programmed as a remote) and a hand-held antenna. (A PC with a network adapter can be connected to each radio in the network to simulate data during this test using the PING command.)

With the hand-held antenna positioned near the proposed mounting spot, a technician can check for synchronization with the Access Point station (shown by a lit LINK LED on the front panel) and measure the

reported RSSI value. (See *"Antenna Aiming"* on Page 135 for details.) If adequate signal strength cannot be obtained, it may be necessary to mount the station antennas higher, use higher gain antennas, select a different site or consider installing a repeater station. To prepare the equipment for an on-the-air test, follow the general installation procedures given in this guide and become familiar with the operating instructions found in the *CHAPTER-* section Page 28.

5.1.7 A Word About Radio Interference

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

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

- Systems installed in rural areas are least likely to encounter interference; those in suburban and urban environments are more likely to be affected by other devices operating in the license-free frequency band and by adjacent licensed services.
- Use a directional antenna at remote sites whenever possible. Although these antennas may be more costly than omnidirectional types, they confine the transmission and reception pattern to a comparatively narrow lobe, that minimizes interference to (and from) stations located outside the pattern.
- If interference is suspected from a nearby licensed system (such as a paging transmitter), it may be helpful to use horizontal polarization of all antennas in the network. Because most other services use vertical polarization in this band, an additional 20 dB of attenuation to interference can be achieved by using horizontal polarization. Another approach is to use a bandpass filter to attenuate all signals outside the 900 MHz band.
- Multiple Access Point units can co-exist in proximity to each other with only very minor interference. Each network name has a different hop pattern. (See *"Protected Network Operation using Multiple Access Points"* on Page 12.) Additional isolation can be achieved by using separate directional antennas with as much vertical or horizontal separation as is practical.
- If constant interference is present in a particular frequency zone (collection of 8 RF channels), it may be necessary to "skip" that zone from the radio's hopping pattern. The radio includes built-in

software to help users identify and remove blocked frequency zones from its hopping pattern. See Page 58 for more information on Skip Zones.

- If interference problems persist even after skipping some zones, try reducing the length of data streams. Groups of short data streams have a better chance of getting through in the presence of interference than do long streams.
- The power output of all radios in a system should be set for the lowest level necessary for reliable communications. This lessens the chance of causing unnecessary interference to nearby systems.

If you are not familiar with these interference-control techniques, contact your factory representative for more information.

Calculating System Gain

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

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

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

3. If the maximum transmitter power allowed is less than 30 dBm, set the power to the desired level using the Management System. (**Main Menu>>Radio Configuration>>RF Output Power Setpoint**)

For convenience, Table 5-3 lists several antenna system gains and shows the maximum allowable power setting of the radio. Note that a gain of 6 dB or less entitles you to operate the radio at full power output –30 dBm.

For assistance in the conversion of dBm to Watts, please see *dBm-WATTS-VOLTS CONVERSION CHART* on Page 148.

Table 5-3. Antenna System Gain vs. Power Output Setting

Antenna System Gain (Antenna Gain in dBi* minus Feedline Loss in dB†)	Maximum Power Setting (PWR command)	EIRP (in dBm)
Omni 6 (or less)	30	36
Omni 9	27	36
Yagi 12	24	36
Yagi 14	22	36
Yagi 16	20	36

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

† Feedline loss varies by cable type and length. To determine the loss for common lengths of feedline, see Table 5-1 on Page 143.

5.2 dBm-WATTS-VOLTS CONVERSION CHART

Table 5-4 is provided as a convenience for determining the equivalent voltage or wattage of an RF power expressed in dBm.

Table 5-4. dBm-Watts-Volts conversion—for 50 ohm systems

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

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

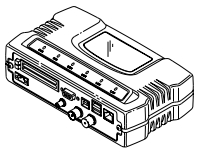
dBm	mV	Po
-17	31.5	
-18	28.5	
-19	25.1	
-20	22.5	.01mW
-21	20.0	
-22	17.9	
-23	15.9	
-24	14.1	
-25	12.8	
-26	11.5	
-27	10.0	
-28	8.9	
-29	8.0	
-30	7.1	.001mW
-31	6.25	
-32	5.8	
-33	5.0	
-34	4.5	
-35	4.0	
-36	3.5	
-37	3.2	
-38	2.85	
-39	2.5	
-40	2.25	.1μW
-41	2.0	
-42	1.8	
-43	1.6	
-44	1.4	
-45	1.25	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

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

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

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

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



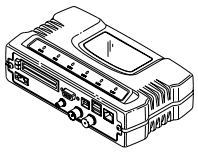
6 TECHNICAL REFERENCE

Contents

5.1 INSTALLATION PLANNING 139

5.1.1 General Requirements 139
5.1.2 Site Selection 141
5.1.3 Terrain and Signal Strength 141
5.1.4 Antenna & Feedline Selection 142
5.1.5 How Much Output Power Can be Used? 145
5.1.6 Conducting a Site Survey 145
5.1.7 A Word About Radio Interference 146

5.2 dBm-WATTS-VOLTS CONVERSION CHART.....149



6.1 DATA INTERFACE CONNECTORS

Three types of data interface connectors are provided on the face of the transceiver. The first, the LAN Port, is an RJ-45 connector. The second are USB connectors, of which there are two Type-A and one Type-B provided. Finally, COM1 is a DB-9 female interface connector that uses the RS-232 (EIA-232) signaling standard.

CAUTION
RADIO FREQUENCY INTERFERENCE POTENTIAL

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

6.1.1 LAN Port

The transceiver's LAN Port is used to connect the radio to an Ethernet network. The transceiver provides a data link to an Internet Protocol-based (IP) network via the Access Point station. Each radio in the network must have a unique IP address for the network to function properly.

- To connect a PC directly to the radio's LAN port, an RJ-45 to RJ-45 cross-over cable is required.
- To connect the radio to a Ethernet hub or bridge, use a straight-through cable.

The connector uses the standard Ethernet RJ-45 cables and wiring. For custom-made cables, use the pinout information below.

