AN-50e System
PTP / PMP
User Manual

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Contact Information	Redline Communications Inc. 302 Town Centre Blvd. Markham, ON Canada L3R 0E8
Web site:	http://www.redlinecommunications.com
Sales Inquiries: North American Toll-free sales line International	 nainfo@redlinecommunications.com 1-866-633-6669 intlinfo@redlinecommunications.com
Support: Email Telephone	 support@redlinecommunications.com Contact your Redline Distributor
Product Registration	http://www.redlinecommunications.com Click 'Support' User ID: Register Password: Redline

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Chapter

1

1 Important Safety & Service Notices

1.1 Safety Warnings

- Read this User Manual and follow all operating and safety instructions.
- Keep all product information for future reference.
- This product is supplied with a grounding power plug. Do not defeat this important safety feature.
- Power requirements are indicated on product-marking label. Do not exceed the described limits.
- Always replace the fuse with the correct type and current rating.
- Position the power cord to avoid possible damage; do not overload wall outlets.
- Do not place this product on or near a direct heat source, and avoid placing objects on the terminal.
- Do not operate this device near water or in a wet location.
- Use only a damp cloth for cleaning. Do not use liquid or aerosol cleaners. Disconnect the power before cleaning.
- Protect the terminal by disconnecting the power if not used for long periods.
- Locate the terminal on a stable horizontal surface or mount it securely in a 19-inch Telco rack.
- The radio transceiver units must not be located near power lines or other electrical power circuits.
- The radio transceiver must be properly grounded to protect against power surges and accumulated static electricity. It is the user's responsibility to install this device in accordance with the local electrical codes: correct installation procedures for grounding of the transceiver unit, mast, lead-in wire and discharge unit, location of discharge unit, size of grounding conductors and connection requirements for grounding electrodes. It is recommended that the installation of the transceiver be contracted to a professional installer.

1.2 Important Warning Symbols

The following symbols may be encountered during installation or troubleshooting. These warning symbols mean danger. Bodily injury may result if you are not aware of the safety hazards involved in working with electrical equipment and radio transmitters. Familiarize yourself with standard safety practices before continuing.

Electro-Magnetic Radiation

High Voltage

1.3 Important Service Information

1. Refer all repairs to qualified service personnel. Do not remove the covers or modify any part of this device, as this will void the warranty.
2. Disconnect the power to this product and return it for service if the following conditions apply:
   a) The terminal does not function after following the operating instructions outlined in this manual.
   b) Liquid has been spilled, a foreign object is inside, or the terminal has been exposed to rain.
   c) The product has been dropped or the housing is damaged.
3. Locate the serial number of the terminal, antenna, and transceiver and record these on your registration card for future reference. Use the space below to affix serial number stickers. Also record the MAC address, located on the back of the terminal.

1.4 FCC Notice

1. The System is used as a fixed wireless Ethernet bridge that requires professional installation with specified antennas and output power levels certified under the FCC Grant for System for point-to-point mode of operations.
2. FCC RF Exposure Requirements:

   T-54 and T-58: The antenna(s) used for these radios must be fixed-mounted on outdoor permanent structures. In point-to-point applications each antenna must be separated from all persons by a distance of at least 2.5 meters. In point-to-multipoint applications each antenna must be separated from all persons by a distance of at least 20 centimetres.

   T-58e: The antenna(s) used for this radio must be fixed-mounted on outdoor permanent structures. In point-to-point applications each antenna must be separated from all persons by a distance of at least 3.1 meters. In point-to-multipoint applications each antenna must be separated from all persons by a distance of at least 20 centimetres.
3. The System is certified by the FCC and Industry Canada with the 5.4/5.8 GHz directional and parabolic antennas listed in the Appendix of this manual.
4. For fixed, point-to-point mode of operations, the transmitting antennas must be directional as specified in this User Manual; the use of omni-directional antenna is prohibit for point-to-point operation.
5. For Class A Unintentional Radiators: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.
6. Warning: Changes or modifications not expressly approved by Redline Communications Inc. could void the user's authority to operate the equipment.

1.5 UL Information

- The equipment must be properly grounded according with NEC and other local safety code requirements
- Caution for all AC and DC models: Double Pole/Neutral Fusing.
- The DC source must be fused at Time Delay 2.5A, 250V.
- The DC input wiring must be minimum 18 AWG.
- The DC input source must be SELV.
- The DC input source must comply with local electrical codes.
- To meet the over voltage safety requirements on the telecommunications cables, a minimum 26 AWG telecommunication line cord must be used.
- "Pour être en conformance avec les exigences finies de sûreté de sur-tension sur les câbles de télécommunications un fil de télécommunication ayant un caliber minimum de 26 AWG doit être utilisé."
- Reminder to all the BWA system installers: Attention to Section 820-40 of the NEC which provides guidelines for proper grounding and, in particular, specifies that the cable ground shall be connected to the grounding system of the building, as close to the point of cable entry as is practical.

1.6 CE Notice

The AN-30e systems are CE certified for operation from 5.4 GHz to 5.8 GHz.

The transceiver and antenna equipment must be installed by a qualified professional installer and must be installed in compliance with regional, national and local regulations. It is the responsibility of the system installer and/or system operator to ensure the installed system does not exceed any operational constraints identified by local regulations.

Refer to the product User Manual for detailed information about the correct installation steps to ensure power and frequency settings are set correctly before connecting the antenna.

Redline Communications Inc. wireless systems comply with the essential requirements of the Directive 1999/5/EC. This product may be used in all EU countries (and other countries following the EU directive 1999/5/EC) that have implemented nationally a decision to allow use of the 5.8 GHz frequency band. Not all countries have allowed access to the frequency band and system installers should be aware of the regulations for any specific country prior to installation.

1.7 Lightning Protection

WARNING: The following notes are general recommendations for the system*. The wireless equipment should be installed by a qualified professional installer and must follow local and national codes for electrical grounding and safety. Failure to meet safety requirements and/or use of non-standard practices and procedures could result in personal injury and damage to equipment. A direct lightning strike may cause serious damage even if these guidelines are followed.*

All outdoor wireless equipment is susceptible to lightning damage from a direct hit or induced current from a near strike. Lightning protection and grounding practices in local and national electrical codes serve to minimize equipment damage, service outages, and serious injury. Reasons for lightning damage are summarized as:

- Poorly grounded tower/antenna sites that can conduct high lightning strike energy into equipment.
- Lack of properly installed lightning protection equipment that can cause equipment failures from lightning induced currents.

A lighting protection system provides a means by which the energy may enter earth without passing through and damaging parts of a structure. A lightning protection system does not prevent lightning from striking; it provides a means for controlling it and preventing damage by providing a low resistance path for the discharge of energy to travel safely to ground. Improperly grounded connections are also a source of noise that can cause sensitive equipment to malfunction.

A good tower grounding system disperses most of the surge energy from a tower strike away from the building and equipment. The remaining energy on the IF cable shield and center conductor can be directed safely to ground by using a lightning arrestor in series with the IF cable.

To limit the equipment damage due to a lightning strike, the following practices are recommended for the wireless system:

- Provide direct grounding from the antenna mounting bracket, the radio and antenna and the lightning arrestors to the <u>same</u> ground point at the base of the tower or a ground bus on the building. Use the grounding screws on the antenna bracket and the radio and antenna for terminating the ground wires.
- Install one RF lightning protector between the radio and antenna in series with the RF cable.
- A lightning arrestor in series with the IF cable at the point of entry to the building.
- Install a lightning arrestor in series with the IF cable at the transceiver on the tower/mast.
- The AC wall outlet ground for the terminal must be connected to the same grounding system as the radio and antenna lightning protectors.
- The ground connection on the back of the terminal should be connected to the same ground for the building.

1.8 Product Information

Use the following table to record important system information:

Product Information	
Terminal SN: _____	MAC Address_____
Transceiver SN: _____	Model #: _____
Antenna Model No.: _____	Antenna SN: _____
Serial Number Stickers	

Chapter

2

2 Getting Started

Congratulations on your purchase of Redline Communications' Access Node-50e wireless broadband system. Redline Communications is a world leader in design and production of Broadband Fixed Wireless (BFW) systems.

The system consists of an indoor terminal and an outdoor radio (transceiver and antenna).

Figure 1: AN-50e System: Terminal, Transceiver, and Antenna

A point-to-point (PTP) link is comprised of a master system and a remote-end system. The master system is connected to customer Ethernet network. The master system establishes a bi-directional data link with an AN-50e remote-end system. The remote-end system is connected to the remote-end customer Ethernet network and receives and sends data under the control of the master system.

The AN-50e can also be deployed in a point-to-multipoint (PMP) configuration, with the master-end system functioning as a central hub communicating to a number of remote-end (subscriber) stations.

2.1 How To Use This Manual

This user manual provides a guide to operating your system, including a product overview, and step-by-step installation procedures.

To help insure a successful installation, please follow these principal steps in the order presented:

The following principal steps should be performed in order:

1. Review the safety and service information (Section 1)
2. Unpack the System (Section 5.1)
3. Install and configure the AN-50e terminal (Section 5.4)
4. Install the outdoor radio (transceiver plus antenna) (Section 5.6)
5. Align the antenna (Section 5.7)

This User Manual also includes additional operational and background information including:

- System Specifications (section 8.1: System Specifications on page 79)
- CLI Commands
- Glossary

2.2 Terms Used in this Manual

The following terms are used in this manual:

Table 1: Terms		
Term		**Description**
AN-50e System	AN-50e terminal (IDU)	Indoor unit
	AN-50e Radio (ODU)	Transceiver + Antenna
Master System		Master Mode ☑ The terminal configured as central equipment. This system controls the wireless link polling and transmission opportunities. The master system is connected to customer Ethernet network and establishes a bi-directional data link over-the-air with one or more remote-end AN-50e systems.
Remote-end System		Master Mode ☐ The terminal configured as remote-end location equipment. The remote-end system is connected to the customer Ethernet network and receives and sends data over-the-air under control of the master system.

Chapter

3

3 System Overview

The AN-50e is a high-performance, high-speed wireless Ethernet bridge terminal providing a scalable multi-service platform from a common equipment infrastructure and management system.

The system operates in the 5.4 GHz to 5.8 GHz band and includes advanced technologies to address inter-cell interference. The system also delivers enhanced security through a proprietary, over-the-air encryption scheme.

The AN-50e can be equipped with a narrow beam antenna to provide high directivity for long-range operations over 80 km in clear line of sight (LOS) conditions.

Figure 2: AN-50e terminal

The AN-50e system is a Class A digital device for use in a commercial, industrial or business environment.

The system is equipped with dynamic frequency selection (DFS) to detect interference from other devices using the same frequency and automatically take a pre-selected action, such as disable transmission or relocate transmission to alternative frequency. The system also includes an automatic transmitter power control (ATPC) function to automatically adjust the Tx level of remote-end systems to match a selected RSSI value.

The AN-50e system utilizes Redline's advanced Medium Access Control (MAC) design to provide efficient transmission of data in both PTP and PMP modes. In PMP mode, the MAC incorporates a proprietary polling algorithm to support up to 250 individual subscriber stations from a single master end operating in a single sector. Note that multiple masters can be installed on a single rooftop or tower to provide multi-sector coverage.

A single sector AN-50e PMP implements a distributed wireless L2 switch, with one uplink port located on the sector controller (master) distributing bandwidth to a variable number of subscriber stations (slaves).

- Each subscriber station (remote-end) is considered a separate wireless link.
- Each configured wireless link adds to the switch one remote-end port that is the Ethernet port on the corresponding subscriber station.
- Each link (remote-end) is assigned one ID that is used to manage both the connection traffic and the wireless link.
- The switch supports one broadcast/multicast group called default group, which is automatically assigned a fixed ID.

The master-end MAC utilizes a request/grant polling mechanism to determine which subscriber station requires bandwidth. This is achieved by periodically polling each subscriber station to determine if there is a request for bandwidth. If the subscriber station requests bandwidth then the MAC allocates the appropriate number of time slots, in both the downstream and upstream direction, in accordance with the CIR rate limits specified for that particular subscriber station. The AN-50e PMP system supports 18 programmable CIR levels. Through an external calculator the minimum Committed Information rate CIR rates allowed for each subscriber station can be determined. Note that a minimum CIR of 8 Kbps implies almost no CIR, and is referred to as Best Effort (BE) service.

With multiple subscriber stations compete for bandwidth, the MAC ensures that time slots are allocated in a balanced manner, according to the different CIR levels, during periods of over-subscription. For example, during peak times, the MAC will first deny time slot allocations for everything above the provisioned CIR, and then reduce bandwidth in a proportional manner to the remaining units with varying CIR levels and priorities. With the support of CIR, the service provider can offer different grades of service to each end user in a controlled manner based on their service level agreements or contracts.

Chapter
4

4 Physical Description

4.1 AN-50e Terminal

The front panel of the terminal includes a LAN interface and three groups of LED indicators: system, Wireless, and Ethernet. The rear of the terminal includes the power connections, an F-Type female connector for the IF cable, and a BNC connector for the time signal (future release).

4.1.1 Mounting

The terminal can be freestanding on a flat surface, or mounted into a standard 19-inch or 24-inch equipment rack.

4.1.2 Power Supply

Power supply options include AC or DC supplies. Refer to the appendix for DC terminal connections.

4.1.3 Wireless Section

This section describes the wireless cable connections and LEDs on the terminal.

IF Port (Radio Control)

The terminal has a female F-type port for communications with the radio. This port is connected with a radio through a coaxial cable. Through this port and cable, the terminal:

- Supplies power to the radio
- Transmits control information to the radio
- Receives status information from the radio
- Exchanges data traffic with other communicating Systems

Wireless LEDs

The Wireless portion of the front panel includes Link and Signal indicator LEDs.

Figure 3: Front Panel - Wireless LEDs

Link LED

The Link LED lights solid green when the radio link to the remote-end terminal is established. The LED will turn off if the link is lost.

Signal LED

The Signal LED lights solid green if the system is operating at the configured Uncoded Burst Rate.

4.1.4 Ethernet Section

This section describes the terminal Ethernet LEDs and port connections.

Ethernet Data Port

The Ethernet Data port is always enabled. The port can be set for auto-sense or to operate specifically in full duplex or half duplex mode and at 10 Mbps or 100 Mbps. Use a straight-through Ethernet cable for connecting to the PC/Server, or a crossover cable for connecting to a switch or router.

The broadband Ethernet access is limited for data traffic and remote-end in-band management. Product option keys are available to activate different rates of Ethernet access. Refer to section 6.4.1: Options Key Screen on page 61.

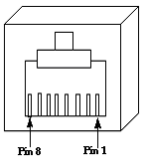


Figure 4: RJ-45 Jack Face

Table 2: terminal LAN Ethernet Port Pinout	
Jack Pin	**Function**
1	Rx +
2	Rx -
3	Tx +
6	Tx -

Warning: Connecting a telephone cable to the Ethernet interface will cause damage to the terminal.

Ethernet LEDs

The Ethernet portion of the front panel display has three LEDs as shown below.

Figure 5: Front Panel: Ethernet LEDs

Link/Act LED

The Link/Act LED lights solid green when the Local Area Network (LAN) connection is established, and there is no traffic. The Link LED will flash when the Local Area Network (LAN) connection is established, and there is traffic.

100 LED

The 100 lights solid green when the Ethernet port is operating at 100 Mb/s. The LED will not illuminate if the port is operating in 10 Mb/s mode. The Ethernet port automatically selects the speed through auto-negotiation with either the host computer/server or router/switch.

FD/Col LED

The FD/Col LED lights solid green when the LAN connection is operating in Full Duplex mode and flashes when collisions are detected on the Ethernet port.

4.1.5 System Section

This section describes other general features of the front panel.

System LEDs

The system LEDs indicate power supply and system faults.

Figure 6: Front Panel: Reset Switch and System LEDs

Pwr LED

The Pwr LED lights solid green when the AC or DC power is properly applied to the terminal. The Pwr light will not illuminate if there is an internal power supply failure, the power cables are disconnected, or the fuse is blown.

