CARLSON WIRELESS TECHNOLOGIES, INC.

Installation & User Manual

Trailblazer Digital Radio

TB 2.4-5.8 and TB 4.9 series

Part Number 490-2000
Rev 3.07

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Repair and Return

Carlson Wireless will replace or repair its Trailblazer product for one year from the original date of shipment if it does not meet its published specification or if it fails while in service. A return material authorization (RMA) is required prior to returning equipment to CWT. Please contact Carlson Wireless if a RMA is needed for return of equipment.

Customer Service

Technical support is available Monday - Friday, 8:30 am to 5:00 pm, PDT.
Tel: +1 707.822.7000
Email: Support@CarlsonWireless.com
URL: http://www.CarlsonWireless.com/support.html

Training

The Customer Service Department offers training classes to include overviews on: applications, engineering, in-house testing, configuration, field testing and maintenance. Please contact our Customer Service Department for more specific details.

SAFETY WARNING

Potentially hazardous voltages exist on TELCO lines and associated equipment. Always observe standard safety precautions during installation, operation and maintenance of these products. To avoid the possibility of electric shock, be sure to disconnect the power from the remote power source before you perform any line connections or repairs. Always disconnect all the cables connected to the system before disconnecting the grounding connection. After disconnecting the power allow a few seconds for the internal capacitances to discharge before accessing the boards.

QUALIFIED PERSONNEL WARNING

The installation procedures described in this manual MUST be performed by qualified personnel aware of the hazards involved. The personnel involved in equipment installation must be trained in the installation of telephone equipment and associated power systems; these personnel must strictly observe all the safety precautions related to the installation of communication equipment. Never install, remove, or adjust equipment and associated cables. Do not work on roofs, masts or towers during a lightning storm.

ATTENTION! STATIC SENSITIVE DEVICES

PROPER HANDLING AND GROUNDING WARNING

Components within the Trailblazer system are sensitive to electrostatic discharge (ESD). To avoid and prevent ESD damage, and device failure, maintain proper grounding during configuration, repair or maintenance. This is achieved through the use of an antistatic wrist strap securely connected to chassis ground. Do not use conductive tools for adjusting channel select switch.

FCC, RF SAFETY HAZARD WARNING

Due to the energy radiated from the antenna, this product must never be mounted so that the cabinet containing the antenna is closer than 2 meters (6.7 feet) to any person. Refer to Section 4.2 for further restrictions.

UL INSTALLATION SAFETY INSTRUCTIONS

- Never install telephone wiring during a lightning storm.
- Never install telephone jacks in a wet location unless the jack is specifically designed for wet locations.
- Never touch telephone wires or terminals unless the telephone line has been disconnected at the network interface.
- Use caution when installing or modifying telephone lines.

Connection to the Telephone Network

This equipment complies with Part 68 of the FCC rules. You will find the label located on the device. This label contains the FCC Registration Number and the Ringer Equivalence Number (REN) for the equipment. You must, upon request, provide this information to your local telephone company. The REN is used to determine the quantity of devices that may be connected to the telephone line and still have all of those devices ring with an incoming call signal. In most areas the sum of the RENs of all devices connected to one line should not exceed five (5.0). Confirm the number of

devices possible on the telephone line (in REN) by contacting the local telephone company who provides the service.

Incidence of Harm

If your telephone equipment causes harm to the telephone network, the telephone company may disconnect your service temporarily. When possible, the telephone company will notify you in advance of pending disconnection. If advanced notice is not practical, you will be notified as soon as possible. You will also be informed of your right to file a compliant with the FCC.

Rights of the Telephone Company

Your telephone company may make changes in its facilities, equipment, operations or procedures that could affect the proper functioning of your equipment. In this case, you will be notified in advance to give you an opportunity to maintain uninterrupted telephone service.

Coin Service or Party Use Line

This equipment may not be used on the coin service provided by the telephone company. Connection to party lines is subject to state tariffs.