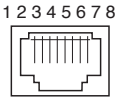


Figure 6-1. LAN Port (RJ-45) Pinout
(Viewed from the outside of the unit)

Table 6-1. LAN Port (IP/Ethernet)

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

6.1.2 USB Ports

The transceiver contains two USB Type-A connectors (see Figure 6-2) and one USB Type-B connector (see Figure 6-3). These ports conforms to version 1.1 of the USB standard. The pin functions for this connector are provided in the table below.

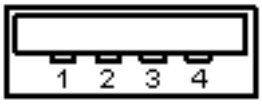


Figure 6-2. USB Type-A Connector
(As viewed from the outside of the unit)

Pin	Signal Name	Description	Std. Cable Color
1	PC_USB_+5V	+5 Vdc	Red
2	USBD–	USB Data Minus	White
3	USBD+	USB Data Plus	Green
4	Ground	Chassis Ground	Black

Figure 6-3. USB Type-B Connector

6.1.3 COM1 Port

To connect a PC to the transceiver's COM1 port use a DB-9M to DB-9F "straight-through" cable. These cables are available commercially, or may be constructed using the pinout information in Figure 6-4 and Table 6-2.

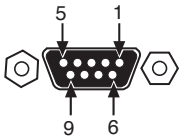


Figure 6-4. COM1 Port (DCE)
(Viewed from the outside of the unit.)

Table 6-2. COM1 Port Pinout, DB-9F/RS-232 Interface

Pin	Functions	DCE
1	Unused	
2	Receive Data (RXD)	<—[Out

Table 6-2. COM1 Port Pinout, DB-9F/RS-232 Interface

Pin	Functions	DCE
3	Transmit Data (TXD)	—>[In
4	Unused	
5	Signal Ground (GND)	
6–9	Unused	

6.2 FUSE REPLACEMENT PROCEDURE

An internal fuse protects the transceiver from over-current conditions or an internal component failure. It should not be replaced until you are certain you are in a safe (non-flammable) environment.

1. Disconnect the primary power source and all other connections to the unit.

2. Place the radio on its back and remove the four Phillips screws on the bottom cover.

3. Carefully separate the top and bottom covers. There is a flat ribbon cable between the top cover's LEDs and the unit motherboard. You do not need to disconnect the ribbon cable.

4. Locate the fuse and fuse holder on the transceiver's PC board. See Figure 6-5 for details.

5. Loosen the fuse from the holder using a very small screwdriver. Use a small pair of needle-nose pliers to pull the fuse straight up and remove it.

6. Using an Ohmmeter, or other continuity tester, verify the fuse is blown.

7. Install a new fuse by reversing the process.

   Littelfuse P/N: 0454002; 452 Series, 2 Amp SMF Slo-Blo
   MDS P/N: 29-1784A03

8. Install the covers and check the transceiver for proper operation.

Figure 6-5. Internal Fuse and Holder Assembly

6.3 TECHNICAL SPECIFICATIONS

GENERAL

Temperature Range:	–40° C to +60° C (–40° F to 158° F)
Humidity:	95% at +40° C (104° F); non-condensing
Primary Power:	10.5–30 Vdc (13.8 Vdc Nominal)
External Power Supply Options:	110–120/210–220 Vac
Supply Current (TX):	AP: 14.5 Watts @ 1 Watt RF Output Remote: 3.2 watts @ 1 Watt RF Output
Supply Current (RX):	AP: 4 Watts Remote: 3 watts
MTBF:	35 Years (Telcordia Method 1, Case 3)
Size (Excluding mtg. hardware):	5.72 x 20 x 12.38 cm (H x W x D) (2.25" x 7.88" x 4.88" in)
Mounting w/Optional Hardware:	• DIN Rail • Flat surface mounting brackets • 19” rack tray (2U high)
Weight:	0.91 kg / 2 lb
Case:	Die Cast Aluminum
Boot Time:	≈ 45 sec
Time Required to Associate with Access Point:	≈ 20 sec

APPROVALS/HOMOLOGATION

- FCC Part 15.247
  FCC identifier: E5MDS-Mercury 900
- Industry Canada RSS-210
  Certification no.: 3738A-Mercury 900
- CSA/US Class 1, Div. 2; Groups A, B, C and D hazardous locations
- Contact factory for information on availability and governmental approvals in other countries

MANAGEMENT

- HTTP (Embedded Web server)
- Telnet, local console
- SNMP v1/v2/v3
- MIB II
- Enterprise MIB
- SYSLOG
- MDS NETview MS compatible

DATA CHARACTERISTICS

PORTS:

Ethernet Interface:	• 10/100BaseT, RJ-45 Standard • IEEE 802.3, Spanning Tree (Bridging), IGMP, IP (DHCP, ICMP, UDP, TCP, ARP)
Raw Bit Rate (LAN port):	12.7 Mbps–64 QAM 4.8 Mbps–16 QAM 2.4 Mbps–QPSK .2 Mbps–BPSK
Serial Interface (COM1):	
Signaling Standard:	EIA-232/V.24
Interface Connector:	DB-9F
Interface:	• DCE • Encapsulation over IP (tunneling) for serial async multidrop protocols
Data Rate:	1200–115,200 bps asynchronous
Data Latency:	< 10 ms typical
Byte Formats:	7 or 8-bit; even, odd, or no-parity; 1 or 2 stop bits
Other Interfaces:	Two CardBus Slots USB Device and host ports Built-in GPS (Optional) LEDs: PWR, COM1, LINK, USB, LAN
OPERATING MODES:	Configurable as Access Point or Remote Station
CONFIGURATIONS::	Serial and Ethernet Remote Serial Gateway Serial only Remote Ethernet Bridge Ethernet only (with multi-drop capability)
:**PROTOCOLS:**	• Wireless: CSMA/CA (Collision Avoidance) • Ethernet: IEEE 802.3, Ethernet II, Spanning Tree (Bridging), IGMP • TCP/IP: DHCP, ICMP, UDP, TCP, ARP, Multicast, SNTP, TFTP • Serial: PPP, Encapsulation over IP (tunneling) for serial async multidrop protocols including Modbus, DNP.3, DF1, BSAP • Special: Allen-Bradley EtherNet/IP* - Modbus/TCP (optional)