Fault LED

The Fault LED lights solid red when a serious fault is detected within the system.

Sync LED

The Sync LED lights solid green when the terminal clock is synchronized with the external GPS clock (future release).

Reset Switch

The reset button is recessed in the front panel of the terminal. To operate the switch, use a small narrow object (i.e., paper clip) to depress the switch.

Table 3: Front Panel Reset Switch	
Operation	**Result**
Depress switch less than 5 seconds.	A short reset is equivalent to cycling the terminal power off/on. Statistical values are reset. The current version of software is retained. A short reset may also be activated remotely from the Web maintenance tool by clicking on the System Reset button at the bottom of the System Configuration screen.
Depress switch longer than 5 seconds.	A long reset reloads the factory default configuration settings. The long reset effects the following settings: IP address = 192.168.25.2 netmask = 255.255.255.0 RF channel = 5765 MHz Radio Enable = disabled Login = admin Password = admin

.

4.1.6 Time Synchronization Port

The AN-50e has one BNC input on the rear panel for time synchronization. This port accepts a standard IRIG-B signal (1 pps pulse) from a GPS satellite clock. This port is currently disabled, and will be enabled in a future release.

4.1.7 Grounding Connection

A ground lug connection terminal is located on the back of the AN-50e system. Correct grounding is very important for safe operation of wireless equipment. Refer to the installation section for additional information.

4.2 Transceiver

The radio transceiver is housed in an aluminum alloy housing. The connectors are listed in the following sections.

Figure 7: Transceiver

IF Port (Radio Control)

The transceiver IF port (female F-type connector) is for communications with the terminal. This port is connected with the terminal through coaxial cable.

RF Connector

The transceiver RF port (female N-type connector) is for sending/receiving the RF signal to/from the antenna. A short coaxial cable is provided to connect the transceiver to the antenna.

Alignment Pin and Audible Signal

To assist in aiming the antenna, an external alignment pin is provided on the transceiver. This pin provides a small voltage output (0-5 VDC) that varies relative to the received signal strength. The transceiver also has an internal buzzer to provide an audible indication of the received signal strength. Use the Web interface field General Antenna Alignment to enable and disable this feature (Refer to section 6.3.1: Configure System on page 49).

4.3 Antenna

The antenna units for master system and the remote-end systems are different. Descriptions and specifications for available antennas are provided in section 8.3: Antenna and Power Specifications on page 82.

Figure 8: One-Foot Flat Antenna

RF Connector

The transceiver RF port (female N-type connector) is for sending/receiving the RF signal to/from the transceiver. A short coaxial cable is provided to connect the antenna to the transceiver.

4.4 Mounting Bracket

A mounting bracket is provided with the system. The vertical mount bracket can accommodate 1 ¾" to 4 ½" (4.45 cm to 11.45 cm) OD masts for many commercial tower installations.

Chapter

5

5 System Installation

This section of the manual presents a basic overview of the steps required to install the terminal, outdoor transceiver, antenna, and associated equipment.

***Important**: This system must be installed by a professional installer who is familiar with both data network issues and RF installations including grounding and lightning protection.*

5.1 Unpacking the AN-50e

The system comes packaged with the following items:

- User Manual
- Terminal
- Radio:
  - T-54, T-58, or T-58 Transceiver
  - Antenna
  - Antenna Mounting Bracket
- Cabling
  - RF Cable
  - IF Cable
  - AC/DC Power Cables (AC option only)
  - DC Power Cable (DC option only)
- Miscellaneous:
  - 19" mounting brackets (terminal)

A complete list of items included in the system is available on the packing list included with the system.

5.2 Site Planning

IMPORTANT: Review the safety tips provided in section 1: Important Safety & Service Notices on page 7 of this manual before installing the system.

Installation steps for the system are not complicated, but do involve some construction and electrical work. This system must be installed by a professional installer who is familiar with both data network issues and RF installations including grounding and lightning protection.

The following tables summarize the requirements for installing the terminal and radio equipment.

Table 4: Terminal (Inside) Installation Checklist

Item	Description	Notes
Supplied with system	Terminal	
	19" rack mounting tabs	
	Power cables (AC and/or DC options)	
	IF port coaxial cable	
Customer supplied Items	Terminal mounting equipment (rack or tray)	
	Power: AC power source DC power source	
	Ethernet port cabling	
	Building ground connection	
	Grounding wire	

Table 5: AN-50e Radio (Outside) Installation Checklist

Item	Description	Notes
Supplied with system	Mounting bracket	
	T-54, T-58, or T-58 transceiver	
	Antenna	
	IF port cable	
	RF port cable	
Customer supplied Items	Antenna aiming directions (site path survey)	
	IF port cable (supplied)	
	Antenna mast	
	Building ground connection	
	Grounding wire	
	Waterproofing material for connections	

5.2.1 Master System Settings

The following table lists the master system parameters must be set prior to operation of the wireless portion of the system.

Refer to section 6.3: System Configuration Screens on page 49 for additional details of these fields.

Table 6: Required Configuration Settings - Master System	
Item	**Description**
Ethernet	
IP address	Network address of the AN-50e master system (must be unique).
IP Subnet Mask	Network subnet mask.
Default Gateway Address	Default router/gateway on the local Ethernet segment.
Ethernet Mode	Select the operating mode of the Ethernet port (auto-negotiate, 10/100 Mbps).
Wireless	
Master Mode	Check this box ☑ to enable the System to operate as the master system. Only one terminal must be designated master.
RF Freq. [MHz]	Enter the channel center frequency of the system.
TX Power [dBm]	Enter the default transmit power level (dBm). Refer to section 8.3: Antenna and Power Specifications on page 82.
DFS Action	Select the mode of operation for DFS on this terminal. If the DFS function is required by local regulations, then DFS will be set on and this selection will be disabled.
DFS Antenna Gain	Enter the antenna gain (dBm). This value must be set to match the system antenna.
ATPC Enable	Check this box ☑ to enable the Automatic Transmit Power Control function.
Adaptive Modulation	Check this box ☑ to enable adaptive modulation mode.
Radio Enable	Check this box ☑ to enable the radio transmitter.

5.2.2 Remote-end System Settings

The following remote-end system parameters must be set prior to operation of the wireless portion of the system. Refer to section 6.3: System Configuration Screens on page 49 for additional details of these fields.

Table 7: Required Configuration Settings - Remote-end system	
Item	**Description**
Ethernet	
IP address	Network address of the AN-50e remote-end system (must be unique).
IP Subnet Mask	Network subnet mask.
Default Gateway	Default router/gateway on the local Ethernet segment.
Ethernet Mode	Select the operating mode of the Ethernet port (auto-negotiate, 10/100 Mbps).
Wireless	
Master Mode	Ensure that the Master Mode check box is not checked (☐).
RF Freq. [MHz]	Enter the channel center frequency of the system.
TX Power [dBm]	Enter the default transmit power level (dBm). Refer to section 8.3: Antenna and Power Specifications on page 82. If the TX power levels are restricted by local regulations, the maximum Tx power available will be limited to this value.
Auto Scan	Check this box ☑ to enable the remote-end System to automatically scan for the frequency of the AN-50e Master (system with Master Mode setting enabled).
DFS Action	Select the mode of operation for dynamic frequency selection (DFS). If the DFS function is required by local regulations, then DFS will be set on and this selection will be disabled.
DFS Antenna Gain	Enter the antenna gain (dBm). This value must be set to match the System antenna.
ATPC Enable	Check this box ☑ to enable the Automatic Transmit Power Control function.
Adaptive Modulation	Check this box ☑ to enable adaptive modulation mode.
Radio Enable	Check this box ☑ to enable the radio transmitter.

5.3 General Site Survey

5.3.1 Site Path Survey

The RF signal path profile is required to determine the location, height, and aiming requirements for installation of the wireless system radio/antenna.

Site Path Profile

The completed path profile should include the following information:

Table 8: Site Path Profile	
Antenna	**Description**
Location	Instructions to identify the location for installing the antenna mast. May include blueprints and specify material list.
Height	Mounting height for antenna.
Azimuth	Horizontal aiming direction for the antenna (magnetic or GPS compass)
Elevation angle	Vertical aiming for antenna (spirit level).
Expected RSSI	Use the Link Budget tool to determine the expected receive signal strength (RSSI).

A critical parameter to consider is the range at which communicating wireless systems are required to operate. Range performance is determined by empirical formulas that consider a number of equipment and environmental factors.

The Link Budget Tool will calculate expected performance of the link for a specified range. Ensure that the installation sites will meet performance requirements before moving to the next step.

Identify Best Path

The next step is to conduct a general site survey to determine the location for the antenna. This involves a survey to identify building and structures that can be used to mount an antenna. Refer to the specification for the maximum IF cable length.

For maximum performance in OLOS deployment, it is recommended to mount the antenna in a location where there is direct line of sight to the receiving wireless system. If the obstruction in the path is not exceptionally high, it may be possible to aim both antennas near the top of the obstruction. The antenna should be positioned to provide maximum clearance within the first Fresnel zone of the direct path (as high as possible, on either a tall building or tower).

The wireless system also supports installation in non-line-of-sight (NLOS) conditions. A satisfactory multipath RF signal can often be obtained by directing each antenna towards a structure in sight of both communicating wireless systems.

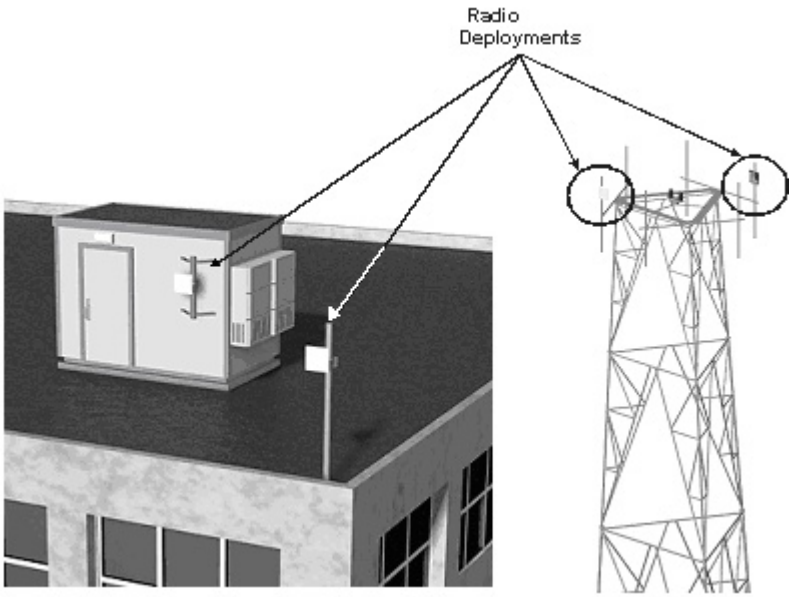


Figure 9: Antenna Mounting Locations

The recommended method for obtaining a satisfactory RF signal is to test a number of antenna positions and measure the signal-to-noise ratio and received signal strength (RSSI) for each position. Antenna aiming instructions are provided in section 5.7: Antenna Alignment on page 40.

Channel Selection -- Identify RF Interference

It is also important to test for RF interference at the intended rooftop or tower installation site. RF interference can be caused by any wireless system in the area that is operating in the same frequency band as the wireless. Accurate analysis requires the use of specialized RF test equipment. The primary purpose of these tests is to determine what channels are available for use on the wireless system.

Antenna Mounting Equipment

When the antenna location has been established, plans should be made for installation of the antenna mast or alternative mounting equipment.

IF Cable Routing

Plans should be made for routing the IF cable from the radio/antenna to the terminal. In some locations it may also be possible to install the IF cable on the outside of the building. If the building must be penetrated to run the IF cable, it is important to verify that building blueprints and/or drawings are up to date and accurate, and that all permissions are obtained for the required modifications.

5.4 Install the AN-50e Terminal

The following are general guidelines for mounting and connecting the terminal.

5.4.1 Mounting

The wireless terminal may be rack or shelf mounted. If rack mounted, each terminal will occupy one rack unit (RU) in a standard 19-inch rack. Do not block the ventilation screens on the terminal.

5.4.2 Grounding

A grounding screw is provided on the rear of the terminal. The terminal must be properly grounded in compliance with local and national codes.

Connect a grounding cable from the grounding screw on the rear of the terminal to the rack grounding or the building ground. The terminal must be adequately grounded for safe operation. Do not rely on the removable power or signal cables to provide system grounding.

5.4.3 IF Cable

The IF cable supplies power to the radio. It is necessary to attach the IF cable before aiming the antenna.

Important: The wireless parameters should be set before the IF cable is connected to the terminal. This will avoid interference with other wireless devices located in the area.

Check the following items before routing the IF cable from the terminal to the radio location:

- Look for a building plan for any existing cable routing.
- Check drilling requirements, through a wall or ceiling for routing the cable.
- Avoid excessive force or stress on the connectors as the cable may get damaged. Do not use connectors as cable grips to pull cable through raceway or conduit.

5.4.4 Power

An AC power cable is supplied with the system. This product is supplied with a grounding power plug. Do not defeat this important safety feature.

The terminal may be equipped with single or dual AC or DC power supplies, or a combination of AC and DC power supplies.

Each AC power supply includes an AC connection cable. A grounded AC outlet must be provided within about one meter of the terminal mounting location. This cable is supplied with a grounding power plug. Do not defeat this important safety feature.

Each DC power supply includes a DC connection cable. A terminal block with the DC connections must be provided within about one meter of the terminal mounting location. There is no on/off switch for DC power supply. Refer to Section 8.2: DC Power Supply Cable Connections for a description of these connections.

5.4.5 Ethernet

Ethernet connections are described in the following sections.

5.4.6 Starting Up the terminal

Connect the DC or AC power to the terminal and turn on using the toggle switch (AC model only, DC models are not equipped with a toggle switch) at the rear of the terminal. The system Pwr LED should illuminate green to indicate power to the terminal. If the Pwr LED is not on or the Fault LED lights red, there is a problem with the terminal.

Important: Power-off the terminal before connecting or disconnecting any cables.

5.5 Configure Essential System Parameters

All system management functions can be performed using the HTML-based graphical user interface. This method allows the operator to use a common Web browser to access and control the terminal. Microsoft Internet Explorer is recommended for its support of context-sensitive help.

This procedure is applicable for the first-time setup of a new terminal, or if the factory default parameters have been restored using the front panel reset or through the network controls.

5.5.1 Setup PC Address

Connecting the Test Computer

The terminal may be connected directly to the host computer using a straight-through CAT 5/UTP cable.

Figure 10: terminal Connected To Host Computer

For correct operation the host computer and the terminal must appear to be on the same subnet. Set the IP address of the PC to 192.168.25.10 and the subnet mask to 255.255.255.0.

Power-on the terminal. Restore the factory default settings by depressing the reset switch on the front panel for more than five seconds. Launch the Web browser and enter http://192.168.25.2 in the address field.

Figure 11: System Address in Browser Address Bar

The login screen will be displayed. Login by entering 'admin' for the User Name and Password.

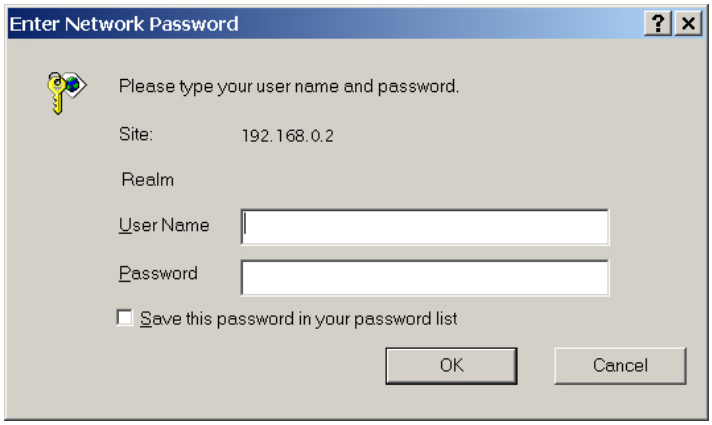


Figure 12: User Name And Password Dialog

The following sections list parameters that must be set before the terminal is connected to the Ethernet port, or the IF cable is connected to the transceiver.