Compliance and US Regulatory Information

Model TB 4.9

FCC Reg No., Part 68	BMD8 USA – 27773-PT-E
FCC Reg No., Part 90 subpart Y	FCCID: OPA-TB49
Industry Canada CS-03	3448A-10241A

Model TB 2.4-5.8

FCC Reg No., Part 68	BMD8 USA – 27773-PT-E
FCC Reg No., Part 15	FCCID: OPA-TB24-58
Industry Canada CS-03	3448A-10241A
Industry Canada RSS-210	3448A-TB24-58

Compliance Classification

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 user's expense.

Radio Interference: Carlson Wireless USA Model TB 2.4-5.8

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) This device must accept any interference received, including interference that may cause undesired operations. Changes of modification not expressly

approved by the party responsible for compliance could void the user's authority to operate the equipment**.**

Declaration of Conformity

Manufacturer's Name: Carlson Wireless Technologies, Inc.
Manufacturer's Address: 1385 8th Street.
Arcata, CA 95521
USA

Declares that the product:
Product Name: **Trailblazer TB 2.4-5.8**

Conforms to the following standard(s) or other normative document(s):
EMC:
FCC Part 15.247

And also declares that the product:
Product Name: **Trailblazer TB 4.9**

Conforms to the following standard(s) or other normative document(s):
EMC:
FCC Part 90 subpart Y

Supplementary Information:
Published Specifications

William Mc Bride
Director of Technical Operations

Arcata, CA USA
March 2007

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1 Introduction

1.1 Scope of Manual

The purpose of this manual is to provide planning and installation personnel with the appropriate procedures for the Trailblazer Digital Microwave Radio and its accessory equipment. In order to avoid harm to persons or damage to the product, please ensure that you have read and understand the safety, unpacking and installation sections before proceeding.

1.2 Functional Overview and Applications

Using state-of-the-art digital electronics, the Trailblazer provides 512kbps of high-quality, reliable, wireless voice and/or data over distances of up to 32mi/ 50 km or more in repeated applications. This radio integrates seamlessly with POTS voice cards and Leased Line cards, V.35 protocol or standard 10baseT Ethernet devices. Carlson Wireless provides competitive price and performance solutions for many of the world's telecommunication needs in both point-to-point and point-to-multipoint applications. Applications include:

- Security Monitoring Cameras
- Public Safety Leased Line Replacement
- Internet Cafés and Telephone Calling Centers
- Point-to-Point Commercial Data Links
- Cellular Backhaul Data Needs
- Permanent or Temporary Telephone Service
- Temporary or Emergency Restoration of Services
- Public Calling Phones
- Retrofit for Exhausted Wire Line Systems
- Islands and other Isolated Areas
- Inaccessible, Environmentally Sensitive and Historic Areas
- Harsh Climates and Geologically Adverse Environments

1.2.1 Main Features and Advantages

Advantages over Wire Line

The Trailblazer's wireless link eliminates the expense of right-of-way and wire line costs, provides solutions for areas where adverse geology, climate or inaccessibility exclude the installation of wire lines, and preserves the beauty and integrity of sensitive environments and historic structures. Wireless links remain operational when wired networks go down due to floods, power pole failures, digging up of fiber and copper cables, fires and other hazards.

Wire Line Quality Voice and Data

You can configure your Trailblazer for data speeds up to 512 kbps or designate part of your bandwidth to POTS lines or Leased lines, as the Trailblazer seamlessly integrates 64kbps full bandwidth PCM POTS or Leased Line cards for high quality, uncompressed audio with an excellent signal-to-noise ratio.

Easy Installation

The outdoor unit mounts on a 1"- 2.25" pipe or pole or attaches to any vertical surface. The indoor rack enclosure mounts in a standard 19" rack. Each unit requires an external antenna and has its own *optional* battery, backed up AC or 48VDC power supply, or runs directly on 12-24 VDC, which is easily powered by solar.