CYBER SECURITY

• MDS Cyber Security Suite, Level 1:	• AES-128 encryption (optional)
• MDS Cyber Security Suite, Level 2:	• RC4-128 encryption •Automatic rotating key algorithm •Authentication: 802.1x, RADIUS, EAP/TLS, PKI, PAP, CHAP •Management: SSL, SSH, HTTPS •Approved AP/Remotes list (local authentication) •Failed login lockdown •900 MHz operation and proprietary data framing

RADIO CHARACTERISTICS

GENERAL:

Frequency Range:	902–928 MHz ISM Band
Frequency Hopping Range:	Five user-configurable 2.5 MHz-wide zones, each containing 5 frequencies
Hop Patterns:	8192, based on network name
Frequency Stability:	20 ppm
Antenna Connectors:	TX/RX and RX (diversity)—TNC GPS—Female SMA
TRANSMITTER:	
Power Output (at antenna connector):	0.1 to 1.0 watt (+20 dBm to +30 dBm) ±1.0 dB, *set by user*
Duty Cycle:	Continuous
Modulation Type:	Orthogonal Frequency Division Multiplex (OFDM)
Output Impedance:	50 Ohms
Spurious:	–67 dBc
Occupied Bandwidth (data channels):	+/- 3 MHz wide data channels
RECEIVER:	
Type:	Double conversion superheterodyne
Sensitivity:	–86 dBm through –101 dBm with 10^{-6} BER
Intermodulation:	59 dB Minimum (EIA)
Desensitization:	70 dB
Spurious:	60 dB

TRANSMIT/RECEIVE RANGE (Nominal)

	512 kbps
Fixed Range (typical):	15 miles (24 km)
Fixed Range (maximum):	60 miles (97 km)
Mobile Range (parked):	5 miles (8 km)
Mobile Range (moving):	3 miles (5 km)
	1.5 Mbps
Fixed Range (typical):	8 miles (13 km)
Fixed Range (maximum):	15 miles (24 km)

Note: Specifications subject to change without notice or obligation.

NOTE: Range calculations for fixed locations assume a 6 dBd gain Omnidirectional antenna on a 100 ft tower at the AP, a 10 dBd gain Yagi on a 25 ft mast at the remote with output power decreased to yield maximum allowable EIRP (36 dBm), a 10 dB fade margin, and a mix of agricultural and commercial terrain with line of sight.

Range calculations for mobile units assume a 6 dBd gain Omni on a 100 ft tower at the AP, a 5 dBd gain Omni with 1 watt output power at 6 ft height, a 10 dB fade margin, and 90% confidence with near line-of-sight in a mix of agricultural and commercial terrain.

Actual performance is dependent on many factors including antenna height, blocked paths, and terrain.

6.4 CHANNEL TABLE

The transceiver operates on x channels, numbered 0 to x as listed in Table 6-3. (Channel info to be supplied.)

Table 6-3. Channel Table

Zone	Channel	Frequency
	0	902.5000
	1	902.8165
	2	903.1330
	3	903.4495
	4	903.7660
	5	904.0825
	6	904.3990
	7	904.7155
	8	905.0320
	9	905.3485
	10	905.6650

6.5 SNMP USAGE NOTES

6.5.1 Overview

The firmware release described in this manual contains major changes to the transceiver's SNMP Agent, several new MIB variables, and new

Agent configuration options. This guide reviews the changes and shows how to properly configure the Agent to take advantage of these new features.

SNMPv3 Support

The updated SNMP Agent now supports SNMP version 3 (SNMPv3). The SNMPv3 protocol introduces Authentication (MD5/SHA-1), Encryption (DES), the USM User Table, and View-Based Access (Refer to RFC2574 for full details). The SNMP Agent has limited SNMPv3 support in the following areas:

- Only MD5 Authentication is supported (no SHA-1). SNMPv3 provides support for MD5 and SHA-1. Currently, only MD5 Authentication is supported in the SNMP Agent.
- Limited USM User Table Manipulation. The SNMP Agent starts with 5 default accounts. New accounts can be added (SNMPv3 adds new accounts by cloning existing ones), but they will be volatile (will not survive a power-cycle).

  New views cannot be configured on the SNMP Agent. Views will be inherited for new accounts from the account that was cloned.

  The SNMP Agent uses one password pair (Authentication / Privacy) for all accounts. This means that when the passwords change for one user, they change for all users.

SNMPv3 Accounts

The following default accounts are available for the SNMP Agent:

enc_mdsadmin—Read/write account using Authentication and Encryption

auth_mdsadmin—Read/write account using Authentication

enc_mdsviewer—Read only account using Authentication and Encryption

auth_mdsviewer—Read only account using Authentication

def_mdsviewer—Read only account with no Authentication or Encryption

Context Names

The following Context Names are used (please refer to RFC2574 for full details):

Admin accounts: **context_a** / Viewer accounts: **context_v**

All accounts share the same default passwords:

Authentication default password: **MDSAuthPwd** / Privacy default password: **MDSPrivPwd**

Passwords can be changed either locally (via the console) or from an SNMP Manager, depending on how the Agent is configured. If passwords are configured and managed locally, they are non-volatile and will survive a power-cycle. If passwords are configured from an SNMP manager, they will be reset to whatever has been stored for local management on power-cycle.

This behavior was chosen based on RFC specifications. The SNMP Manager and Agent don't exchange passwords, but actually exchange *keys* based on passwords. If the Manager changes the Agent's password the Agent doesn't know the new password; just the new key. In this case, only the Manager knows the new password. This could cause problems if the Manager loses the password. If that happens, the Agent becomes unmanageable. Resetting the Agent's passwords (and therefore keys) to what is stored in flash memory upon power-cycle prevents the serious problem of losing the Agent's passwords.