5.5.2 Ethernet Settings

The network address settings for the every terminal must be configured before the terminal can be connected to the local area network. Only the following Ethernet settings need to be adjusted at this time:

IP address: Enter the IP address for this terminal. Each System must also have a unique IP address.

IP Subnet Mask: Enter the IP subnet mask.

Default Gateway Address: Enter the IP address of the default router or gateway on the local Ethernet segment.

Ethernet Mode: Select the operating mode of the Ethernet port (auto-negotiate, 10Base-T, or 100Base-T).

5.5.3 Wireless Settings

The wireless parameters must be set properly before the terminal is enabled to transmit -- otherwise it may cause interference to other high frequency devices operating in the vicinity. See section 6.3.1: Configure System on page 49 for more details.

Master System Settings (Master Mode ☑)

The following settings should be set for the system operating as master:

Master Mode: Check ☑ this box to enable this system to operate as the master system. Only one terminal must be designated Master.

RF Freq. [MHz]: Enter the channel center frequency of the system.

TX Power [dBm]: Enter the default tx power level (dBm). Refer to section 8.3: Antenna and Power Specifications on page 82.

DFS Action: Select the mode of operation for DFS on this terminal.

Important: Where specified by local regulations, the DFS feature will always be enabled. The default selection will be Chg Freq.

DFS Antenna Gain: Enter the antenna gain (dBm). This value must be set to match the system antenna.

ATPC Enable: Check this box ☑ to enable the Automatic Transmit Power Control function. This feature will automatically adjust the power level of the remote-end system.

Adaptive Modulation: Check ☑ this box to enable adaptive modulation mode.

Radio Enable: Check ☑ this to enable the radio transmitter.

Remote-end system Settings

Configuration is the same for the remote-end system, except for the following settings:

Master Mode: Ensure that this setting is not checked (☐). Only one of the systems must be operated in Master Mode.

Auto Scan: Check ☑ this box to enable the remote-end system to automatically scan for the transmitting/receiving frequency channel of the Master-end system (Master Mode setting enabled).

Save Settings

Save: Click the Save button to save the current parameter settings.

Depress the reset switch on the front panel for less than five (5) seconds (standard reset) to make these changes active.

Important: Following the reset, you will need to enter the new IP address for the terminal in the Web browser to access the Web screens. Also, the IP address and IP Subnet Mask setting of the PC must be in the same subnet as the new IP address. Otherwise, you will be unable to communicate with the terminal.

5.6 Install the Transceiver and Antenna

The next step is to assemble and mount the radio and antenna on a building structure, pole or tower.

5.6.1 Assemble Mounting Bracket

The antenna and mounting brackets have been designed to withstand strong winds; it is imperative that all hardware for the mounting brackets be securely fastened to avoid any movement, which could introduce misalignment.

This mounting bracket can be used for any supplied flat panel antenna.

1. Using the long bolts to connect the major parts of the bracket.
2. Attach the antenna mounting plate using the four sets of screws and washers.
3. Complete the assembly of the mounting bracket, ensuring that you utilize all washers and split washers supplied.

5.6.2 Mounting the Transceiver

The transceiver can now be mounted to the bottom of the bracket. The transceiver is secured by two tabs located on the bottom of the bracket. Refer to the following illustration.

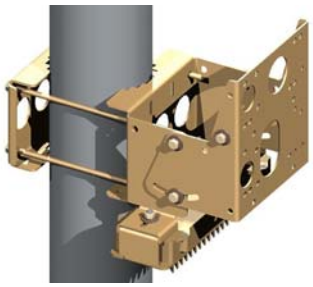


Figure 13: Example Mounting Bracket with Radio

Position the radio, with the connectors facing downwards, below the bracket. The radio must endure high winds and extreme changes in weather. Ensure that all nuts are correctly tightened.

5.6.3 Mounting the Antenna

There is an arrow on the back of the antenna. The arrow must point in the same direction for both the local and remote-end systems to ensure proper polarization when the antenna is deployed (see Figure 14: Antenna Polarization). Ensure the proper polarization is used for the antenna before attaching the mounting bracket.

Figure 14: Antenna Polarization

Attach the antenna to the bracket using the four bolts and washers.

5.6.4 Connecting the RF and IF Cables

It is extremely important to ensure that all connectors are correctly tightened. Over tightening the mounting screws may damage the transceiver unit.

The following steps describe the cable installation process:

1. Connect the RF cable to the transceiver and the antenna. Ensure that the cable droops downward from the transceiver to facilitate water runoff. The connector should be tightened finger-tight and then tightened an additional 1/8 of a turn. Properly weatherproof the connection.
2. Connect the IF cable to the transceiver. Ensure that the cable droops downward from the transceiver to facilitate water runoff. The connector should be tightened finger-tight and then tightened an additional 1/8 of a turn. Properly weatherproof the connection.

3. Ground the radio and antenna and the mounting bracket using the grounding screws provided. All grounding connections should be made with wire that is at least #2 AWG. Painted or dirty surfaces should be cleaned thoroughly down to bare metal and connections should be well tightened. Follow all local and national codes.

5.6.5 Weatherproofing Procedure

The professional installer may use their own weatherproofing preferences, provided they do not use silicon-based materials or PVC tape.

Important: This method of weatherproofing must be completed on ALL external connections. If lightning arrestors are used, all the associated connections and arrestors must be completely wrapped in splicing tape.

1. Begin by wrapping with splicing tape. Try to start as close to the radio/antenna as possible. Stretch and wind the tape back along the connector housing making very sure there are no gaps in the tape. Continue to wrap the tape tightly along the cable for at least 15 cm.
2. Use mastic putty and work this in well around the connector and the body of the radio. Continue to work the putty to make a watertight seal.
1. The connection is now weatherproof.

Figure 15 Waterproofing Outdoors Connections

5.7 Antenna Alignment

The antenna alignment can be performed after the antenna and transceiver are mounted and connected to the terminal using the IF cable.

It is recommended to perform alignment first on one antenna, and then to repeat the procedure at the remote-end end.

5.7.1 Basic Alignment

Basic antenna alignment can be performed using the alignment voltage pin built into the transceiver. This transceiver alignment pin is always active. A higher voltage indicates a stronger signal received from the remote-end transmitter.

The site survey should include the antenna aiming instructions. When using a magnetic compass, the tower metal will affect the accuracy. Magnetic declination (difference between true North and Magnetic North) must also be taken onto account.

Swing the antenna elevation adjustment through the peaks and valleys to obtain the maximum strength. Repeat this to obtain maximum strength for the azimuth adjustments. Repeat these steps for the remote-end antenna. When the alignment is complete, all loosened nuts should be tightened. Tightening all nuts evenly in rotation may help avoid altering the antenna position.

If the link is non line-of-sight (NLOS), a suitable reflecting surface such as a building or billboard must be used. The only certain way to determine if a NLOS link will work is to install the link and then swivel the antennas until a usable signal is received.

5.7.2 Verify Alignment Using RSSI

Once the basic alignment has been completed, the RSSI value should be checked against the estimated value obtained from the link budget. If the link is LOS, the value should not differ by more than about 5 dBm. If the RSSI is much less than the budget prediction, the antenna may be aligned to an OLOS, or an NLOS path.

It is also possible that the antennas may be aligned to a sidelobe. Alignment on a sidelobe of the received beam may be indicated by an unstable reading or a large difference in RSSI values at each end. A thorough elevation and azimuth sweep should then be repeated, while observing the RSSI values. The value should rise when a sidelobe is aligned, then fall and rise higher when the antenna is aligned to a direct signal path. Further movement of the antenna will cause the RSSI value to decrease and rise to a lower peak as the antenna is aligned to another sidelobe. This procedure should be repeated for both the elevation and azimuth at each end of the link.

Chapter

6

6 Using the Web Interface

This section: describes the procedures for configuring and operating the terminal via the web interface.

Communication with the terminal is achieved over the Ethernet port using hypertext transfer protocol (HTTP). This offers the advantage of allowing the operator to access and control the terminal remotely from any geographical location having access to the Internet.

6.1 System Menu

When the user is successfully logged in, the General information page will be displayed. On the left will be a menu of all available pages. The operator can point and click on any of the blue text lines in the menu to display the selected page.

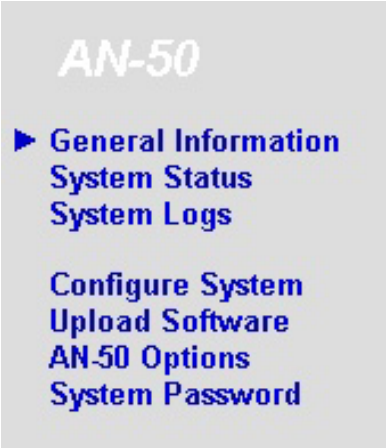


Figure 16: On-Screen Menu

The administrator (admin) has unrestricted access to all screens. All other users have restricted access. See the following table for details.

Table 9: Web Screens			
Screen	**Admin Access**	**User Access**	**Description**
General Information	X	X	View general system identification and configuration settings.
System Status	X	X	View system information, Ethernet statistics, and wireless statistics.
System Logs	X	X	View the last forty system activity and error messages recorded by the terminal.
Configure System	X		View and adjust configuration settings for general system identification, IP address, management functions, and wireless.
Upload Software	X		Upgrade the existing software load of the terminal with new software stored in a binary file on the server or host computer.
AN-50e Options	X		Upgrade the terminal with custom options.
System Password	X	X	Change your login password.

Table 10: Default System Users		
Username	**Default Password**	**Description**
admin	admin	Access to all screens.
user	user	Access restricted to monitoring screens.

6.2 System Monitoring Screens

6.2.1 General Information

Click General Information to view general system information, Ethernet LAN address information and wireless settings. This page includes a view of the terminal front panel LEDs (refreshed every 30 sec.), plus a summary of general information related to the configuration and status of the local terminal.

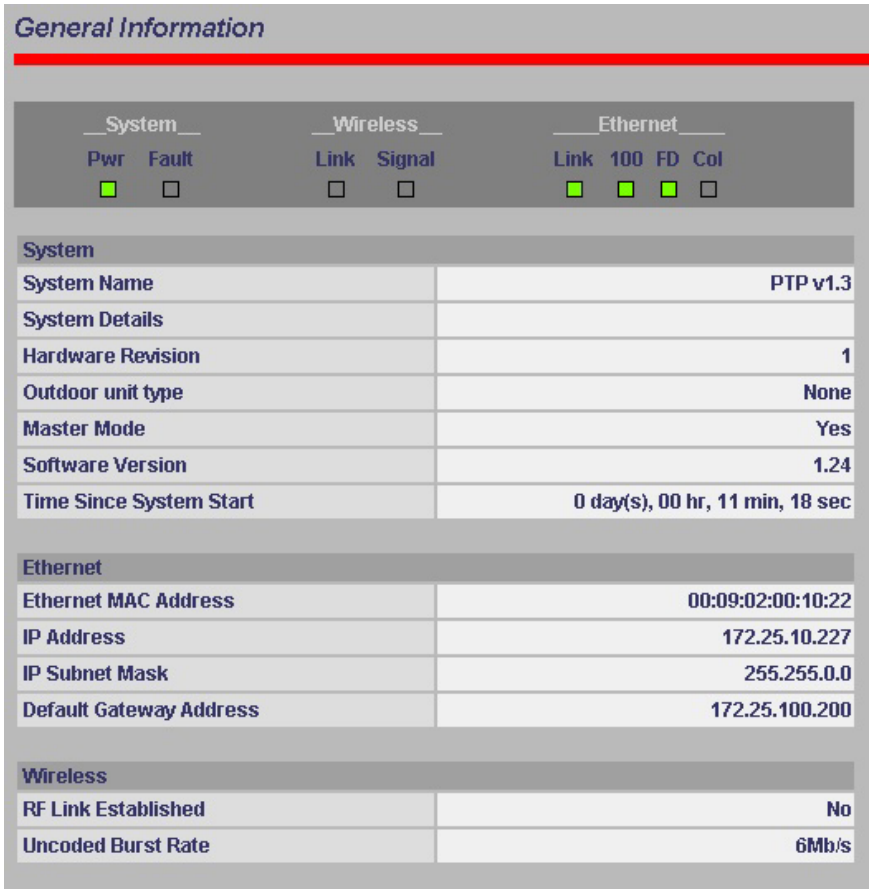


Figure 17: General Information Screen

System

The following is a brief description of each field on the General Information page:

System Name: Identifies the local terminal.

System Details: Specifies the location, telephone number and/or contact information.

Hardware Revision: Indicates the hardware revision level for this terminal.

Outdoor Unit Type: Indicates the transceiver model number.

Master Mode: Indicates if the system is operating as the master system.

Yes: Master system.

No: Remote-end system.

Software Version: Specifies the software version in use.

Time Since System Start: Specifies the time [dd/hh/mm/ss] since the system started.

Ethernet:

Ethernet MAC Address: Hardware address of terminal.

IP Address: IP address of the terminal.

IP Subnet Mask: Subnet for the IP address.

Default Gateway Address: IP address of the default router/gateway on the local Ethernet segment.

Wireless:

RF Link Established: Status for the wireless link connection.

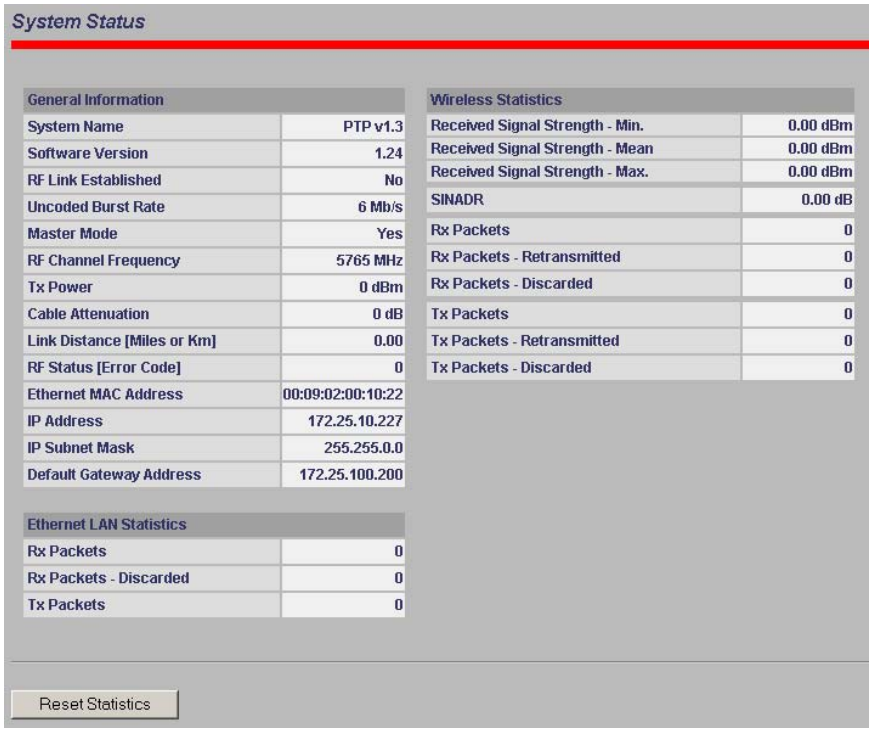
Yes - RF link has been successfully established with the remote-end terminal.

No - RF link has not been established with the remote-end terminal.

Uncoded Burst Rate [Mb/s]: The actual current uncoded burst rate for the link.

6.2.2 System Status

Click System Status in the menu to view system information and Ethernet statistics and wireless statistics.