Low Power Draw: Ideal for Solar Applications

The low power consumption of 2 to 5 Watts makes the Trailblazer very energy efficient. The Trailblazer operates at any DC voltage from 12V to 24V and is thus easily powered by a solar system. CWT solar powering kits are available with up to 7 days of back-up power.

Flexible & Programmable

All Trailblazer models are bench or field programmable. Using the GUI (Graphical User Interface) application with a Windows PC and serial COM port, you can configure the amount of bandwidth, allocate voice and data channels, select different frequencies and CDMA codes, use antenna alignment aids and other diagnostic tools, as well as upgrade software and firmware. The Trailblazer models support all CLASS features, fax and V.90 dial-up modems.

Rugged & Weatherproof

In the weatherproof enclosure *option*, all components, including the digital radio cards, power supplies & CPU, are fully integrated into a NEMA 4X waterproof enclosure, which is built to last in tough climates. The lockable polycarbonate enclosure, with a neoprene gasket, will protect against wind, rain and ice thus providing years of service.

No License Required for the 2.4 and 5.8 GHz, Simple License for 4.9 GHz

The Trailblazer uses the license-exempt (in most countries) 2.4 GHz or 5.8 GHz frequency bands, or the 4.9GHz public safety band.

Private and Secure

The signal is fully encrypted spread-spectrum CDMA modulation with a proprietary framing structure and packet size that ensures complete privacy and security.

Standard ISO 2593 V.35 DTE port

Because the Trailblazer models feature a standard ISO 2593 V.35 DTE port, most other V.35 devices plug right into the Trailblazer Phone Extender.

Repeater
A digital repeater is available to extend the range of the network or to work around terrain obstacles.

Expandable
Starting with only one link, you can add CPE units, gaining the features of a point-to-multipoint topology for your current and future growth needs without loosing any of your original investment.

10BaseT On-Board Ethernet Port
On-board Ethernet satisfies simultaneous LAN / IP data and PCM voice needs with an Industry Standard RJ45 10BaseT connection. Some of its advanced features include 802.3 Ethernet supported by Transparent LAN bridging and Automatic LAN MAC address filtering at the MAC level, making it transparent to higher level protocols such as TCP/IP, DECnet, NETBIOS, and IPX network protocols. Broadcast, multicast, or frames set up for peered LAN are forwarded while reserving maximum RF bandwidth.

1.2.2 General Specifications

Note: *More technical details are found in the Appendix to this manual*

Product Description	Digital Microwave Radio with POTS, Leased Lines and 10BaseT / V.35 port
Data Interfaces	
Primary Serial Data Port	(1) RJ45 port providing 10BaseT
Data Rate and Type	128/256/384/512 kbps, synchronous
Serial Command Port	RS 232, 57.6 kbps, N, 8, 1, no handshaking
Latency	< 4.4ms depending on speed selected
Power Requirements	
Input Voltage	12 to 24 VDC or 100-260 VAC with AC power supply (optional)
Power Consumption	3 - 5 Watts depending on configuration
Battery Backup (optional)	Over 8 hours with a 5Ah battery
RF Specifications	
RF Frequency Range	2.400 to 2.4835 GHz 4.900 to 5.900 GHz
Modulation Type	BPSK (256kbps) or QPSK (512kbps) DSSS
Transmitter Output Power	+20dBm
Receiver Sensitivity (10^{-6} BER)	-93dBm @ 256 kbps, -90dBm @ 512 kbps
Operating Temp	-30 to +60 Degrees C with solar shielding, 0-90% Non-Condensing

Physical Characteristics

Outdoor Enclosure Dimensions	13 x 11 x 6 in / 33 x 28 x 15 cm
Rack Mount Dimensions	19" rack mount 3RU (5 ¼ in)
Unit Weight	8 lbs / 3.7kg
Outdoor Enclosure Specs	NEMA 4X, rain, wind and ice protected GE Valox99® polycarbonate w/ neoprene gasket
Mounting	1"-2.25" or 2.5cm-5.7cm pipe/pole