If passwords are managed locally, they can be changed on the Agent (via the console). Any attempts to change the passwords for the Agent via an SNMP Manager will fail when the Agent is in this mode. Locally defined passwords will survive a power-cycle.

In either case, the SNMP Manager needs to know the initial passwords that are being used in order to talk to the Agent. If the Agent's passwords are configured via the Manager, then they can be changed from the Manager. If the passwords are managed locally, then the Manager must be re-configured with any password changes in order to continue to talk to the Agent.

Password-Mode Management Changes

When the password management mode is changed, the active passwords used by the Agent may also change. Some common scenarios are discussed below:

Common Scenarios

- Passwords are currently being handled by the Manager. The assigned passwords are **Microwave** (Auth), and **Rochester** (Priv). Configuration is changed to manage the passwords locally. The passwords stored on the radio were Fairport (Auth), and Churchville (Priv) (If local passwords have *never* been used, then MDSAuthPwd and MDSPrivPwd will be used). These passwords will now be used by the Agent to re-generate keys. The Manager will need to know these passwords in order to talk to the Agent.

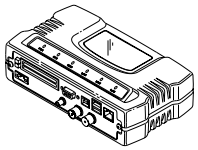
- Passwords are currently being managed locally. The local passwords are **Fairport** (Auth) and **Churchville** (Priv). Configuration is changed to handle the passwords from the Manager. The same passwords will continue to be used, but now the Manager can change them.
- Passwords are currently being managed locally. The local passwords are **Fairport** (Auth) and **Churchville** (Priv). Passwords are changed to **Brighton** (Auth) and **Perinton** (Priv). The Agent will immediately generate new keys based on these passwords and start using them. The Manager will have to be re-configured to use these new passwords.
- Passwords are currently being managed locally. The local passwords are **Fairport** (Auth) and **Churchville** (Priv). Configuration is changed to handle the passwords from the Manager. The Manager changes the passwords to **Brighton** (Auth) and **Perinton** (Priv). The radio is then rebooted. After a power-cycle, the radio will use the passwords stored in flash, which are **Fairport** (Auth) and **Churchville** (Priv). The Manager will have to be re-configured to use these new passwords.

Table 6-4. SNMP Traps *(Sorted by Code)*

SNMP Trap	Severity	Description
systemBoot(32)	INFORM	SNR Within threshold/Below threshold
systemReboot(33)	MAJOR	Telnet User Logged Out/Logged In
startScan(34)	INFORM	Reprogramming Started
rxBeaconErrored(35)	INFORM	Received Beacon - Netname Does Not Match
rxBeaconWrongNetworkName (36)	INFORM	Received Beacon - AP is Blacklisted
rxBeaconFromBlacklistAP(37)	MAJOR	Max Beacon Wait Time Exceeded
expectedSync(38)	INFORM	Expected Sync Lost/Established
hopSync(39)	INFORM	Hop Sync Lost/Established
snr(41)	INFORM	Scanning Started
ber(42)	INFORM	Bit Error Rate Below threshold/Above threshold
associated(43)	MAJOR	Association Lost/Established
apParmChange(44)	MINOR	Association Lost - AP Hop Parameter Changed
reprogStarted(45)	MAJOR	Reprogramming Failed
reprogComplete(46)	MAJOR	Rem Ethernet Link Connected/Disconnected
reprogFailed(47)	INFORM	Reprogramming Complete
telnetLogin(48)	MAJOR	Telnet Access Locked for 5 Min
httpLogin(49)	MAJOR	HTTP User Logged Out/Logged In
countrySkipZoneMismatch(50)	INFORM	Country/SkipZone Mismatch
desiredAPIPMismatch(51)	INFORM	Desired AP IP Addr Mismatch
eventLogCleared(52)	INFORM	Log Cleared

Table 6-4. SNMP Traps *(Sorted by Code)* ***(Continued)***

SNMP Trap	Severity	Description
authDemoMode(53)	MAJOR	Auth Demo Mode Expired -- Rebooted Radio/Enabled
keyEntered(54)	MAJOR	Auth Key Entered - Key Valid/Key Invalid
apEthLinkDown(55)	MAJOR	Association Lost - AP's Ethernet Link Down
noBeacons(56)	MAJOR	MAC Param Changed
apNotApproved(57)	MAJOR	Current AP No Longer Approved
netnameChanged(58)	MAJOR	Association Lost - Local Network Name Changed
ipAddrChanged(59)	MAJOR	Association Lost - Local IP Address Changed
assocTryFail(60)	MAJOR	Association Attempt Success/Failed
remEthLinkLost(61)	INFORM	Received Beacon - Valid/Errored
consoleLogin(62)	MAJOR	Console User Logged Out/Logged In
consoleLockdown(63)	MAJOR	Console Access Locked for 5 Min
telnetLockdown(64)	INFORM	System Bootup (power on)
httpLockdown(65)	MAJOR	HTTP Access Locked for 5 Min
eventRemote(66)	INFORM	Remote added/removed from internal database
eventEndpoint(67)	INFORM	Endpoint added/removed from internal database
routeAdded(68)	INFORM	Radio attempted but failed to add a route to its internal routing table
routeDeleted(69)	INFORM	Radio attempted but failed to delete a route from its internal routing table
sinRemSwitch(70)	INFORM	Remote mode was switched (serial to ethernet, ethernet to serial)
ChanCnt(71)	INFORM	Number of channels defined does not match (Channel 130 only)
tftpConnection(73)	INFORM	TFTP Server on AP started or finished a transfer
apNetNameChanged(74)	MAJOR	Remote lost association due to a change in the AP’s netname
ipConnectivityOK(75)	INFORM	Radio is associated AND 1) has an IP address statically defined, OR 2) received an IP address via DHCP
compressionChanged(76)	INFORM	Compression state has changed (enabled, disabled)
macDecryptError(77)	INFORM	MAC has received a packet that it could not decrypt
lanPortStatus(78)	INFORM	Ethernet port has changed (enabled, disabled)
tftpConnFailed(79)	INFORM	TFTP server on AP failed to transfer
sdbError(80)	INFORM	AP encountered an internal database error



7 GLOSSARY OF TERMS AND ABBREVIATIONS

If you are new to wireless IP/Ethernet systems, some of the terms used in this guide may be unfamiliar. The following glossary explains many of these terms and will prove helpful in understanding the operation of your radio network.