System Status

General Information	
System Name	PTP v1.3
Software Version	1.24
RF Link Established	No
Uncoded Burst Rate	6 Mb/s
Master Mode	Yes
RF Channel Frequency	5765 MHz
Tx Power	0 dBm
Cable Attenuation	0 dB
Link Distance [Miles or Km]	0.00
RF Status [Error Code]	0
Ethernet MAC Address	00:09:02:00:10:22
IP Address	172.25.10.227
IP Subnet Mask	255.255.0.0
Default Gateway Address	172.25.100.200

Ethernet LAN Statistics	
Rx Packets	0
Rx Packets - Discarded	0
Tx Packets	0

Wireless Statistics	
Received Signal Strength - Min.	0.00 dBm
Received Signal Strength - Mean	0.00 dBm
Received Signal Strength - Max.	0.00 dBm
SINADR	0.00 dB
Rx Packets	0
Rx Packets - Retransmitted	0
Rx Packets - Discarded	0
Tx Packets	0
Tx Packets - Retransmitted	0
Tx Packets - Discarded	0

Reset Statistics

Figure 18: System Status Screen

General Information:

System Name: Identification for this terminal.

Software Version: Version of the running system software.

RF Link Established: Status of wireless link connection to remote-end system.

Yes- Link established to the remote-end system.

No - Link not established to the remote-end system.

Uncoded Burst Rate: Measured burst rate of wireless link.

Master Mode: Indicates the terminal configuration.

Yes - This is the master system.

No - This is a remote-end system.

Important: For each set of Systems*, only one terminal must be designated Master.*

RF Channel Frequency: Center frequency of the channel in use.

Tx Power: Transmit power level.

Cable Attenuation: Attenuation of the 800 MHz signal over the IF cable.

Link Distance [Miles or Km]: Distance between systems.

RF Status [Error Code]: An error code indicating the condition of the system RF components. See the RF Status Error Code Table 24: RF Status Error Codes on page 74 for details. Code zero is normal.

Ethernet MAC Address: MAC address of this terminal.

IP address: IP address for the this terminal

IP Subnet Mask: IP subnet mask.

Default Gateway Address: IP address of the default router / gateway.

Ethernet LAN Statistics:

Rx packets: Number of non-errored packets received.

Rx packets - Discarded: Number of errored packets received.

Tx Packets: Number of Ethernet packets transmitted.

Wireless Statistics:

Received Signal Strength: Min: Minimum RSSI measured since the last screen refresh.

Received Signal Strength: Mean: Average RSSI measured since the last screen refresh.

Received Signal Strength: Max: Maximum RSSI measured since the last screen refresh.

SINADR: Average signal to interference, noise and distortion ratio measured since the last screen refresh. The ratio is based on the digital information provided from the output of the A/D converter, and includes the effects of the AGC.

Rx Packets: Number of wireless packets received over the air from the remote-end terminal.

Rx Packets: Retransmitted: Number of wireless packets retransmitted from the remote-end terminal.

Rx Packets: Discarded: Number of wireless packets originating from the remote-end terminal received over the air with errors due to degradation in the RF link.

Tx Packets: Number of wireless packets (including Ethernet frames and error correction bytes) successfully transmitted over the air by the local terminal.

Tx Packets: Retransmitted: Number of wireless packets retransmitted over the air by the local terminal. The retransmission scheme is based on the Automatic Repeat Request (ARQ) algorithm that detects when packets are lost, and makes a request to the MAC scheduler to repeat transmission of the lost packets.

Tx Packets: Discarded: Total number of transmitted wireless packets discarded by the remote-end terminal, due to degradation in the RF link.

Statistics Control Button:

Reset Statistics: Click this button to zero the counters for the Wireless and Ethernet LAN Statistics displayed on this page.

6.2.3 System Logs Screen

Click System Logs in the menu to view the last forty system activity and error messages recorded by the terminal.

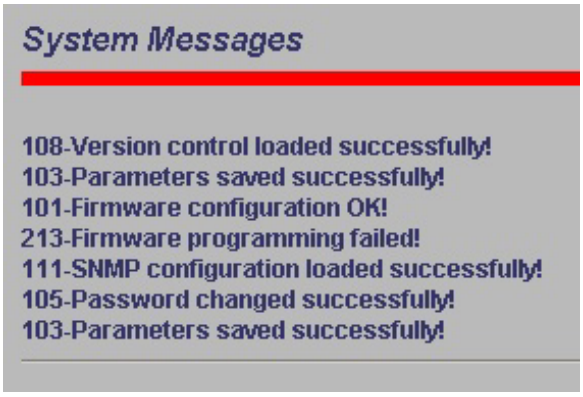


Figure 19: System Logs Screen

The logs will also indicate if the following transactions were successfully completed:

Save Configuration:	Configuration screen.
Upload:	Upload Software screen.
Change Password:	System Password screen.
Send Options Key:	AN-50e Options screen

Refer to section 7: Diagnostics and Troubleshooting on page 65 for a detailed description of all event messages.

6.3 System Configuration Screens

6.3.1 Configure System

Click Configure System in the menu to view and adjust configuration settings for general system identification, Ethernet, and the wireless interface.

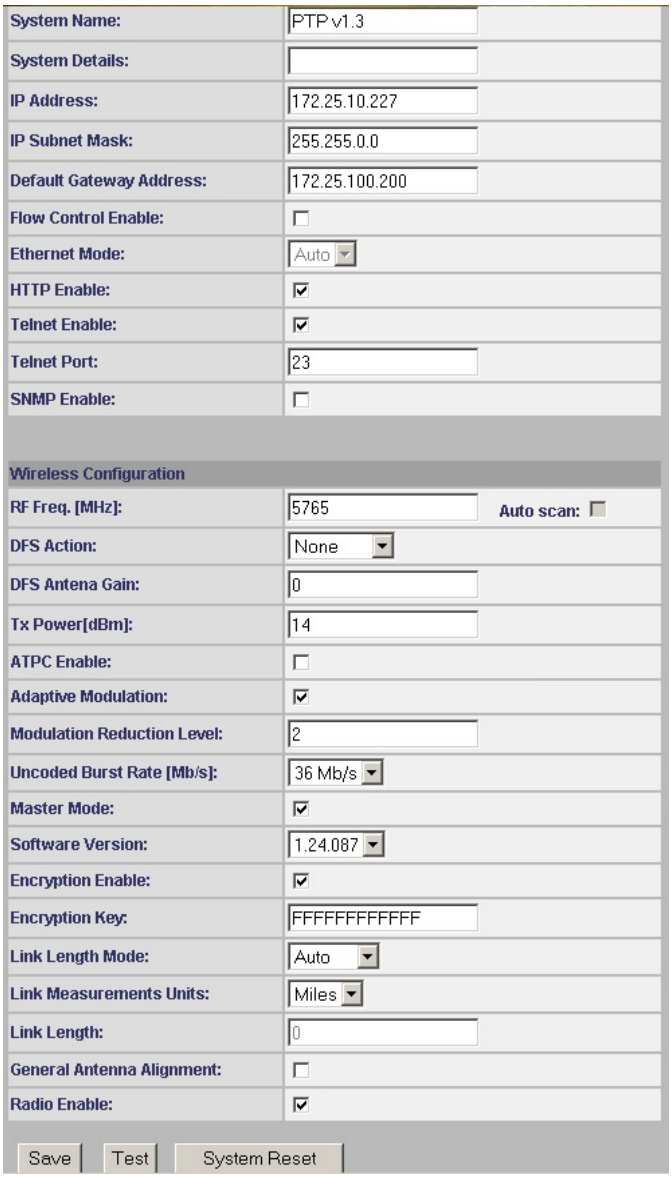


Figure 20: System Configuration Screen

Important: Ensure that all fields on the System *Configuration Screen are filled out properly for local and remote-end terminals. Errors in these fields will result in the inability to establish a communication link. Please read carefully to ensure a quick, trouble-free deployment.*

Ethernet Configuration:

The IP address information must be set properly before the terminal is connected to a public network -- otherwise address conflicts may occur with other devices on the network.

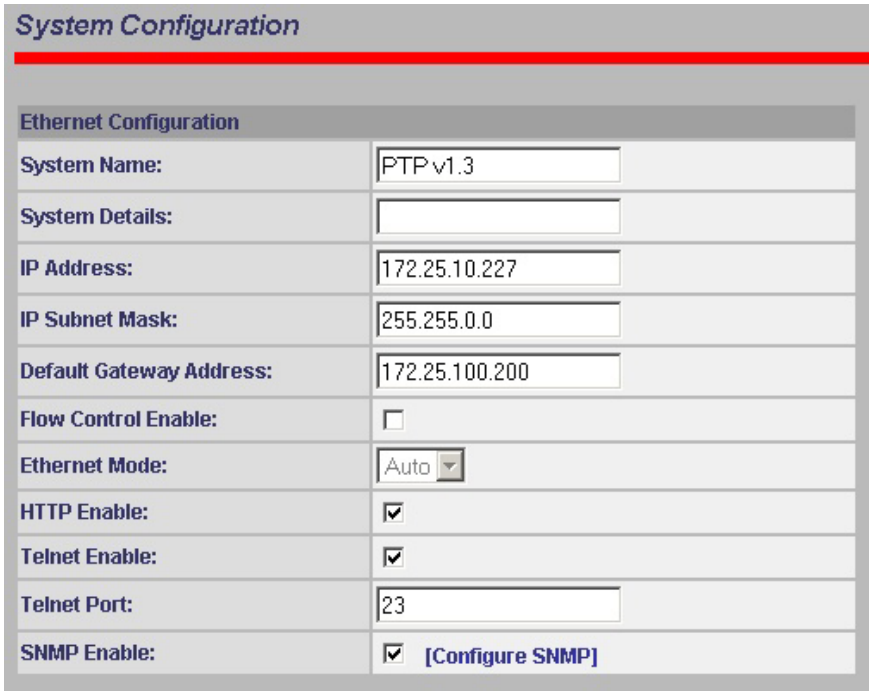


Figure 21: System Configuration Screen - Ethernet Settings

System Name: Enter the name for this terminal. The name can be any combination of up to 20 letters and numbers. The default name for the system from the factory is set to WEB01.

System Details: Enter additional descriptive details about this terminal. The description can be any combination of up to 20 letters and numbers.

IP address: Enter the IP address for this terminal. The factory default address is 192.168.25.2.

IP Subnet Mask: Enter the IP subnet mask. The factory default mask value is *255.255.255.0* (Class C subnet).

Default Gateway Address: Enter the IP address of the default router / gateway on the local Ethernet segment.

Flow Control Enable: Check this box ☑ to enable flow control on the terminal.

The Flow control feature enables the terminal to request other Ethernet devices to pause transmission during busy periods.

Ethernet Mode: Select the operating mode of the Ethernet port.

Auto - Auto-negotiate the speed connection speed.

10 - Operate at 100Base-T only.

100 - Operate at 100Base-T only.

HD - Operate at half-duplex only.

FD - Operate in full-duplex only.

HTTP Server Enable: Check this box ☑ to enable configuration using the HTTP (Web) interface.

Telnet Enable: Check this box ☑ to enable configuration using a Telnet session. Refer to the CLI commands in section 8.4: CLI Interface on page 87.

Telnet Port: Enter the Telnet port address. The default Telnet port is 23. The port can be changed to any other number between 23 and 65,000, excluding port 80.

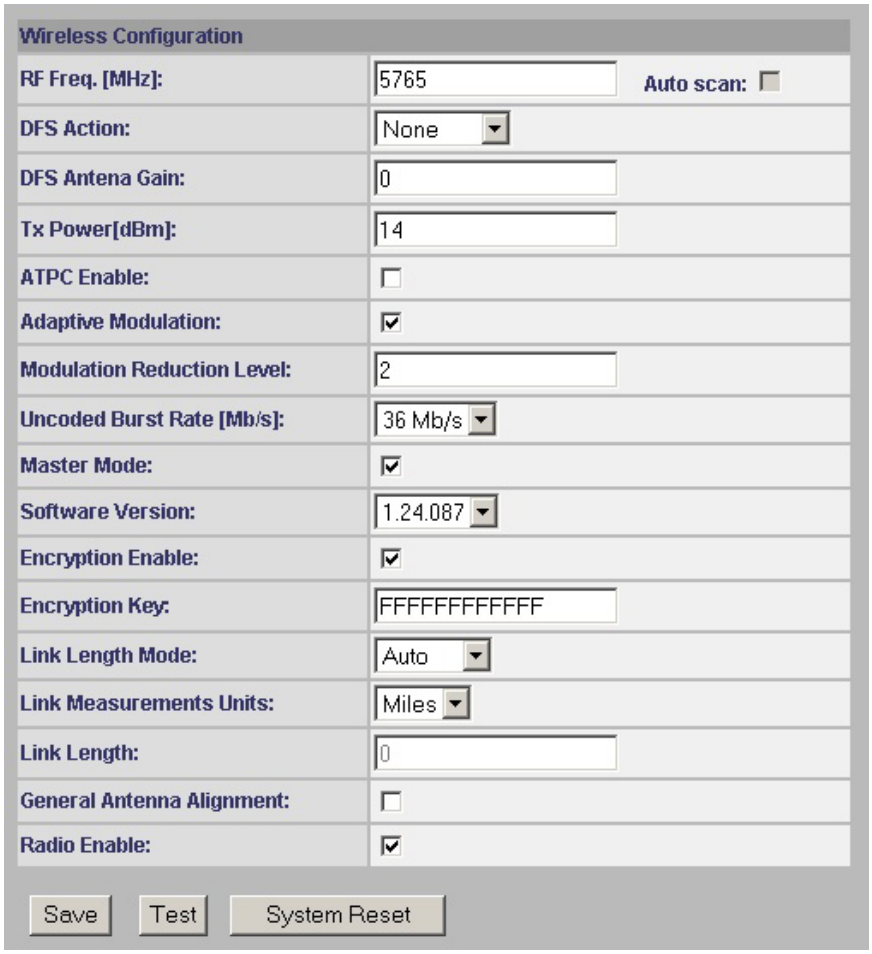
SNMP Enable: Check this box ☑ to enable the Simple Network Management Protocol (SNMP) agent. When this item is checked, clicking on the blue text 'Configure SNMP' beside the checkbox displays the SNMP Configuration screen.

See section 6.4.3: SNMP Settings on page 63 for additional information on setting up SNMP for the AN-50e.

Wireless Configuration:

The wireless parameters must be set properly before the terminal is allowed to transmit using the radio -- otherwise it may cause interference to other high frequency devices operating in the vicinity.

Refer to section 5.5: Configure Essential System Parameters on page 34 for information about parameters that must be set before operating the wireless portion of the system.



Wireless Configuration	
RF Freq. [MHz]:	5765 Auto scan: ☐
DFS Action:	None
DFS Antena Gain:	0
Tx Power[dBm]:	14
ATPC Enable:	☐
Adaptive Modulation:	☑
Modulation Reduction Level:	2
Uncoded Burst Rate [Mb/s]:	36 Mb/s
Master Mode:	☑
Software Version:	1.24.087
Encryption Enable:	☑
Encryption Key:	FFFFFFFFFFFF
Link Length Mode:	Auto
Link Measurements Units:	Miles
Link Length:	0
General Antenna Alignment:	☐
Radio Enable:	☑

Save Test System Reset

Figure 22: System Configuration Screen - Wireless Settings

RF Freq. [MHz]: Enter the channel center frequency of the system. The table below specifies the center frequencies of each permitted channel. To avoid interference, the channel frequencies of two links operating within close proximity must be separated by 20 MHz or more.

Note: Availability of frequency bands listed in the following tables is based on the factory entered option key.

Refer to the tables on the following page.

The following table lists the 5.4 GHz channels available in CE regulated regions.

Table 11: CE: RF Channel Frequencies		
T-54 Radio: 5.4 GHz		
Center Frequency (GHz)	Center Frequency (GHz)	Center Frequency (GHz)
5.500	5.580	5.660
5.520	6.500	5.680
5.540	5.620	5.700
5.560	5.640	

The following table lists the 5.8 GHz channels available in the United Kingdom.