2 Pretest and System Planning

2.1 Site Requirements and System Planning

2.1.1 Grounding

A ground is defined as a low impedance electrical connection to earth that is used to dissipate energy. Grounding your Trailblazer is very important for safety reasons as well as to protect your system from damage due to lightning and static charge build up. Since lightning strikes and surges are high current and high frequency events, all ground wires must be as short and straight as possible and not be coiled or looped. Choose the largest diameter ground wire your ground connectors will accept for good electrical conductivity. A #8 gauge copper wire or larger is recommended.

Recommended grounds are: the utility company ground, a ground rod, well casings, and cold water pipes that are of continuous metal. A note of caution: sometimes the metal-cold water pipes are repaired and/or extended with PVC piping hidden behind drywall. The introduction of PVC material disrupts the material's conductivity and thus renders it unacceptable as a ground. In desert areas, where ground conductivity is poor, many ground rods are often needed, bonded together to make a suitable connection to the ground. 5 ohm impedance is a minimum.

Unacceptable grounds are: sprinkler pipes, PVC pipes, conduit, buried wire, and any ground that cannot be verified.

2.1.2 Lightning Protection

Lightning protection with a poor ground is the same as having no protection at all!

Lightning is one of the most dangerous and unfortunately most frequently encountered natural hazards to your Trailblazer. Ensure that your system is adequately protected. A good connection to ground is indispensable for your lightning protection to work correctly and thus prevent lightning damage to your Trailblazer. The Trailblazer system is equipped with on-board ***secondary active lightning protection*** only. This secondary lightning protection is only effective when the system is powered up. If you power down your Trailblazer, disconnect the antennas and phone lines to prevent damage from lightning strikes. Primary lightning protection is located outside the enclosure. Install ***primary lightning protection*** with a good ground on all RF, data and voice line

connections that have even a moderate outdoor line build out. A good rule of thumb is that all lines entering or exiting a building need protection. Both ends of the cables between buildings must be protected! See section 5.2 for detailed specifications and usage information on *optional* primary lightning protection available from Carlson Wireless.

2.1.3 Line of Sight

Visual line of sight is the straight, unobstructed line between the Base unit's antenna and the CPE's antenna. In other words, when you look from one antenna you can see the other one. Because RF waves do not travel in a narrow beam, but spread out as they travel through space, simple line of sight is **not adequate** for a microwave path. As the waves travel out from the transmitting antenna, the signal density decreases and more area around the visual LOS is necessary to be able to receive a reasonable signal at the receiving antenna. This three dimensional space is called the RF line of sight and is described by Fresnel zones named after the French physicist who first discovered their importance.

2.1.4 Fresnel Zone

The first Fresnel Zone is the football shaped volume area, around the line-of-sight, that radio waves spread into after they leave the antenna.

Trees, buildings, mountains and any number of other objects can occupy the Fresnel Zone. The curvature of the earth, even for some short paths, also tends to put the ground into the Fresnel Zone. These objects can either reflect or absorb the signal traveling between antennas. A rule of thumb is that the center **(60% of the first Fresnel Zone) must be free of any obstruction for tolerable attenuation of the signal.** It is better to have the first Fresnel zone entirely clear of any objects. For paths over water, it is recommended that the entire first Fresnel Zone be clear to eliminate fading from the strong out-of-phase reflections off the surface of the water.

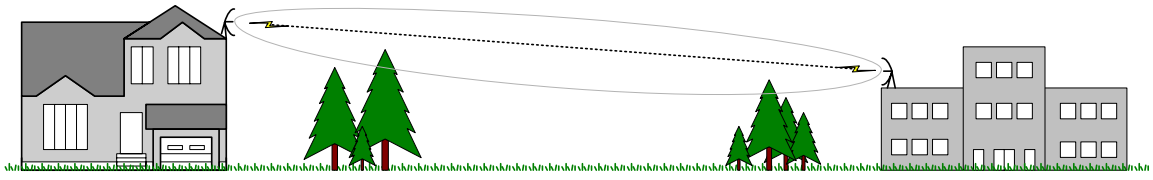


Figure 1: Line of Sight is clear, the first Fresnel Zone is NOT clear. This path will experience significant outages.