Access Point (AP)—The transceiver in the network that provides synchronization information to one or more associated Remote units. AP units may be configured for either the Access Point (master) or Remote services. (See *"Network Configuration Menu"* on Page 44.)

Active Scanning—See *Passive Scanning*

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

AP—See *Access Point*

Association—Condition in which the frequency hopping pattern of the Remote is synchronized with the Access Point station and is ready to pass traffic.

Authorization Key—Alphanumeric string (code) that is used to enable additional capabilities in the transceiver.

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

Bits-per-second—See *BPS*.

BPDU—Bridge Protocol Data Units

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

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

CSMA/CA—Carrier Sense Multiple Access/Collision Avoidance

CSMA/CD—Carrier Sense Multiple Access/Collision Detection

Cyclic Redundancy Check (CRC)—A technique used to verify data integrity. It is based on an algorithm which generates a value derived

from the number and order of bits in a data string. This value is compared with a locally-generated value and a match indicates that the message is unchanged, and therefore valid.

Data Circuit-terminating Equipment—See *DCE*.

Data Communications Equipment—See *DCE*.

Datagram—A data string consisting of an IP header and the IP message within.

Data Terminal Equipment—See *DTE*.

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

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

DCE—Data Circuit-terminating Equipment (or Data Communications Equipment). In data communications terminology, this is the "modem" side of a computer-to-modem connection. COM1 Port of the transceiver is set as DCE.

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

Delimiter—A flag that marks the beginning and end of a data packet.

Device Mode—The operating mode/role of a transceiver (Access Point or Remote) in a wireless network.

DHCP (Dynamic Host Configuration Protocol)—An Internet standard that allows a client (i.e. any computer or network device) to obtain an IP address from a server on the network. This allows network administrators to avoid the tedious process of manually configuring and managing IP addresses for a large number of users and devices. When a network device powers on, if it is configured to use DHCP, it will contact a DHCP server on the network and request an IP address.

The DHCP server will provide an address from a pool of addresses allocated by the network administrator. The network device may use this address on a "time lease" basis or indefinitely depending on the policy set by the network administrator. The DHCP server can restrict allocation of IP addresses based on security policies. An Access Point may be configured by the system administrator to act as a DHCP server if one is not available on the wired network.

Digital Signal Processing—See *DSP*.

DSP—Digital Signal Processing. DSP circuitry is responsible for the most critical real-time tasks; primarily modulation, demodulation, and servicing of the data port.

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

Encapsulation—Process in by which, a complete data packet, such as Modbus frame or any other polled asynchronous protocol frame, is placed in the data portion of another protocol frame (in this case IP) to be transported over a network. Typically this action is done at the receiving end, before being sent as an IP packet to a network. A similar reversed process is applied at the other end of the network extracting the data from the IP envelope, resulting in the original packet in the original protocol.

Endpoint—IP address of data equipment connected to the ports of the radio.

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

Fade Margin—The greatest tolerable reduction in average received signal strength that will be anticipated under most conditions. Provides an allowance for reduced signal strength due to multipath, slight antenna movement or changing atmospheric losses. A fade margin of 15 to 20 dB is usually sufficient in most systems.

Fragmentation—A technique used for breaking a large message down into smaller parts so it can be accommodated by a less capable media.

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

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

Frequency Zone—The radio uses up to 80 discrete channels in the 902 to 928 MHz spectrum. A group of 8 channels is referred to as a zone; in total there are 10 zones.

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

Hop Pattern Seed—A user-selectable value to be added to the hop pattern formula in an unlikely event of nearly identical hop patterns of two collocated or nearby radio networks to eliminate adjacent-network interference.

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

HTTP—Hypertext Transfer Protocol

IAPP (inter-Access Point Protocol)—A protocol by which access points share information about the stations that are connected to them. When a station connects to an access point, the access point updates its database. When a station leaves one access point and roams to another access point, the new access point tells the old access point, using IAPP, that the station has left and is now located on the new access point.

ICMP—Internet Control Message Protocol

IGMP (Internet Gateway Management Protocol)—Ethernet level protocol used by routers and similar devices to manage the distribution of multicast addresses in a network.

IEEE—Institute of Electrical and Electronic Engineers

Image (File)—Data file that contains the operating system and other essential resources for the basic operation of the radio's CPU.

LAN—Local Area Network

Latency—The delay (usually expressed in milliseconds) between when data is applied at the transmit port at one radio, until it appears at the receive port at the other radio.

MAC—Media Access Controller

MD5—A highly secure data encoding scheme. MD5 is a one-way hash algorithm that takes any length of data and produces a 128 bit "fingerprint." This fingerprint is "non-reversible," it is computationally infeasible to determine the file based on the fingerprint. For more details review "RFC 1321" available on the Internet.

MIB—Management Information Base

Microcontroller Unit—See *MCU*.

Mobile IP—An emerging standard by which access points and stations maintain network connectivity as the stations move between various IP networks. Through the use of Mobile IP a station can move from its home IP network to a foreign network while still sending and receiving data using it's original IP address. Other hosts on the network will not need to know that the station is no longer in its home network and can

continue to send data to the IP address that was assigned to the station. Mobile IP also uses DHCP when the station moves into a foreign network.

Mobility—Refers to a station that moves about while maintaining active connections with the network. Mobility generally implies physical motion. The movement of the station is not limited to a specific network and IP subnet. In order for a station to be mobile it must establish and tear down connections with various access points as it moves through the access points' territory. To do this, the station employs roaming and Mobile IP.

Mode—*See Device Mode.*

MTBF—Mean-Time Between Failures

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

Network Name—User-selectable alphanumeric string that is used to identify a group of radio units that form a communications network. The Access Point and all Remotes within a given system should have the same network address.