Table 12: UK: RF Channel Frequencies	
T-58 Radio: 5.8 GHz	T-58e Radio: 5.8 GHz
Center Frequency (GHz)	Center Frequency (GHz)
5.735	5.735
5.755	5.755
5.775	5.775
	5.835

The following table lists the 5.8 GHz channels available in North America.

Table 13: North America: RF Channel Frequencies		
T-54 Radio: 5.4 GHz	T-58 Radio: 5.8 GHz	T-58e Radio: 5.8 GHz
5.480 to 5.715 (steps of 5 MHz)	5.735 to 5.815 (steps of 5 MHz)	5.735 to 5.840 (steps of 5 MHz)

DFS Action: Select the mode of operation for DFS.

The system set to master-mode monitors for interference from radar devices and other equipment using the same channel frequency. When interference is detected, the system automatically takes the action selected using the drop-down menu:

Important: DFS Action selection should be set to None where DFS function is not required by regulations. DFS cannot be disabled where required by regional regulations.

None: DFS is disabled.

Tx Off: Transmission is immediately disabled when radar signals are detected. This action is recorded in the message log and an SNMP trap message is sent (if SNMP enabled).

Following an interval of thirty minutes, the same channel is monitored for one minute and if there are no DFS triggering events, the system resumes normal operation. If DFS trigger conditions are still detected, operation is suspended

for an additional thirty minutes. This cycle continues until no DFS trigger events are detected or the operator manually reconfigures the system.

Chg Freq: Relocate transmission to alternative frequency immediately when radar signals are detected. This action is recorded in the message log and a trap message is sent (if SNMP enabled).

The new channel is selected based on allowable frequencies for the regulatory region of that installation. The channel is monitored for one minute before the system is allowed to transmit. If DFS triggering events are detected, the next available channel is selected and monitored. The system is not allowed to return to a channel on which DFS trigger events were detected for a period of thirty minutes. If DFS trigger events are detected on all channels the system suspends operation until the thirty-minute time interval expires for at least one channel.

DFS Antenna Gain: Enter the gain (dBm) for the system antenna.

It is important that this value is set to correctly match the antenna gain. If the antenna gain is set higher than the actual antenna gain, the DFS is less sensitive to detecting interference, and the system is not operating in compliance with the UK/ETSI standard. If the antenna gain is set lower than the actual antenna gain, the DFS is more sensitive to detecting interference and may cause false triggers.

Important: The DFS Antenna Gain must be set when DFS is required by regional regulations.

TX Power [dBm]: Enter the default tx power level (dBm).

Refer to section 8.3: Antenna and Power Specifications on page 82 lists the maximum transmit power setting based on the antenna gain for a series of frequency settings.

Note: In some countries outside of North America, the maximum operational power per channel for a specific antenna is limited in accordance to maximum allowable EIRP levels for the region.

Table 14: Max. Operational Power Per Channel (in dBm) vs. Modulation lists the maximum transmit power levels for each modulation setting. Restrictions exist when operating at data rates above 24 Mb/s.

Table 14: Max. Operational Power Per Channel (in dBm) vs. Modulation

	64QAM ¾ (54 Mb/s)	64QAM ⅔ (48 Mb/s)	16QAM ¾ (36 Mb/s)	16QAM ½ (24 Mb/s)	QPSK ¾ (18 Mb/s)	QPSK ½ (12 Mb/s)	BPSK ¾ (9 Mb/s)	BPSK ½ (6 Mb/s)
Max Tx Power	14	15	19	20	20	20	20	20

ATPC Enable: Check this box ☑ to enable the ATPC function. The master-end system will automatically adjust the Tx level of both the master-end and remote-end systems to optimize the system performance.

Adaptive Modulation: Check this box ☑ to enable adaptive modulation mode.

It is recommended to use adaptive modulation mode when using Ethernet only traffic. When enabled, the system can automatically change the modulation scheme to the highest possible order, based on measured RF performance. Adjust the modulation scheme by setting the Uncoded Burst Rate parameter. If packet errors exceed one in one million, the system will automatically step down the modulation scheme to maintain the link.

Modulation Reduction Level: This manual setting specifies how many levels the system must drop in modulation during re-transmission of erroneous wireless packets. The level can be set from 0-7, with 2 being the recommended value. Valid only when Adaptive Modulation is disabled.

Uncoded Burst Rate [Mb/s]: Select the desired uncoded burst rate for the link.

Master Mode: Check this box ☑ to enable the system to operate as the master system. Each link is comprised of a master system and one or more remote-end systems. The master system establishes and manages the bi-directional data link with each AN-50e remote-end system. The remote-end system receives and sends data under the control of the master system. Only one system in a wireless link must be set for Master mode.

Software Version: Select the current version of the system software. The system includes sufficient memory to hold two independent software images. The operator can specify which software image is used in the system. See Upload Software Section 6.4: for additional details.

Encryption Enable: Check this box ☑ to enable over-the-air encryption. If encryption is enabled, no Ethernet packets can be transferred unless encryption is enabled on both the local and remote-end terminals.

Encryption Key: Enter the MAC address of the remote-end terminal as the over-the-air data encryption key. No Ethernet packets can be transferred unless the correct encryption is entered at both the local and remote-end terminals.

Link Length Mode: Distance from master-end to remote-end.

Auto: Distance calculated automatically by the terminal (recommended).

Manual: the operator enters Link distance.

Link Measurements Units: Select the units for the Link Length Mode field.

Miles: Link length distance is displayed in miles.

Kilometers: Link length distance is displayed in kilometers.

Link Length: Enter the actual length of the path that the wave travels in order to establish the link. Only valid if Link Length Mode is set for Manual.

General Antenna Alignment: Check this box ☑ to enable the antenna alignment audible tone generator in the transceiver.

Radio Enable: Check this box ☑ to enable the radio transmitter.

System Configuration Buttons

Save*:* Click this button to save the current parameter settings. Note that when certain parameters are changed clicking Save will initiate a system reboot.

Test: Click this button to have the system reset using the current configuration settings. After a period of five minutes, the system will reboot using the previously saved settings and current settings will be lost. Click the Save button at any time to save the current changes.

System Reset: Click this button to boot the system. Resets all statistics and unsaved changes to the configuration will be lost.

6.3.2 PMP - ID Configuration and Status

The ID Configuration and Status page provides a simple to use Graphical User Interface (GUI) for the operator to configure all channel parameters. Click the Save IDs in Flash button at the bottom of this page to save changes in non-volatile memory. These operations are recorded in the system logs.

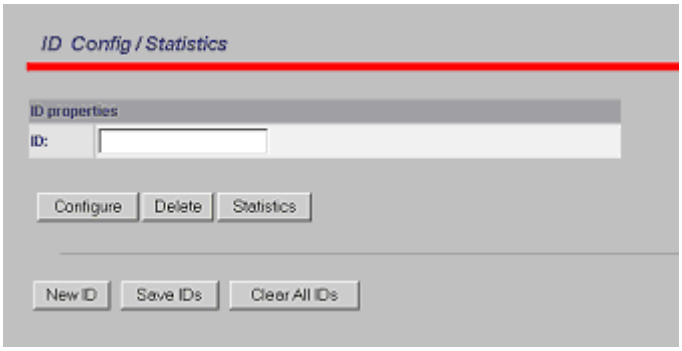


Figure 23: ID Config / Status

Note: It is important to ensure that all fields on the ID Configuration page are filled out properly for local and remote terminals. Errors in these fields will result in the inability to establish a communication link. Please read this section carefully to ensure a quick, trouble-free deployment.

ID Properties

ID: Select the channel ID to be configured, deleted or displayed for the system in which you are interested. If the ID number is not known, click the ID Browser menu (left side of screen) to locate the required ID number.

ID Screen Buttons

Configure: Calls the Link Configuration screen for the selected ID (master-end system only).

Delete: Delete the selected ID (master-end system only).

Statistics: Display the Link/Connection Status screen for the selected ID.

New ID: Add a new ID by opening the Link Configuration screen (master-end system only).

Save IDs: Save all IDs (master-end system only).

Clear All IDs: Clears all IDs from the the ID tables (master-end system only). This process cannot be undone.

6.3.3 PMP - Link Configuration

This screen is displayed through the ID Config / Status screen by clicking the Config button. The fields in the Link Configuration screen need to be filled out for each individual subscriber station. This function is available only at the master - end system.

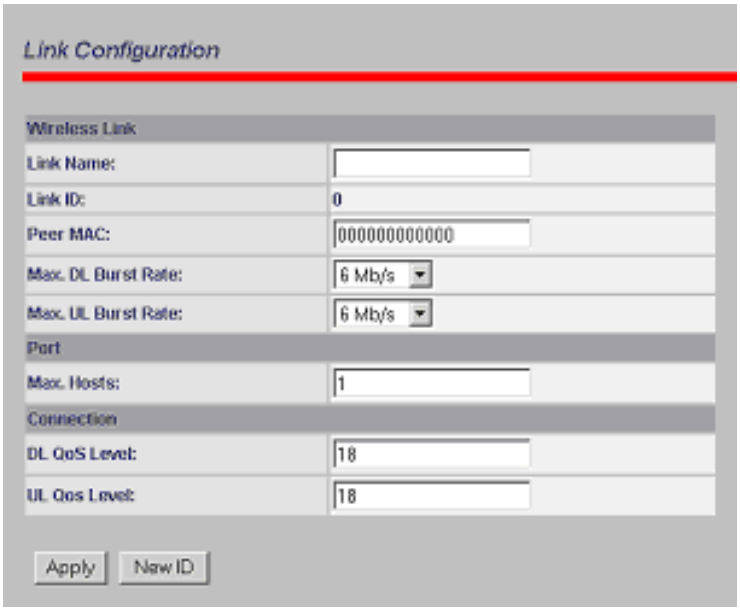


Figure 24: Link Configuration

Wireless Link

Link Name: A user specified alphanumeric identifier for the link. The name remains with the system, even during power-off states, until the operator re-types a new name using this menu field. This field is limited to 8 characters.

Link ID: Automatically generates a numeric ID for the specified link name. For a new link, the default ID is always zero. After saving the parameter on the Link Configuration screen, the AN-50e system will automatically choose a link ID other than zero. Use the ID Browser to search for a link name and the associated Link ID.

Peer MAC: Enter the MAC address of the subscriber station to register the remote unit. If the MAC address is not properly entered, the wireless link will not be established and no Ethernet packets can be transferred.

Max. DL Burst Rate: Maximum downlink (DL) burst rate. Specifies the maximum downstream burst rate Base Station can use to send data to this Subscriber Station.

Max UL Burst Rate: Maximum uplink (UL) burst rate. Specifies the maximum upstream burst rate this Subscriber Station can use to send data to the Base Station.

Port

Max Host: Defines the maximum number of hosts (i.e., PCs, …etc) to be learned from the corresponding Subscriber Station.

Connection

DL QoS Level: Enter the downlink QoS level.

UL QoS Level: Enter the uplink QoS level.

Link Configuration ID

Apply: Saves changes to the current link ID configuration. In order to save Ids configuration in memory use "Save ID" button in the "ID Config/Status" screen. Otherwise, all the Ids changes made since the last reboot will be lost.

New ID: Save current ID configuration under a new Link Name.

6.4 Upload Software

Clicking on Upload Software in the left hand menu will display the Upload AN-50e Software screen. The upload screen shown is used to upgrade the terminal with new software stored in a binary file on a server or host computer.

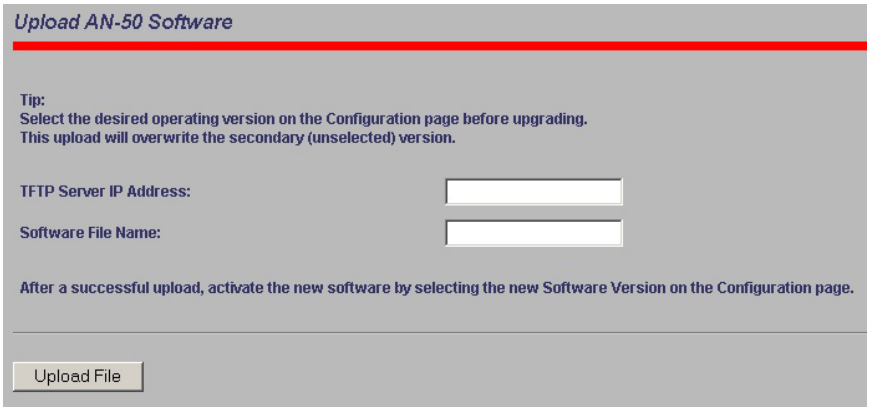


Figure 25: Upload Software Screen

TFTP Server IP Address: IP address of the computer that runs the TFTP server that contains the upgrade software in binary format.

Software File Name: Name of the binary file including the file extension.

The terminal contains two non-volatile RAM banks for storing two versions of the software. It is important to select the desired operating version before beginning the upgrade process, as the upload will always overwrite the non-operational (unselected) version. Use the System Configuration screen (section 6.2) to select the current operating version of system software.

The upgrade process is achieved remotely using the Trivial File Transfer Protocol (TFTP). The operator must fill in two input fields: TFTP Server IP Address and File Name.

After typing the TFTP Server IP Address and File Name, click the Upload File button to begin the file transfer. A status screen will display the number of bytes transferred from the TFTP server to the terminal in real time. The upgrade file size is approximately 1.8 MB and will take approximately two to four minutes to download from the server to the terminal memory.

When the file transfer is complete, the terminal will verify the integrity of the new software. If errors were introduced during the transfer process, the terminal will reject the new software load and provide a warning that the upgrade was unsuccessful. In this case, the operator will need to repeat the upload process.

Use the System Configuration screen (section 6.3) to select the current operating version of system software.

6.4.1 Options Key Screen

Clicking on AN-50e Options in the left hand menu will display the AN-50e Product Options screen. This screen is used to upgrade the terminal with custom options.

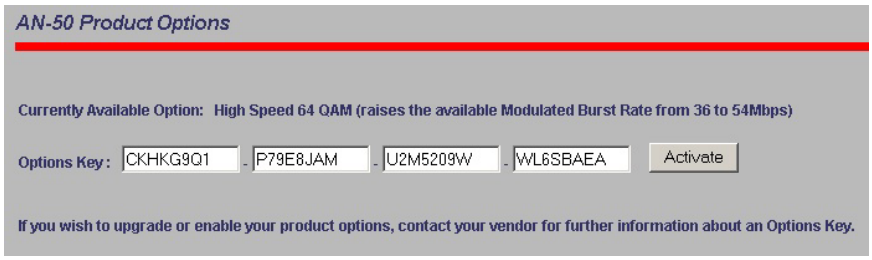


Figure 26: Product Options Screen

The options key controls the availability of functions and default settings on the AN-50e. This includes maximum Tx power levels and the DFS function.

The key is personalized to each terminal's MAC address. Please ensure that the correct MAC address is provided when requesting a key from your local representative.

Enter the key (case sensitive), ensure it is correct, and click the Activate button.

6.4.2 System Password Screen

Clicking on System Password in the left hand menu will display the System Password screen. This screen allows the operator to modify the system passwords.

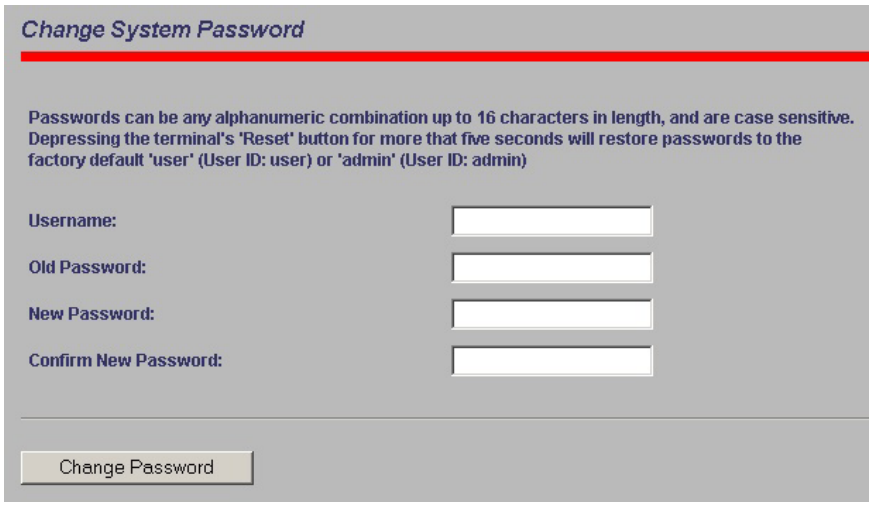


Figure 27: System Password Screen

The factory default password for the system is 'admin' for the username 'admin' and 'user' for the username 'user'. To change the password, enter the username and the old password. Enter a new password in the two lower fields using any alphanumeric combination. Note the field is case sensitive and can be up to sixteen characters in length.