2.1.5 Path Loss

After confirming line of sight and adequate Fresnel Zone clearance, add the Free Space Loss of the radio signal, RF cable losses and antenna gains to determine your system's remaining signal, i.e. fade margin. The chart below shows various antenna and distance combinations.

Distance in miles	Distance in km	Bandwidth in kb/s	Ant1 Gain in dBi	Ant2 Gain in dBi	RF cables in dB	Freq in GHz	FRSPL in dB	RF power in dBm	ERP in dBm	Rx Thrshld in dBm	Link Mrgn in dB
24.3	39.1	512	31.0	31.0	6.6	5.80	140	20	51	-91	22.5
1.6	2.6	256	14.0	14.0	4.0	2.45	108	20	34	-94	25.2

Table 1: Fade Margin Chart

You can also calculate your own path loss using the integrated radio link margin calculator included on the Carlson Wireless product CD in a folder called “Calculators”. This is an approximate calculation – an exact calculation includes factors such as local weather patterns and must be performed by a qualified engineer.

What’s an acceptable fade margin? The rule of thumb theory is that 10 dB of fade margin will deliver about 90% reliability and 20 dB will deliver over 99% reliability. Because there is only a small ground wave component involved in the radio propagation, the above numbers presume a clear first Fresnel Zone. A fade margin of 20 dB is suggested to overcome multi-path degradation and polarization. On long paths (over 20 miles) particularly at 4.9 GHz and 5.8 GHz, it is better to have 30 dB of fade margin.

2.1.6 Interference

The 2.4 and 5.8 GHz radio bands are unlicensed and shared. All users in the band must accept all other signals within the band, interfering or not. Devices operating in this band can become a source of interference for Trailblazer products. If the interfering signal is stationary and has a bandwidth less than 3 MHz, it will not create any significant problem even if it is 100 times (20dB) stronger than the receive threshold. If the interfering signal has a bandwidth wider than 4 MHz and is 10 times (10dB) stronger than the receive threshold, it can render channel(s) unusable. If the interfering signal is frequency hopping throughout the band, such as the LAN bridge device, and is only 1/10 (–10dB) as strong as the receive threshold, it can cause significant dropouts.

Some examples of these devices are:

Video Transmitters
Video transmitters use analog radios which are usually fixed in frequency, utilize 6 to 10 MHz of bandwidth and are low power with an ERP of less then +10dBm.

Cordless Phones
Cordless phones are narrow band and fixed in frequency (during each use), utilize 1 to 2 MHz of bandwidth, are low power with an ERP of less than +10dBm. It is strongly recommended to avoid the use of 2.4GHz cordless phones in the vicinity of Trailblazer products.

Local Area Network (LAN) Bridges
Wireless LAN devices are true spread spectrum devices. They either frequency hop, a 1 MHz bandwidth over the complete band, or utilize CDMA of 16 MHz bandwidth and are stationary. ERPs can range up to +30dBm.

Microwave Ovens
Microwave oven outputs have been measured at levels up to +20dBm ERP. The magnetrons built into the ovens cause transmission of narrow pulses that sweep the 2.4GHz band. The energy is normally concentrated in the upper half of the band between 2.450 and 2.485 GHz.

2.1.7 RF Cable Sizing and Recommendations

Before making any decisions as to which cable to use, first consider several factors; the final length of the cable, the amount of power you want the cable to tolerate, the loss factor of the cable at your chosen frequency and the outdoor climate conditions the cable will be exposed to. For most general installations with short runs, LMR400 will work fine. Heliax™ is recommended for any cable runs over 100 feet. The chart below provides the loss factor for several popular cable sizes.