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

NTP—Network Time Protocol

Packet—The basic unit of data carried on a link layer. On an IP network, this refers to an entire IP datagram or a fragment thereof.

Passive Scanning—Scanning is a process used by stations to detect other access points on network to which it may connect if it needs to roam. Passive scanning is a slower process in which it listens for information offered by the access points on a regular basis. Active scanning is a faster process in which the station sends out probe message to which the access points respond. Passive scanning can be done while maintaining the current network connectivity. Active scanning affects the RF configuration of the radio and therefore, at least temporarily, disconnects the station from the access point.

PING—Packet INternet Groper. Diagnostic message generally used to test reachability of a network device, either over a wired or wireless network.

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

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

Portability—A station is considered connected when it has successfully authenticated and associated with an access point. A station is considered authenticated when it has agreed with the access point on the type of encryption that will be used for data packets traveling between them. The process of association causes a station to be bound to an access point and allows it to receive and transmit packets to and from the access point. In order for a station to be associated it must first authenticate with the access point. The authentication and association processes occur automatically without user intervention.

Portability refers to the ability of a station to connect to an access point from multiple locations without the need to reconfigure the network settings. For example, a remote transceiver that is connected to an access point may be turned off, moved to new site, turned back on, and, assuming the right information is entered, can immediately reconnect to the access point without user intervention.

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

PuTTY—A free implementation of Telnet and SSH for Win32 and Unix platforms. It is written and maintained primarily by Simon Tatham Refer to http://www.pobox.com/~anakin/ for more information.

Remote—A transceiver in a network that communicates with an associated Access Point.

Remote Terminal Unit—See *RTU*.

RFI—Radio Frequency Interference

Roaming—A station's ability to automatically switch its wireless connection between various access points (APs) as the need arises. A station may roam from one AP to another because the signal strength or quality of the current AP has degraded below what another AP can provide. When two access points are co-located for redundancy, roaming allows the stations to switch between them to provide a robust network. Roaming may also be employed in conjunction with Portability where the station has been moved beyond the range of the original AP to which it was connected. As the station comes in range of a new AP, it will switch its connection to the stronger signal. Roaming refers to a station's logical, not necessarily physical, move between access points within a specific network and IP subnet.

RSSI—Received Signal Strength Indicator

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

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

Skip Zone(s)—Groups of operating channels (frequencies) deleted from the radio transmitter and receiver operating range.

SNMP—Simple Network Management Protocol

SNR—Signal-to-Noise Ratio. A measurement of the desired signal to ambient noise levels.This measurement provides a relative indication of signal quality. Because this is a relative number, higher signal-to-noise ratios indicate improved performance.

SNTP—Simple Network Time Protocol

SSL—Secure Socket Layer

SSH—Secure Shell

STP—Spanning Tree Protocol

Standing-Wave Ratio—See *SWR*.

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

TCP—Transmission Control Protocol

TFTP—Trivial File Transfer Protocol

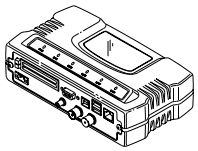
Trap Manager—Software that collects SNMP traps for display or logging of events.

UDP—User Datagram Protocol

UTP—Unshielded Twisted Pair

WINS—Windows Internet Naming Service. Part of Microsoft Windows NT and 2000 servers that manages the association of workstation names and locations with Internet Protocol addresses. It works without the user or an administrator having to be involved in each configuration change. Similar to DNS.

Zone—See *Frequency Zone*.



INDEX

Numerics
100BaseT 139
10BaseT 139
802.11b 8

A
Access Point (AP), defined 167
accessories 15
Active Scanning, defined 167, 171
Actual Data Rate 87
Add Associated Remotes 83
AgeTime 94, 95
alarm conditions 128
  correcting 130
Alarmed 126
Antenna
  aiming 135
  directional 146
  Minimum Feedline Length versus Antenna Gain 144
  omnidirectional 143
  polarization 142
  selection 142
  SWR check 134
  system gain 167
  system gain vs. power output setting 148
  system gain, defined 167
  Yagi 143
AP
  Auto Upgrade 94
  Reboot when Upgraded 94
application
  IP-to-Serial 73
  Mixed-Modes 78
  Point-to-Multipoint Serial-to-Serial 75
  Point-to-Point Serial-to-Serial 74
  Serial Port 78
Approved
  Access Points/Remotes List 81
  Remotes/Access Points List 82
Associated 126
Association
  Date 94
  defined 167
  Process 93
  Time 94
attenuation 22
Auth Traps Status 52
Authorization Key 116, 119
  defined 167
Authorized Features 116
Auto Data Rate Menu
  RSSI Threshold/Delta 57
  SNR Threshold/Delta 57
Auto Key Rotation 81
Auto-Upgrade/Remote-Reboot 116

B
Backhaul
  for Serial Radio Networks 7
  Network 7
bandpass filter 146
Beacon
  Period 54, 100, 101
  signal 93
Begin Wizard 65
Bit, defined 167
Bits-per-second (bps), defined 167
BPDU 98
  defined 167
BPS, defined 167
Bytes
  defined 167
  in on port 97
  in on socket 97
  out on port 97
  out on socket 97
  received 91, 92
  sent 91, 92

C
cable
  Ethernet crossover 23
  feedlines 143
  serial 23
Clear
  Com# statistics 97
  Ethernet stats 92
  Log 89
  Wireless stats 92
Collocating Multiple Radio Networks 13
Commit Changes and Exit Wizard 67, 69, 70, 72, 73
compression 53, 101
Computer
  host, defined 170
configuration 23, 67, 68, 70, 71, 72
  basic device parameters 42
  defaults 23
  DHCP server 48
  editing files 114
  Ethernet Port 47
  file 108, 123
  IP address 46
  network 44
  PPP Mode 72
  radio parameters 52
  scripts 107, 108
  security 79
  serial interfaces 62
  SNMP Agent 50
  TCP Mode 69
  UDP mode 66
Connection Status 93
connectors 153
Contact 43

cost of deployment 8
Count 119
CRC (Cyclic Redundancy Check), defined 167
CSMA
  CA, defined 167
  CD, defined 167
Current
  Alarms 89
  AP IP Address 94
  AP Mac Address 94
Custom Data Buffer Size 67, 69, 70, 72, 73