Username: Enter user name.

Old Password: Enter current password.

New Password: Enter new password.

Confirm New Password: Re-enter new password (avoids typing errors).

Note: The original factory default passwords can be restored by depressing the front panel Reset button for more that five seconds. This will also reset the configuration to the factory default settings. The software version is not effected.

6.4.3 SNMP Settings Screen

Click Configure SNMP (blue text) on the System Configuration screen to view and edit the SNMP settings. The blue text will only appear if the SNMP Enable box is checked.

Figure 28: System Configuration Screen - SNMP Access

The SNMP Configuration screen displays a list of the current communities. The control buttons can be used to add, edit or delete communities.

Figure 29: SNMP Configuration Screen

SNMP Configuration: The list of defined communities is displayed in the Community Name table.

Edit: Select a community from the pull down menu and click the Edit button to modify an existing community. The Community Configuration/Trap Configuration screen will be displayed.

Delete: Select the community from the pull down menu (bottom left of screen) and then click the Delete button to delete that community. Note that it is not possible to delete the public SNMP community, but the access level can be changed.

Add Community: Click the Add Community button to add a new community. The Community Configuration/Trap Configuration screen will be displayed.

Add Community: To add a new community, click Add Community button. The Community Configuration/Trap Configuration screen will be displayed.

Community Configuration:

Community Name: The SNMP community name. After clicking Save, this name will appear in the drop down list on the main SNMP Configuration screen.

Community Access - Read: Check the Read box to grant read access permission to members of this community. Uncheck this box (☐) to deny read permission.

Community Access - Write: Check this box ☑ to grant write access permission to members of this community. Uncheck this box (☐) to deny write permission.

Trap Configuration:

Trap Enable: When the SNMP Agent in the terminal detects an error condition, a message known as a trap is sent. A Trap Host is an IP system/server that is set up to receive SNMP trap messages. Checking this option enables sending traps.

Trap Destination (IP Addr. 1): Enter the IP address of the Trap Host in dotted decimal format. At least one (1) IP address is required.

Trap Destination (IP Addr.2): Enter the IP address of the Trap Host in dotted decimal format. This address may be left blank.

Trap Destination (IP Addr. 3): Enter the IP address of the Trap Host in dotted decimal format. This address may be left blank.

Trap Destination (IP Addr. 4): Enter the IP address of the Trap Host in dotted decimal format. This address may be left blank.

Save: Click Save to permanently save the current parameters and return to the main SNMP configuration screen.

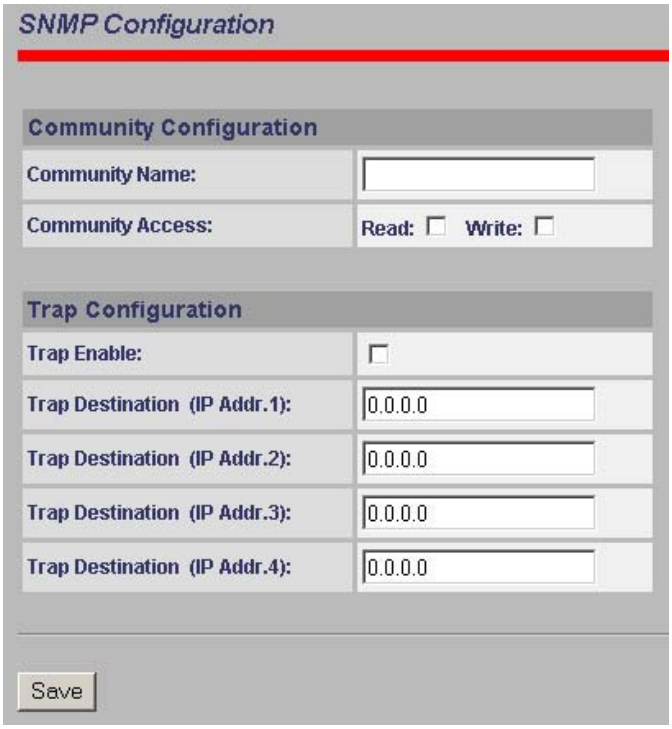


Figure 30: SNMP Community/Trap Settings Screen

Chapter
7

7 Diagnostics and Troubleshooting

Troubleshooting can be performed using the front panel LEDs and the host computer/server connected locally or remotely to the terminal.

Important: Before beginning any troubleshooting via the front panel, check that all cables are securely attached. Also verify that all fields on the System *Configuration page are correct for both the local and remote-end terminals (entry errors in these fields may cause the terminal to be unable to establish a communication link).*

This section provides basic diagnostic and troubleshooting procedures to help solve problems that may occur with the system. If, after reading this section, you are unable to get the system operating properly, please contact your local Redline representative. Include the model name and serial number of the system (located on the back of the terminal) in your communications.

7.1 Factory Default Settings

The following parameters are the factory default setting for the terminal.

Table 15: Factory Default Settings

Section	Item	Factory Default Setting
System	User Name	admin
	Password	admin
Ethernet	IP Address	192.168.25.2
	Subnet Mask	255.255.255.0
	Gateway	0.0.0.0
Wireless	RF Channel	Set by factory key.
	Tx power	14 dBm
	Encryption	Disabled / no key

7.2 Front Panel Diagnostics

The front panel of the terminal includes a LAN interface and three groups of status indicators to help with first level diagnoses of problems encountered with the terminal.

Figure 31: Front Panel LEDs

System Reset Button

Throughout this section, reference is made to the *Reset* button, which is a micro-switch recessed in the front panel in the system block. Use a small narrow object, such as a paper clip, to access the button.

Depressing the button for less than five (5) seconds will activate a short reset, which is equivalent to turning the terminal off and on. Statistical values are reset, and the currently loaded software / firmware will be retained. Note that a short reset may be accomplished remotely by clicking on the System Reboot button from System Configuration screen.

Depressing the Reset button for more than five (5) seconds executes a long reset. A long reset reloads the factory default configuration settings such as IP Address, IP Subnet Mask, Channel, System Name, Passwords and restarts the system. The software version that existed in the system before the long reset is retained.

An example of when a long reset will help is in the event that a password or IP address is forgotten. The long reset function will simply restore the system back to its original factory default settings. A long reset is confirmed by the Wireless Link LED flashing three times, followed by the LED power-up sequence:

All Ethernet LEDs light for one second, then individual Ethernet LEDs blink twice in the following order: FD/Col, 100, and Link/Act. The Fault LED lights for approximately four seconds, then turns off. The two Wireless LEDs remain off for approximately five seconds, and then blink once. Following this sequence, all LEDs will indicate the current operational status.

System Power LED

If the *Pwr* LED is not illuminated solid green, power is not getting to the terminal. The most probable causes are:

Figure 32: Front Panel: System Pwr LED

Table 16: System Power Diagnostics		
Symptom	**Possible Problem**	**Solution**
Pwr LED does not illuminate	On/Off switch in Off position	Turn on switch at back of terminal.
	Fuse blown	Replace fuse. (spares are provided)
	Power cord disconnected	Securely connect cord to terminal and outlet.

To replace a fuse, pry off the black plastic cover located on the back panel beside the power switch, and extract the red fuse holder. Be certain to replace the fuse(s) into the lower half of the holder, as shown in the diagram below. The fuse holder holds two fuses, both of which are active. Be certain to use fuses of the same type and rating.

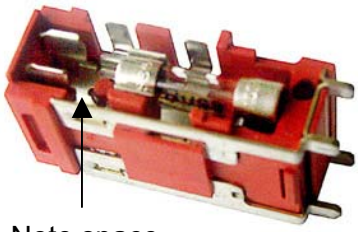


Figure 33: Fuse Holder

System Fault LED

If the *Fault* LED lights solid red, it is an indication that there is a serious problem with the system software or hardware.

Figure 34: Front Panel: System Fault LED

Check the IF cable. A short or long reset may fix the problem. If not, contact your local representative. Also refer to the System Logs screen and RF Status codes.

Wireless Link LED

The Wireless *Link* LED lights solid green when the wireless link is established to the remote-end terminal.

Figure 35: Front Panel - Wireless Link LED

When the Link LED is off, it is an indication there is a problem with either the terminal link, radio, or with the actual propagation path itself. Check the RF Status parameters in the System Status screen. Table 17: Wireless Link Diagnostics following lists some of the potential causes.

Table 17: Wireless Link Diagnostics

Symptom	Possible Problem	Solution
No wireless link (Link LED does not illuminate)	Remote-end terminal is not on or is malfunctioning.	Verify operation of remote-end terminal.
	The propagation path is blocked.	Clear path or re-locate antennas.
	The transceiver is mal-functioning.	Repair or replace transceiver
	Antenna has moved and is no longer aligned with remote-end terminal.	Re-align the antenna.
	Cable between transceiver and antenna or between transceiver and terminal not properly connected.	Properly secure cables.
	Power not getting to the transceiver from the terminal.	Repair or replace terminal.
	Receiver and transmitter have been set to different RF channels.	Make sure both terminals are operating on the same RF channel.

Wireless Signal LED

When Adaptive Modulation is enabled, the Wireless *Signal* LED will light solid green if the system is operating at or above the configured Uncoded Burst Rate, and will flash when the system is operating at a lower order modulation scheme (i.e., the current Uncoded Burst Rate is lower than the configured Uncoded Burst Rate). If the system cannot maintain the lowest modulation scheme due to link errors, the Signal LED will turn off.

Figure 36: Front Panel - Wireless Signal LED

When Adaptive Modulation is disabled, the Wireless Signal LED will light solid green if the system is operating at an error rate of less than one out of one million packets. If errors exceed one in one million, the LED will flash. If the wireless link becomes poor, the LED will turn off.

Flashing may not be a serious problem if the LED flashes only intermittently, however, if it flashes constantly refers to the following table for some of the possible causes.

Table 18: Wireless Signal Diagnostics		
Symptom	**Possible Problem**	**Solution**
Weak RF Link (Signal LED flashes)	Obstructions in the propagation path causing signal degradation.	Try to remove obstacles or re-locate antenna.
	Antenna moved, due to high winds.	Re-align the antenna.
	Poor cable connection between transceiver and antenna.	Repair or replace the RF cable.

Ethernet Link/Act LED

The Ethernet *Link/Act* LED will light when the LAN connection to the host computer/server or switch/router is functioning properly.

Figure 37: Front Panel: Ethernet Link/Act LED

The Link/Act LED flashes when the LAN connection to the host computer/server or switch/router is functioning properly and there is traffic. If the LED is off, look for the following problems:

Table 19: Ethernet Link/Act Diagnostics		
Symptom	**Possible Problem**	**Solution**
No Ethernet Link (*Link/Act* LED off)	Poor cable connection between terminal and computer/server or between terminal and switch/router.	Carefully check all cable connections.

Table 19: Ethernet Link/Act Diagnostics		
Symptom	**Possible Problem**	**Solution**
	Wrong type of Ethernet cable between terminal LAN port and host computer/server or switch/router.	If the terminal LAN port is connected to a host computer or server directly, then ensure a straight-through cable is used. Otherwise, to connect the terminal to a switch or router, ensure a crossover cable is used.
	The auxiliary Network equipment including switch/router, host computer/server, may be malfunctioning.	Repair or replace faulty terminals.
	Processor malfunction.	Try short reset or long reset.

Ethernet 100 LED

The Ethernet 100 LED is on when the link is operating at 100Base-T.

Figure 38: Front Panel: Ethernet 100 LED

Note that when connected to a hub, it is typical for packet collisions to occur intermittently. On a Half-Duplex link, there will be collisions. Some causes include:

Table 20: Ethernet 100 Diagnostics		
Symptom	**Possible Problem**	**Solution**
Ethernet Link 100 LED off	Ethernet connection manually set for 10Base-T operation.	Change Ethernet Mode setting to Auto or 100 in the System Configuration web screen.
	The connected Ethernet device may be operating at 10Base-T.	If the terminal LAN port is connected to a host computer or server operating at 10Base-T, you may have to change the settings for that device.

Ethernet FD/Collision LED

The Ethernet FD/*Col* LED flashes when packet collisions occur over the LAN.

Figure 39: Front Panel: Ethernet FD/Col LED

Note that when connected to a hub, it is typical for packet collisions to occur intermittently. On a Half-Duplex link, there will be collisions. Some causes are listed in the following table.

Table 21: Ethernet Collision Diagnostics

Symptom	Possible Problem	Solution
Link Collision (***FD/Col*** LED flashes)	Collisions are normal for Half Duplex links. However, if the terminal is connected to is not configured for auto-negotiation, but manually set for Full Duplex, then the terminal will not be able to negotiate this mode and will stay set to Half Duplex. This results in CRC errors on the network device port.	Change the configuration from hard coded Full Duplex to auto-negotiation
	Incompatible Ethernet port speed.	Confirm speed and duplex mode of devices.

7.3 Troubleshooting the Web Interface

These troubleshooting hints assume that the status LEDs on the front panel of the terminal indicates normal functionality.

Table 22: Web Interface Diagnostics

Symptom	Possible Problem	Solution
Home Screen (General Information) cannot be accessed.	Incorrect IP address and/or Subnet Mask.	Perform a ping test from the host computer command line. If the ping test is unsuccessful, then the problem is with the IP address. Perform a long reset to apply the default address (192.168.25.2) and Subnet Mask (255.255.255.0)
	Problems with host computer, or terminal.	If the ping is successful try a short reset of the terminal, and/or reboot the host computer.
	Host PC ARP table is incorrectly configured	Run 'arp:d' whenever the terminal is swapped. Check that the subnet mask for the host PC matches the subnet mask of the terminal. Check that the host PC's address is 192.168.25.n, where 'n' is not equal to 0,2, or 255.

Attempt to login to the terminal using a Web browser. Microsoft Internet Explorer is recommended. If the terminal does not respond by displaying the login dialog box, check that the correct IP address is being used. The value 192.168.25.2 is the factory default value and may have been changed during installation.

The next test is to verify the IP address is reachable from the computer. Use the ping command to test the connection between the terminal and host computer. The system will always respond to ping frames less that 577 bytes in length.

>Ping 192.168.25.2

If the ping test is successful, the host computer was able to send and receive packets to/from the terminal. The problem may be with the Internet browser or related settings on the host computer. Re-boot the host computer to try to resolve the problem.

If the ping is unsuccessful, there may be problems using that IP address; the IP address may be incorrect, or there may be a duplicate address. For correct operation the host computer and the terminal must appear to be on the same subnet. For example, if the terminal is using the factory default settings, the host computer could be set for an IP of *192.168.25.3 and a subnet mask of 255.255.255.0.*

If the correct IP address of the terminal cannot be determined, it is recommended to perform a long reset to restore the terminal to the default value.

Warning: performing a long reset will restore the terminal's IP address (192.168.25.2) and IP Subnet Mask (255.255.255.0) to the factory default value.

7.4 Troubleshooting The RF

RF Error Codes

The terminal monitors the status of the outdoor transceiver unit and reports any fault conditions in the system logs.

Table 23 lists the general fault conditions are reported by the system.