Coax Cable Attenuation (dB per 100 feet)			
Cable Type	**2.4 GHz**	**4.9 GHz**	**5.8 GHz**
LMR 400	6.7 dB	9.9 dB	10.8 dB
½ inch Heliax	3.6 dB	5.5 dB	6.0 dB
5/8 inch Heliax	2.8 dB	4.2 dB	4.7 dB
7/8 inch Heliax™	2.1 dB	3.2 dB	Not recommended

Table 2: Coax Cable Loss Table

2.1.8 Audio and Data Cable Recommendations

Standard telephone twisted pair wiring (Cat 3, 4 or 5) is recommended for audio connections to the Trailblazer. The Leased Line interface and the rack mount enclosures use RJ45 connectors for the audio connections. The POTS interface in the outdoor enclosure uses screw terminals. For the Ethernet connection, CAT 5 cable is recommended. CAT 5 cable is also recommended for sync cables in installations where multiple Trailblazers are co-located.

NOTE: On the outdoor enclosure, feed the cable through the weatherproof cord grip **before** terminating it. The cord grip is too small to accept an RJ45 connector especially while occupied by other cables!

2.1.9 General Tools

- ESD Gear
- Desktop PC or Laptop Computer with Windows™
- Wrench Set
- Socket Set
- Screwdriver Set
- Multi Meter
- Butt-set or Test Telephone with Bare Wire Connection
- Wire Cutters
- Wire Strippers
- Vapor Wrap
- Electrical Tape
- Small Non-Conductive Adjustment Tool

- Safety Gear

2.2 Unpacking

NOTE: Always observe ESD precautions when handling circuit boards!

Before opening package(s), inspect the shipping box(es) and report any damage to the shipping carrier. Your package was insured and the shipping carrier will be responsible for any damage to the equipment. Unpack and compare the contents against the packing slip and inspect all for damage. Report any damage to the units or missing components to your Carlson Wireless customer service representative.

Included with your purchase are:

- The 'Quick Start Guide' helps you become familiar with your system
- The Carlson Wireless Product CD (containing the user manuals, back- up configuration software and other needed items!)
- (2) Test Antennas for bench testing
- One Serial Interface Cable per unit to connect to the GUI
- Mounting Hardware (optional)
- Optional Power Supplies, if ordered, will be pre-installed in the enclosures
- Optional Surge Protectors (RF and phone lines)
- Antennas (optional)
- Optional Batteries, if ordered, will be shipped outside the enclosure to prevent damage.

2.3 Bench Testing Instructions

Before going into the field, set up the Trailblazer units on your bench so you can become familiar with their operation, configuration and verify their functionality. Each system is shipped with a handy, full-color "Quick Start Guide" for simplified step-by-step instructions for bench testing. The following section will provide you with the same information in greater detail.

2.3.1 Setting up Your Trailblazer on the Bench

Set your units next to each other and attach the included test antennas to the 'N' female connectors on the enclosures as shown below. The units may not achieve an RF connection without these little antennas.