D

data
  baud 72
  baud rate 67, 68, 70, 71
  buffering 64, 70
  compression 101
  rate 53
Database
  Logging 46
  Timeout 46
Datagram, defined 168
DataRate 95
Date 43
  Format 43
dB, defined 168
dBi, defined 168
dBm
  defined 168
  watts-volts conversion 149
DCE, defined 168
default gateway 46
defaults
  reset to factory 119
Delete
  All Remotes 83
  Remote 82
Delimiter, defined 168
deployment costs 8
Description 43
Device
  IP Address 72
  Mode 40, 44, 45
  Mode, defined 168
  Name 40, 43
  Status 40, 126
DHCP 46, 47
  defined 168
  Netmask 49
  Server Configuration 45
Diagnostic Tools 128
dimensions 139
DKEY command 134
DNS Address 49
DSP (Digital Signal Processing), defined 169
DTE 9, 62
  defined 169
Dwell Time 54, 100
Dynamic Mode 47

E

EIA-232 9
Embedded Management System 23
Encapsulation, defined 169
Encryption 81
  Phrase 82
Ending Address 49
Endpoint
  defined 169
  Listing 87
  Listing Menu 95
Equalization, defined 169
Ethernet
  Address 46
  Link (H/W) Watch 48
  Link Poll Address 48
  Packet Statistics 92
  port enabled/disabled 48
  Rate Limit 48
Event Log 87, 88, 126, 128, 130, 131

F

Fade Margin 169
Feedline
  selection 142, 143
Filename 90, 103, 107
firmware
  installing 104
  upgrade 103, 117
  version 41, 43
Flow Control 65, 67, 69, 70, 71, 72
  hardware, defined 169
Force Key Rotation 82
Force Reboot 117
Fragmentation
  defined 169
  Threshold 54, 100
Frame, defined 169
Frequency 118
  hopping, defined 169
  zone, defined 169
fuse replacement 155

G

gain
  antenna, defined 167
  system 147
Glossary 167–173
Go 119

H

Hardware
  flow control, defined 169
  Version 41, 43
Hop
  Format 55
  pattern 146
  Pattern Seed 54
  Pattern Seed, defined 170
  Sync 126
Hopping
  channels 159
  frequency, defined 169
  pattern seed, defined 170
Host computer, defined 170
HTTP
  defined 170
  Security Mode 81

I
IANA 63
IAPP, defined 170
ICMP, defined 170
IEEE, defined 170
IETF standard RFC1213 50
IGMP, defined 170
Image
  Copy 103
  file, defined 170
  Verify 103
iNET II, differences of 53, 55, 57, 59, 135
Installation
  antenna & feedline 142
  feedline selection 143
  general information 3
  planning 139
  requirements 139
  site selection 141
  site survey 145
Interference 146
Internet
  Assigned Numbers Authority 63
  Control Message Protocol, defined 170
IP 48
  Addr 119
  Address 40, 44, 94, 95, 115
  address 47
  Address Configuration 45
  Address Mode 47
  Gateway 115
  Mobile, defined 170
  Protocol 66, 68, 69, 71, 72
  tunneling 63

K
Key
  transmitter, for antenna SWR check 134
KEY command 134

L
LAN 47
  defined 170
Latency 101
Latency, defined 170
Latest AP Firmware Version 94
LED
  COM1 27
  LAN 26, 124
  LINK 26, 27, 124, 136, 145
  PWR 26, 27, 88, 90, 124, 128, 131
  use during troubleshooting 123
Link Established 73
Local
  Area Network, defined 170
  IP Port 66, 68
  Listening IP Port 71
Location 43, 115
Logged Events 131
Lost Carrier Detected 92, 127

M
MAC Address 94, 95, 98
Management System 23
  user interfaces 31
Maximum Remotes 45
MD5, defined 170
MDS Security Suite 14
measurements
  radio 133
Media Access Controller, defined 170
MIB
  defined 170
  files 50
Mobile 59
Mobile Data
  Beacon Period 61
  Compression 61
  configuration 59
  Dwell Time 61
  Fragmentation Threshold 61
  RTS Threshold 62
Mobile IP, defined 170
Mobility
  defined 171
Mobility Capability 10
MODBUS 70
Mode
  Device, defined 168
  mixed 77
  serial gateway interface 10
  TCP 10
  UDP 10
Model Number 42
MTBF, defined 171
Multicast
  IP Address 66
  IP Port 66
multiple
  protocols 7
  services 7

N
NEMA 8
net mask 46
Network
  Name 13, 21, 40, 44, 45, 115
  Name, defined 171
  Time Protocol (NTP), defined 171
  -wide diagnostics 171
network
  maintenance 101
  operation principles 97
  performance optimization 100
  performance verification 86
network design 10
  antennas 11
  collocating multiple radio networks 13
  network name 11
  repeaters 10
  using multiple Access Points 12
  Using the AP as a Store-and-Forward Packet Repeater 12
  using two transceivers to form a repeater station 10
NTP (Network Time Protocol), defined 171