Table 23: RF Errors

Error Type	Description
AN-50e PLL Error	The PLL (Phase Locked Loop) section within the terminal experienced an error. The System Fault LED may light. Try resetting the terminal.
Communication Error Over IF Cable	Communication between the terminal and the transceiver failed. Check the IF cable and connectors.
Radio High Temp. Warning	The transceiver's internal temperature rose above 185F / 85C. The transceiver will shut down for 30 seconds to allow cooling time.
Radio Power Supply Fault	Indicates a fault in the transceiver's power supply. This error could be due to a problem with the internal power supply, or with the power source from the terminal. If the Low DC Voltage At Radio error is also indicated, (see below) check the IF cable and connectors. If the Low DC Voltage At Radio error is *not* indicated, the transceiver will require servicing.
Low DC Voltage At Radio Input	The DC voltage at the transceiver (carried by the IF cable from the terminal) is lower than the required 24 VDC. Check the IF cable and connectors. The minimum required voltage for operation is 12 VDC.

See Table 24: RF Status Error Codes for a list of the thirty-two possible error codes.

Table 24: RF Status Error Codes					
Error Code	**Terminal PLL Error**	**Comm Error Over IF Cable**	**Radio High Temp. Warning**	**Radio Power Supply Fault**	**Low DC Voltage At Radio Input**
0	No Errors	No Errors	No Errors	No Errors	No Errors
1					**X**
2				**X**	
3				**X**	**X**
4			**X**		
5			**X**		**X**
6			**X**	**X**	
7			**X**	**X**	**X**
8		**X**			
9		**X**			**X**
10		**X**		**X**	
11		**X**		**X**	**X**
12		**X**	**X**		
13		**X**	**X**		**X**
14		**X**	**X**	**X**	
15		**X**	**X**	**X**	**X**
16	**X**				
17	**X**				**X**
18	**X**			**X**	
19	**X**			**X**	**X**
20	**X**		**X**		
21	**X**		**X**		**X**
22	**X**		**X**	**X**	
23	**X**		**X**	**X**	**X**
24	**X**	**X**			
25	**X**	**X**			**X**
26	**X**	**X**		**X**	
27	**X**	**X**		**X**	**X**
28	**X**	**X**	**X**		
29	**X**	**X**	**X**		**X**
30	**X**	**X**	**X**	**X**	
31	**X**	**X**	**X**	**X**	**X**

7.5 System Error Log Messages

The following table provides a brief description of the key messages recorded in the logs by the system.

Table 25: System Log Messages

Log Message	Description
100-Parameters loaded successfully!	All system parameters have been successfully downloaded.
101-Firmware configuration OK!	The onboard firmware configuration has been properly set up.
102-Ethernet port configured!	The Ethernet port has been properly configured and is operational.
103-Parameters saved successfully!	The latest configuration parameters have been successfully saved into the system memory.
104-Upgrade OK!	The software upgrade process completed successfully.
105-Password changed successfully!	The system password was successfully changed.
106-Firmware programmed OK!	The firmware was successfully programmed.
107-Statistics initialized!	Reset of statistics was successful.
108-Version control loaded successfully!	Software version control data was successfully loaded.
109-Options Key activated!	Product Options Key was accepted.
110-Options Key already used!	The Product Options Key was not accepted because it was already used once. Contact your local Redline representative.
111-SNMP configuration loaded successfully!	The SNMP configuration was successfully loaded.
201-EEPROM corrupted. Def. param. loaded!	The memory area containing the system configuration has been corrupted. Default parameters loaded.
202-Error while saving parameters!	The latest configuration parameters have not been successfully saved. In this case, repeat the save configuration process to try to resolve the problem.
203-Another upgrade in progress!	The system is already in upgrade mode, in the event the operator inadvertently invoked multiple simultaneous upgrades.
204-Invalid upgrade parameters!	The parameter entered is in error. If this message appears, check for typing errors.
205-Upgrade failed!	The software upgrade process completed unsuccessfully.
206-Password changed unsuccessfully!	The new password entered into the system was not successful. In this case, repeat the process.
207-Timeout on reading data packet!	The system has timeout looking for packets from the host computer or server. Check for obvious problems such as disconnected or faulty cable.
209-TFTP error received!	The Trivial File Transfer Protocol (TFTP) routine used to download the software to the terminal during the Upgrade process failed. Likely cause is disconnected or faulty cable.
210-Error: TFTP unknown message!	The TFTP client received an unknown message. In this case, repeat the upgrade process.

Table 25: System Log Messages	
Log Message	**Description**
211-Error: while writing flash!	While writing the new software into terminal flash memory an unexpected error occurred. Try to repeat the process and if the error persists contact your local representative.
212-Error firmware configuration!	An unexpected error occurred while writing the onboard firmware configuration. Try to repeat the process.
213-Firmware programming failed!	The firmware programming failed.
214-Error while loading version control!	Software version control data was not loaded successfully.
215-Log buffer full!	The log buffer overflowed.
216-Invalid Options Key!	User entered an invalid Product Options key.
217- PLL unlocked!	One or more RF synthesizers unlocked. The unit stopped RF transmissions and attempted to reprogram the synthesizers. If this message repeats or if the RF link is not back on, try to reset the terminal. If the problem persists, contact customer support.
218-Outdoor unit over temperature!	The internal temperature of the transceiver is above 185F / 85C. The transceiver will shut down for 30 seconds to allow cooling.
219-Excessive DC loss on IF cable!	The DC voltage at the transceiver (carried by the IF cable from the terminal) is lower than the required 24 VDC. Check the IF cable and connectors.
220-Outdoor unit power supply fault!	Indicates a fault in the transceiver's power supply. This error could be due to a problem with the internal power supply, or with the power source from the terminal. If the 'Excessive DC loss on IF cable' error is also indicated, check the IF cable and connectors. If not, the transceiver will require servicing.
221-\public\ community can't be deleted!	The default 'Public' SNMP community cannot be deleted.
222-Max. community number already defined!	No more communities may be defined, as the maximum number has been reached
223-Community name already defined!	The name for the SNMP community has already been used. Choose another name.
224-MIB initialization error!	MIB construction process generated an error. Try to reset the terminal. If the problem persists, contact customer support.
225-Error while loading SNMP configuration!	EEPROM memory was corrupted and the SNMP configuration couldn't be loaded. Default SNMP configuration was loaded.
226-Error while saving SNMP configuration!	SNMP configuration saving process wasn't successfully. Try again. If the problem persists, contact customer support.

7.6 Saving System Parameters

The AN-50e is a highly configurable communications device. All configurable options are saved in NVRAM (programmable flash ROM).

There are a number of steps required for editing and activating changes to the personalization of each terminal. The following table describes the basic operations available and how to control selection of the parameters and operation of the terminal.

The Test button is located in the System Configuration page. You must click the Save button at the bottom of the System Configuration screen to save these system parameter settings in the NVRAM.

Chapter

8

8 Appendix

8.1 System Specifications

Table 26: AN-50e Technical Specifications	
Wireless System	
System Capability:	LOS, Optical-LOS, and Non-LOS
RF Band:	T-54 Radio: 5.470 GHz to 5.725 GHz[1] T-58 Radio: 5.725 GHz to 5.825 GHz[1] T-58e Radio: 5.725 GHz to 5.850 GHz[1]
Center Frequency Steps:	5 MHz
Channel Size:	20 MHz
RF Dynamic Range:	> 50 dB
Data Rate:	Up to 49 Mbps average Ethernet rate
Max TX Power:	-20 dBm to 20 dBm (region specific)[2]
Rx Sensitivity:	-86 dBm @ 6 Mbps (based on BER of 1x10e-9)
IF Cable:	Multiplexed IF, DC, control (Tx/Rx, AGC, APC) Up to 68 m (225 ft) using RG-6U cable[3] Up to 228 m (750 ft) using high-grade cable[3]
Network Attributes:	802.1p network traffic prioritization[4] 802.3x Ethernet flow control[4] Automatic Link Distance Ranging[4] DHCP pass-through Transparent bridge VLAN pass-through
Dynamic Channel Control:	Dynamic Frequency Selection (DFS), Automatic Transmit Power Control (ATPC)
Modulation/Coding Rates:	Adaptive Modulation (bi-directional burst to burst) auto selects; 1/2 BPSK, 3/4 BPSK, 1/2 QPSK, 3/4 QPSK, 1/2 16 QAM, 3/4 16 QAM, 2/3 64 QAM and 3/4 64 QAM
Over The Air Encryption:	64-bit private key encryption
MAC:	PTP and PMP deployment TDMA Concatenation/Fragmentation[5] Automatic Repeat Request (ARQ) error correction Dynamic adaptive modulation (BPSK to 64 QAM)
Range:	Up to 25 km (15 mi) line-of-sight @ 33 dBm EIRP (for Europe) Up to 80 km (50 mi) line-of-sight @ 48 dBm EIRP
Network Services:	Transparent to 802.3 services and applications
Duplex Technique:	Dynamic TDD (time division duplex)
Wireless Transmission:	OFDM (orthogonal frequency division multiplexing)

Table 26: AN-50e Technical Specifications	
Network Connection:	10/100 Ethernet (RJ-45)
System Configuration:	HTTP (Web) interface, SNMP CLI via Telnet and local console
Network Management:	SNMP: standard and proprietary MIBs Full management by RedAccess NMS
Power Requirements:	39 W maximum Single/dual auto-sensing 110/220/240 VAC 50/60 Hz Single/dual 18 - 72 VDC
Redundant Power:	Optional dual AC or dual DC power supply (dual cord) with automatic fail-over
Compliance:	EN 60950, EN 301 893, EN 301 390, EN 301 489-1 & 17, FCC part 15
Operating Temperature:	IDU Operating Cond.: 5 C to 40 C, IDU Short-Term Cond.: -5 C to 55 C for up to 16 hours ODU Operating Cond.: -40 C to 60 C
Dimensions/Weight:	IDU: 431.8 x 304.8 x 44.45 mm (17 x 12 x 1.75 in)
Weight:	2.5 Kg (5.5 lb)

[1]In some countries outside of North America, the maximum operational power per channel with a given antenna is limited in accordance to maximum allowable EIRP levels for the region.
[2]Center frequency is dependent on region.
[3]With two lightning arrestors installed.
[4]Point-to-Point Mode only.
[5]Point-to-Multipoint mode only.
Subject to change without notice.

8.2 DC Power Supply Cable Connections

This section provides important instructions for connecting to a DC power source.

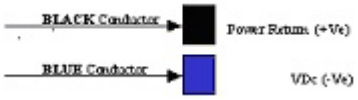
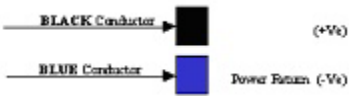
The DC power supply (optional) is rated for operation using 24, 48 or 60 VDC. Power is connected to the terminal via a fused power entry module located on the rear of the terminal. All DC terminals are shipped with a power cord assembly, consisting of the power entry module's mating dual pin polarized female plug, pre-crimped with 18 AWG blue and black insulated wires.

Important: All power wiring must be at least 18 AWG.

The DC power input is floating (+Ve and -Ve not connected to chassis), allowing positive (minus to ground), negative (positive to ground) and floating power connections as required. Refer to table below for connection details.

If the terminal does not power-on, it is possible that the blue and black wires are connected incorrectly resulting in a reversal of polarity. In this event the diode protection prevents permanent damage to the power supply. Reverse the power connections and verify that the terminal powers up properly.

Table 27: DC Power Supply Cable Connections

Wire Color	Negative DC Power (-18 to -72 VDC)	Positive DC Power (+18 to +72 VDC)
Blue	Negative power	Power Return
Black	Power Return	Positive Power
Schematics		

Note: DC units are not equipped with power switches and activate immediately when connected to a power source.

8.3 Antenna and Power Specifications

8.3.1 T-58 Radio: Antenna Power Specifications

The system is FCC certified for the antennas listed in the following table.

Table 28: T-58 Radio: Antenna Power Specifications

Redline PN	Ant. Gain (dBi)	Antenna Type	App.	Minimum Conducted Power (dBm)	Max Conducted Power Ratings (dBm)	Average GUI Power Display (dBm)	FCC Max EIRP (dBm)
48-00006	28	Directional Flat Panel	PTP	-20	26	20	No Limit
48-00020	22	Directional Flat Panel	PTP	-20	26	20	No Limit
48-00030	22	Directional Parabolic	PTP	-20	26	20	No Limit
48-00031	28	Directional Parabolic	PTP	-20	26	20	No Limit
48-00032	31.2	Directional Parabolic	PTP	-20	26	20	No Limit
48-00033	34.6	Directional Parabolic	PTP	-20	26	20	No Limit
48-00006	28	Directional Flat Panel	PMP	-20	8	2	36
48-00014	15	Directional, Flat Panel	PMP	-20	21	15	36
48-00017	14	Directional, Flat Panel	PMP	-20	22	16	36
48-00020	23	Directional Flat Panel	PMP	-20	13	6	36
48-00028	17	Directional, Flat Panel	PMP	-20	19	13	36
48-00029	16	Directional, Flat Panel	PMP	-20	20	14	36
48-00030	22	Directional Parabolic	PMP	-20	14	8	36
48-00031	28	Directional Parabolic	PMP	-20	8	2	36
48-00032	31.2	Directional Parabolic	PMP	-20	4	-2	36
48-00033	34.6	Directional Parabolic	PMP	-20	1	-5	36

***Note**: The RF output power and selection must be professionally programmed and installed by the manufacturer or a trained professional installer for compliance with FCC requirements of maximum EIRP of 36 dBm.*

8.3.2 T-58e Radio: Antenna Power Specifications

The system is FCC certified for the antennas listed in the following table.

Table 29: T-58e Radio: Antenna Power Specifications

Redline PN	Ant. Gain (dBi)	Antenna Type	App.	Minimum Conducted Power (dBm)	Max Conducted Power Ratings (dBm)	Average GUI Power Display (dBm)	FCC Max EIRP (dBm)
48-00006	28	Directional Flat Panel	PTP	-12.7	26.2	20	No Limit
48-00020	23	Directional Flat Panel	PTP	-12.7	26.2	20	No Limit
48-00020-01	22	Directional Flat Panel	PTP	-12.7	26.2	20	No Limit
48-00030	22	Directional Parabolic	PTP	-12.7	26.2	20	No Limit
48-00031	28	Directional Parabolic	PTP	-12.7	26.2	20	No Limit
48-00032	31.2	Directional Parabolic	PTP	-12.7	26.2	20	No Limit
48-00033	34.6	Directional Parabolic	PTP	-12.7	26.2	20	No Limit
48-00006	28	Directional Flat Panel	PMP	-12.7	8	2	36
48-00014	15	Directional, Flat Panel	PMP	-12.7	21	15	36
48-00017	14	Directional, Flat Panel	PMP	-12.7	22	16	36
48-00020	23	Directional Flat Panel	PMP	-12.7	13	7	36
48-00020-01	22	Directional Flat Panel	PMP	-12.7	14	8	36
48-00028	17	Directional, Flat Panel	PMP	-12.7	19	13	36
48-00029	16	Directional, Flat Panel	PMP	-12.7	20	14	36
48-00030	22	Directional Parabolic	PMP	-12.7	14	8	36
48-00031	28	Directional Parabolic	PMP	-12.7	8	2	36
48-00032	31.2	Directional Parabolic	PMP	-12.7	4	-2	36
48-00033	34.6	Directional Parabolic	PMP	-12.7	1	-5	36
48-00047	15	Directional Flat Panel	PMP	-12.7	21	15	36
48-00048	9	Omni-Directional	PMP	-12.7	27	20	36

***Note**: The RF output power and selection must be professionally programmed and installed by the manufacturer or a trained professional installer for compliance with FCC requirements of maximum EIRP of 36 dBm.*

8.3.3 T-54 Radio: Maximum RF Power vs. Antenna Gain

The following table provides the adjustment available for maximum RF power settings based on the angle of deployment. applies to sectorized antennas only.