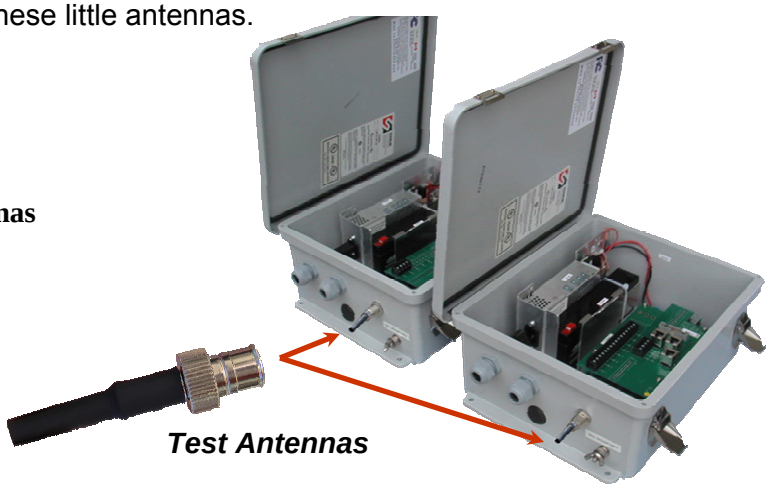


Figure 2: Test Antennas

2.3.2 Powering the Trailblazer

The Trailblazer units accept 12 -24VDC **negative ground**. If your system is equipped with a battery backup you will need to install the battery and connect the battery wires. Place the battery into the Trailblazer with the positive terminal toward the outside of the enclosure. Secure the battery with the battery bracket and the hardware supplied as shown in the figures. Make sure that the red wire is connected to the positive battery terminal.