O
Outgoing Connection's Inactivity Timeout 70
Owner 43

P
Packet
defined 171
Redundancy Mode 67, 68
Size 119
Statistics 87, 91, 127
Packets
Dropped 91, 92, 127
Received 91, 92
Received by Zone 92
Sent 91, 92
Passive Scanning, defined 171
Password Reset 119
PC
connection to transceiver 23
Performance Information Menu 100
PING 21, 27, 145
defined 171
Ping Utility 119
PLC 9
defined 172
Point-Multipoint System, defined 171
Point-to-Point
LAN Extension 6
Link 7
Poll, defined 171
port
antenna 134
COM1 9, 23, 24, 62, 73, 142, 154
COM2 9, 24, 62, 73
Ethernet 21
IP 73
LAN 23, 24, 153
not Enabled 73
Portability, defined 172
ports
serial 7
power
how much can be used 145
primary 22
transmitter power output 134
PPP 64
Primary Host Address 69
Primary IP Port 70
Programmable Logic Controller 9
protocol
BPDU 98
ICMP, defined 170
IP 24, 48, 62
MODBUS 70
PPP 64
SNMP 31, 50, 161
defined 173
SNTP 45, 173
STP 98
STP, defined 173
TCP 62, 63, 69, 73, 77, 101
defined 173
TFTP 104
defined 173
UDP 62, 63, 73, 74, 77, 101
defined 173
PuTTY usage 35
defined 172

R
Radio
Frequency Interference 13, 146
Remote, defined 172
Test 117
range, transmission 8
Read Community String 51
Reboot
Device 103
on Upgrade 117
Receive errors 91, 92, 127
Received Signal Strength Indicator 22, 141
defined 172
Redundancy
Using multiple Access Points 12
Remote
IP Address 68
IP Port 68
Listing 87
Listing Menu 94
Performance Listing 87, 96
radio, defined 172
Terminal Unit 9
Terminal Unit, defined 172
Repeater 10
antennas 11
Network Name 11
Using the AP as a Store-and-Forward Packet Repeater 12
Using two transceivers to form a repeater station 10
reprogramming 102
Resetting the Password 119
Restart DHCP Server 50
Retries 92, 127
Retrieve File 103, 108
Retry errors 92, 127
RetryEr 96
RF Output Power 53, 86
RFI 13
defined 172
Roaming, defined 172
RSSI 22, 86, 118, 127, 135, 141
by Zone 87
defined 172
Threshold 55
RTS Threshold 54, 100
RTS/CTS handshaking 67
RTU 9, 62, 73, 78
defined 172
RxBCMC 96
RxPkts 95, 96
RxRate 96
RxViaEP 96

S
Save Changes 83
SCADA 7, 9, 64
defined 173
Scanning 126
Active, defined 171
Passive, defined 171
Seamless Inter-Frame Delay 67, 69, 70, 72, 73
Secondary
Host Address 70
IP Port 70
security
Approved Access Points/Remotes List 81

Auto Key Rotation 81
encryption 81
Encryption Phrase 82
Force Key Rotation 82
general information 3
HTTP Security Mode 81
risks 14
suite 14
Telnet Access 80
Two-Way Authentication 80
User Password 80
Send
File 108
Log 89
Sending LCP Requests 73
Serial
Configuration Wizard 64
Data Statistics 97
encapsulation 63
Mode 67, 69, 70, 71, 72
Number 41, 42
Port Statistics 127
radio networks, backhaul 7
Server Status 49
Signal strength 141
Signal-to-Noise Ratio 86
defined 173
Simple Network
Management Protocol, defined 173
Time Protocol, defined 173
Site selection 141
Skip Zone, defined 173
SNMP 31
Config Menu 45
defined 173
Mode 51, 80
traps 164
usage 161
V3 Passwords 52
SNR 55
defined 173
Threshold 55
SNTP 45
defined 173
Spanning Tree Protocol 98
Spanning Tree Protocol, defined 173
Specifications 156–159
SSH, defined 173
SSL, defined 173
Standing Wave Ratio 173
Starting
Address 49
Information Screen 42
State 94
Static IP
Address 47
Gateway 47
Netmask 47
Status 40, 66, 68, 69, 71, 72
STP, defined 173
subnet 47
SWR 134, 173
defined 173
performance optimization 134
Syslog Server 90
system gain, antenna 167
system gain, antenna (defined) 167
System Mode 115

T

TCP 10, 63, 77, 101
Client 63
defined 173
Server 63
Telnet 73
Access 80
Test Mode 118
TFTP
defined 173
Host Address 89, 103, 107
Time-out 90
Timeout 103, 108
Time 43
Time to Live (TTL) 66
Transmission
Control Protocol, defined 173
range 8
transparent encapsulation 63
Trap
Community String 51
Manager 52
Manager, defined 173
Version 52
Troubleshooting 123–133
Using the Embedded Management System 124
Two-Way Authentication 80
TX Output Power 118
TxKey 118
TxPkt 96
TxPkts 96
TxViaEP 96

U

UDP 10, 63, 74, 77, 101
defined 173
mode 66
Unit Name 115
Uptime 41, 43
User Datagram Protocol, defined 173
User Password 80
Using multiple Access Points 12
UTP, defined 173

V

V3
Authentication Password 51
Privacy Password 51
via Remote 95
View
Approved Remotes 83
Current Alarms 90
Current Settings 65
Event Log 91
Log 89
volts-dBm-watts conversion 149

W

watts-dBm-volts conversion 149
WINS
Address 49
defined 173

Wireless
Address 46
Network Status 87, 93
Packet Statistics 91
wizard
serial configuration 64
Write community String 51

Y
Yagi antenna 143

Z
Zone, defined 173

IN CASE OF DIFFICULTY...

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

TECHNICAL ASSISTANCE

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

Phone: 585 241-5510 E-Mail: TechSupport@microwavedata.com

FAX: 585 242-8369 Web: www.microwavedata.com

FACTORY SERVICE

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

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

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

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

Microwave Data Systems
Product Services Department
(SRO No. XXXX)
175 Science Parkway
Rochester, NY 14620 USA

When repairs have been completed, the equipment will be returned to you by the same shipping method used to send it to the factory. Please specify if you wish to make different shipping arrangements. To inquire about an in-process repair, you may contact our Product Services Group at 585-241-5540 (FAX: 585-242-8400), or via e-mail at ProductServices@microwavedata.com.

industrial/wireless/performance

Microwave Data Systems Inc.
175 Science Parkway
Rochester, NY 14620
General Business: +1 585 242-9600
FAX: +1 585 242-9620
Web: www.microwavedata.com

A product of Microwave Data Systems Inc.