Table 30: 5.4 GHz Band RF Power vs Antenna Gain

	A6017 RWS	A9016 RWS	A6015 MTS	A9014 MTS
deg	dBm	dBm	dBm	dBm
0	-1	0	4	2
1	0	1	5	3
2	1			4
3				5
4				6
...				
12	2			
13	3			
14	4			
15	5			
...				
24	6			
25		2		
26		3		
27		4	6	
28		5	7	
29		6	8	
...				
32				7
37				8
39				9
...				
45		7		

8.3.4 Operational Power for T54 (FCC)

The following table provides the maximum RF power settings based on the gain of the antenna.

Table 31: 5.4 GHz -- Antenna Gain vs Max. Op. Power				
Ant. Gain [dBi]	Max. Power [dBm]		Ant. Gain [dBi]	Max. Power [dBm]
6.0	15		21.0	-1
6.5	15		21.5	-1
7.0	14		22.0	-2
7.5	14		22.5	-2
8.0	13		23.0	-3
8.5	13		23.5	-3
9.0	12		24.0	-4
9.5	12		24.5	-4
10.0	11		25.0	-5
10.5	11		25.5	-5
11.0	10		26.0	-6
11.5	10		26.5	-6
12.0	9		27.0	-7
12.5	9		27.5	-7
13.0	8		28.0	-8
13.5	8		28.5	-8
14.0	7		29.0	-9
14.5	7		29.5	-9
15.0	5		30.0	-9
15.5	5		30.5	-10
16.0	4		31.0	-10
16.5	4		31.5	-11
17.0	3		32.0	-11
17.5	3		32.5	-12
18.0	2		33.0	-12
18.5	2		33.5	-13
19.0	1		34.0	-13
19.5	1		34.5	-14
20.0	0		35.0	-14
20.5	0			

8.3.5 PTP Antenna Specifications

The system is FCC certified for the directional and parabolic antennas listed in the following tables.

Table 32: PTP Antenna Specifications

PN	Polarization	Freq GHz	Gain dBi	Beam Width Degree @ -3 dB	F/B Ratio dB	VSWR R.L.	Size cm	Kg
48-00006	Vertical or Horizontal	5.4 5.8	28	4.5	- 40	1.7:1	60x60	5.0
48-00020	Vertical or Horizontal	5.4 5.8	23	9	-32	1.7:1	30x30	1.5
48-00030	Vertical or Horizontal	5.4 5.8	22	12	- 30	1.5:1	30	6.8
48-00031	Vertical or Horizontal	5.4 5.8	28	6.2	-36	1.5:1	60	9.9
48-00032	Vertical or Horizontal	5.4 5.8	31.2	4.2	-38	1.5:1	90	15.8
48-00033	Vertical or Horizontal	5.4 5.8	34.6	3.4	-42	1.5:1	120	27

8.4 CLI Interface

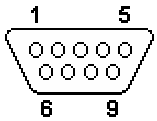
8.4.1 Console (RS-232) Port

All operator communications with the terminal may be made using a direct connection to the serial Console Port on the back of the terminal. This section describes the procedures for configuring and operating the terminal via the Console Port using the command line interface (CLI).

Connect a PC/Terminal to the terminal's serial port DB9 connector using a cross-connect or null modem cable (DB9 female-female). Set the PC/Terminal to emulate a VT-52 or VT-100 terminal, using the following port settings: Bits Per Second: 9600; Data Bits: 8; Parity: None; Stop Bits: 1; Flow Control: Hardware

The following table lists the terminal 9 PIN D-SUB male connector pinout.

Table 33: Console (RS-232) Port Pinout



Pin	Name	RS232	V.24	Description
2	RXD	BB	104	Receive Data
3	TXD	BA	103	Transmit Data
5	GND	AB	102	System Ground

V.24 column is ITU-TSS V.24 circuit name.
RS232 column is RS232 circuit name.

8.4.2 Connecting via Telnet

All operator communications with the terminal may be made using CLI over Telnet. This offers the advantage of allowing the operator to access and control the terminal remotely from any geographical location, without the need for a web browser. This section describes the procedures for configuring and operating the terminal via Telnet using the command line interface (CLI).

To connect to the terminal, Telnet to the IP address of the terminal (default address shown below).

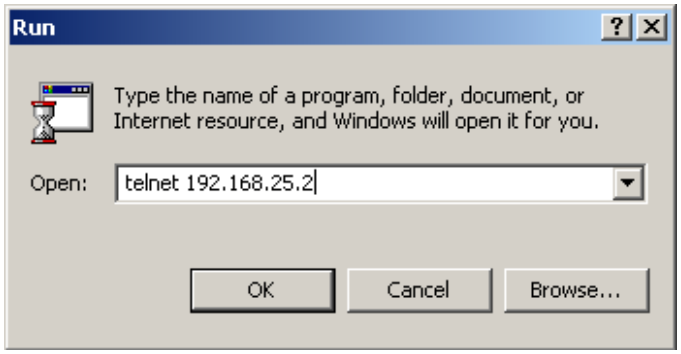


Figure 40: Connecting via Telnet

When the command prompt screen appears, login using the Username: admin and Password: admin. The terminal may now be configured and queried using a set of CLI commands. Type ‘help’ for a list of general commands.

8.4.3 CLI Commands

The following commands are available via Telnet and Console connections to the terminal. For online help, type ‘help <command>’ at the command prompt.

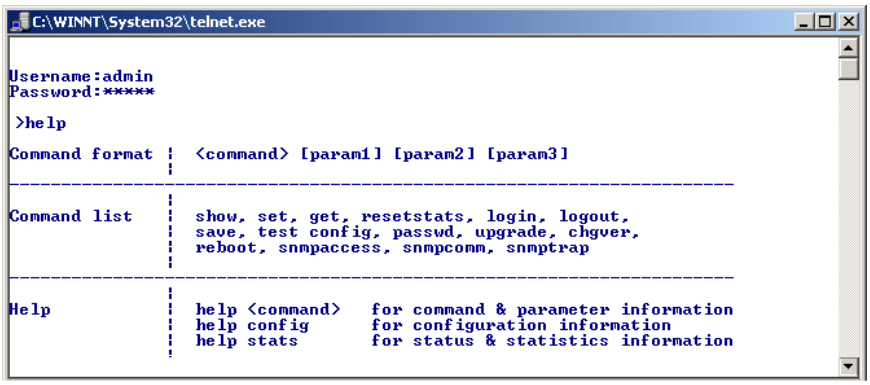


Figure 41: CLI Help Screen

General Commands

Table 34: CLI - General Commands	
Command	**Description**
chgver	Swaps the operating and secondary software versions
get	Get <parameter name> displays the value for a status parameter. For configuration parameters, use Set command.
login	Allows login under a different username and password
logout	Disconnects user from the terminal.
passwd	Change password for user. passwd <username> <newpassword>
reboot	Reboots the terminal. Reboot <time in seconds>
resetstats	Resets all statistics
save config	Permanently saves system configuration settings. This command is required to activate all Configuration settings set previously
save snmp	Permanently saves SNMP configuration settings. This command is required to activate all SNMP settings set previously.
set	Set one configuration parameter: <parameter name> [<value>] Without <value>, 'set' returns the actual value for configuration parameters. For status parameters, use the Get command.
show config	Returns a list of all System Configuration parameters.
show log	Returns a list of current system log entries.
show snmp	Returns a list of all SNMP communities and related parameters.
show stats	Returns a list of all System Status parameters.
snmpaccess	Modify access rights for a community (see snmpcomm) snmpaccess <community name> <access>
snmpcomm	To add a new SNMP community: snmpcomm add <community name> <access> <access> can be: r,w,t or any combination To delete an SNMP community snmpcomm del <community name>
snmptrap	To add a trap destination for an SNMP community: snmptrap add <community name> <IP destination> To delete a trap destination for an SNMP community: snmptrap del <community name> <IP destination>
test config	Allows testing of configuration settings for 5 minutes, after which the system reverts to the previously saved settings. To make settings permanent use 'save' command.
upgrade	Begin a software upload.

Table 34: CLI - General Commands	
Command	**Description**
	upgrade <ipaddr> <filename>

General Information

Table 35: CLI - General Information Commands	
Command	**Description**
gateway	Specifies the IP address of the default router
ipaddr	Specifies the IP address used by the local terminal
ipmask	Specifies the IP Subnet Mask used by the local terminal
macaddr	Specifies the Ethernet MAC address used by local terminal
master	Indicates whether the system is operating as the master system. *Important: For each set of* Systems*, only one terminal must be designated Master.*
rflink	Yes: RF link up / No: RF link down
starttime	Specifies the time elapsed since the system started
swver	Specifies the operating software version
sysdetails	Specifies the location, telephone #, contact information, etc.
sysname	Identifies the local terminal
ubrate	Indicates the system's current uncoded burst rate

System Status

Table 36: CLI - System Status	
Command	**Description**
cableattn	The attenuation of the signal over the IF cable
erxpkt	Number of packets successfully received locally
erxpktd	Number of packet errors received locally
etxpkt	Number of Ethernet packets transmitted
gateway	Specifies the IP address of the default router
ipaddr	Specifies the IP address used by the local terminal
ipmask	Specifies the IP Subnet Mask used by the local terminal
ll	Actual length of the path that the wave travels.
macaddr	Specifies the Ethernet MAC address used locally
master	Indicates if the system is serving as the master system. *Important: For each set of* Systems*, only one terminal must be designated Master.*
resetstats	Resets all statistics
rffreq	The center frequency of the channel in use
rflink	Yes: RF link up. No: RF link down

Table 36: CLI - System Status	
Command	**Description**
rfstatus	An error code (0-31), indicating the RF status
rssimax	The maximum received signal strength
rssimean	The average received signal strength
rssimin	The minimum received signal strength
sinadr	The no. of successful wireless pkt. received over the air
swver	Specifies the operating software version
sysname	Identifies the local terminal
txpower	The actual current transmit power level
ubrate	Indicates the system's current uncoded burst rate
wrxpkt	The no. of successful wireless pkt. received over the air
wrxpktd	The no. of wireless pkt. received with errors over the air
wrxpktr	The no. of wireless pkt. retransmitted over the air
wtxpkt	The no. of wireless pkt. successfully transmitted over the air
wtxptd	The no. of transmitted pkt. discarded by the remote-end terminal
wtxpktr	The no. of wireless pkt. retransmitted over the air

System Configuration

Table 37: CLI - System Configuration	
Command	**Description**
adaptmod	Enables Adaptive Modulation mode.
buzzer	Specifies whether the antenna buzzer is enabled - defaults to voltage.
chgver	Change the operating software version
encrypt	Specifies whether over-the-air data encryption is enabled
encryptkey	Enter the remote-end terminal's MAC address if encryption is enabled
flowctrl	Specifies whether flow control on the Ethernet port is enabled
gateway	Specifies the IP address of the default router
http	Specifies whether configuration over HTTP is enabled
ipaddr	Specifies the IP address used by the local terminal
ipmask	Specifies the IP Subnet Mask used by the local terminal
llmod	Specifies if the link length is calculated automatically or manually. Available options: off for auto and on for manual.
llmu	Specifies the current measurements units used for the link length. Available options: off for miles and on for kilometers.
ll	Actual length of the path that the wave travels.
macaddr	Specifies the Ethernet MAC address used by the local

Table 37: CLI - System Configuration	
Command	**Description**
	terminal
master	Indicates whether the system is operating as the master system. *Important: For each set of* Systems*, only one terminal must be designated Master.*
modreduct	Used when 'AdaptMod' is disabled.
radio	Specifies whether radio transmission is enabled
reboot	Reset all statistics and reboot the terminal
rfchannel	Available channel options: 1, 1A, 2, 2A, 3, 3A, 4, 4A, 5.
save config	Permanently saves configuration settings
snmp	Specifies whether configuration over SNMP is enabled
sysdetails	Specifies the location, telephone #, contact information, etc.
sysname	Identifies the local terminal
telnet	Specifies whether configuration over telnet is enabled
telnetport	Specifies the TCP port used for telnet
test config	Allows testing of these settings for 5 minutes, after which the system reverts to the previously saved settings. Use 'Save' to make settings permanent .
txpower	Specifies the max. power level of the system
ubrate	Sets the desired burst rate for the link.

8.5 Glossary Of Terms

Table 38: Glossary of Terms	
Term	**Definition**
Antenna Gain	The measure of antenna performance relative to a theoretical antenna called an isotropic antenna.
ARQ	Automatic Repeat Request. This is the protocol used over the air for error correction.
ATPC	Automatic Transmission Power Control. The link master-end system automatically adjusts the Tx level of remote-end system to match a target RSSI value.
Beamwidth	The angle of signal coverage provided by an antenna.
BFW	Broadband Fixed Wireless
Bps	Bits Per Second A unit of measurement for the rate at which data is transmitted.
BPSK	Binary Phase Shift Keying.
Channel	A communications path wide enough to permit a single RF transmission.
dB	A ratio expressed in decibels.
dBi	A ratio, measured in decibels, of the effective gain of an antenna compared to an isotropic antenna.
dBm	Decibels above a milliwatt
DFS	Dynamic Frequency Selection (DFS) can detect interference from other devices using the same frequency (especially radar) and automatically take a pre-selected action such as disable transmission or relocate transmission to alternative frequency.
DHCP	Dynamic Host Configuration Protocol. A DHCP server will automatically issue IP addresses within a specified range to devices on a network.
Directional Antenna	An antenna that concentrates transmission power into one direction.
Encryption	For the purposes of privacy, the transformation of data into an unreadable format until reformatted with a decryption key.
Ethernet	A LAN architecture using a bus or star topology
FD	Full Duplex. Refers to the transmission of data in two directions simultaneously (i.e. a telephone)
FWA	Fixed Wireless Access
Gain	The ratio of the output amplitude of a signal to the input amplitude of a signal. Typically expressed in decibels (dB).
Gateway	A network point that acts as an entrance to another network.
GHz	Gigahertz. 1,000,000,000 Hz, or 1,000 MHz
GUI	Graphical User Interface
IF	Intermediate Frequency.
IP	Internet Protocol. See TCP/IP.
Isotropic	A theoretic construct of an antenna that radiates its signal 360

Table 38: Glossary of Terms	
Term	**Definition**
	degrees both vertically and horizontally—a perfect sphere. Generally used as a reference.
IXC	Inter-exchange Carrier. A long-distance phone company.
LEC	Local Exchange Carriers. The traditional local wired phone company.
LED	Light Emitting Diode
LOS	Line Of Sight. A clear direct path between two antennas, with no obstructions within the first Fresnel zone.
MAC	Media Access Control. A unique number assigned to a network device. Corresponds to ISO Network Model Layer 2 data link layer.
MHz	Megahertz. 1,000,000 Hz
Modem	MOdulator/DEModulator. A hardware device that converts digital data into analog and vice versa.
Modulation	Any of several techniques for combining user information with a transmitter carrier signal.
Multipath	The radio echoes created as a radio signal bounces off objects.
NVRAM	Non-volatile RAM. System parameters are stored in NVRAM. This data is not affected by powering off the system.
NLOS	Non Line Of Sight. Completely obstructed path between two antennas.
OFDM	Orthogonal Frequency Division Multiplexing. OFDM spreads data to be transmitted over a large number of orthogonal carriers.
OLOS	Optical Line Of Sight. A clear direct path between two antennas, with obstructions within the first Fresnel zone.
Packet	A bundle of data organized in a specific way for transmission. The three principal elements of a packet include the header, the text, and the trailer (error detection and correction bits).
PHY	Physical Layer. Provides for the transmission of data through a communications channel by defining the electrical, mechanical, and procedural specifications.
PMP	Point to Multipoint
PTP	Point to Point
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
Receiver Sensitivity	A measurement of the weakest signal a receiver can receive and still correctly translate it into data.
RF	Radio Frequency
Rx	Receiver
S/N	Signal to Noise Ratio
SINADR	Signal to noise and distortion ratio.
TCP/IP	Transmission Control Protocol/Internet Protocol The standard set of protocols used by the Internet for transferring information between computers, handsets, and other devices.
TFTP	Trivial File Transfer Protocol
Tx	Transmitter

302 Town Centre • Suite 100 • Markham, Ontario • Canada • L3R 0E8

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