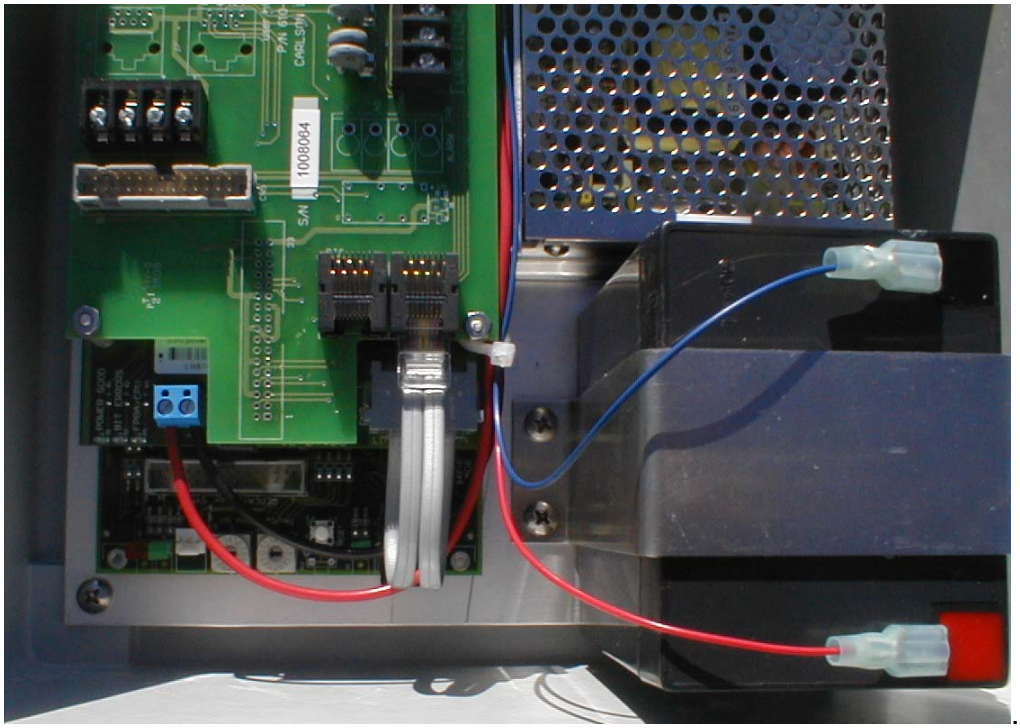


Figure 3: Outdoor Unit Battery and Power Connection

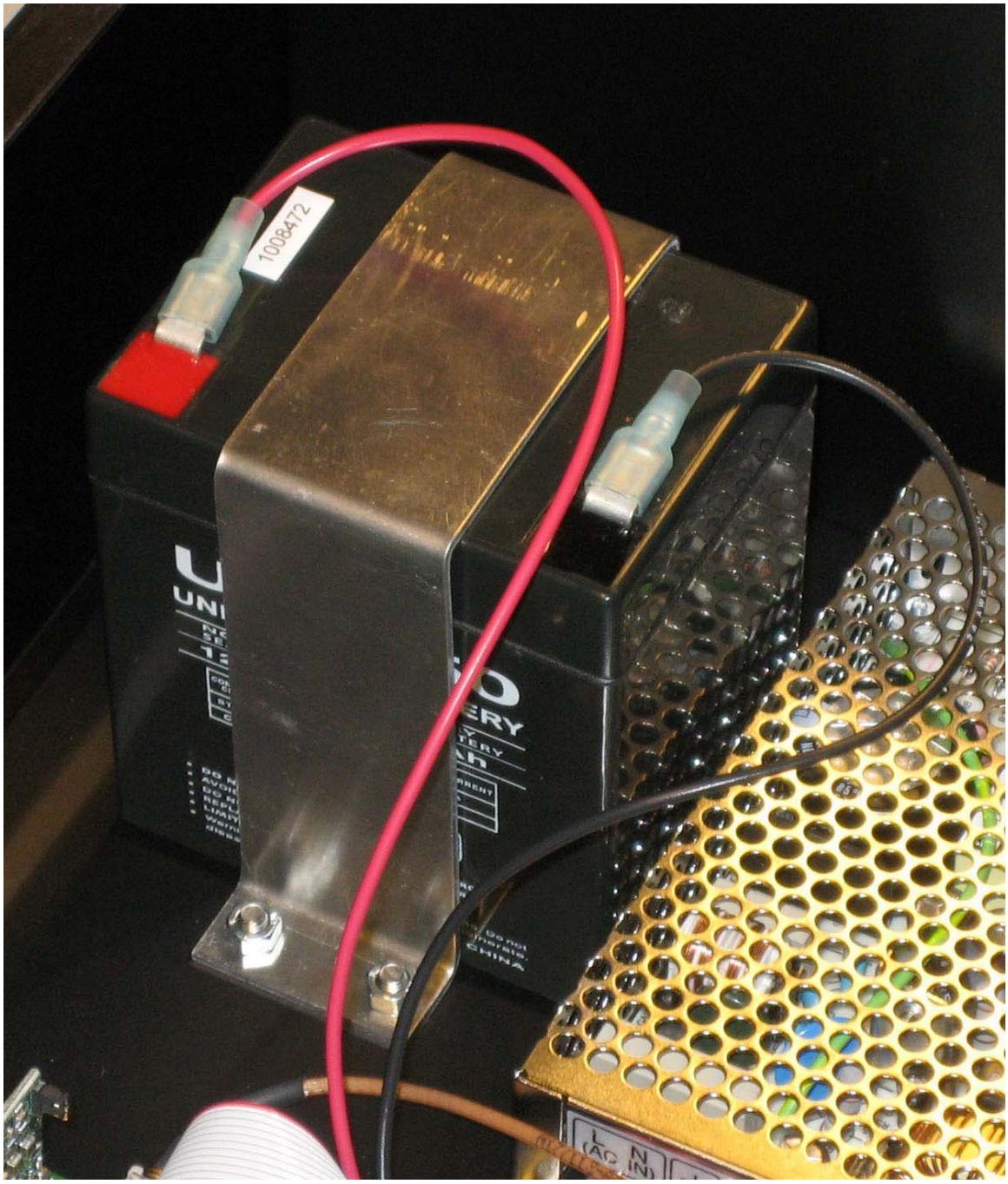


Figure 4: Rack Mount Battery Connection

If you are not using the Carlson Wireless power supply, make sure that you power the unit with 12 – 24VDC with a power supply rating of at least 10 Watts.

2.3.3 Connecting POTS Lines

Connect POTS lines as shown in the figure below using the black screw terminals on the units' interface card. Remember to connect the telephone line(s) from the phone company to the Base unit and the telephones to the CPE unit. The location of your active lines will depend on the time slots selection made by the CPE and the bandwidth

used. Note the “Active Line” label on your Base and CPE units.

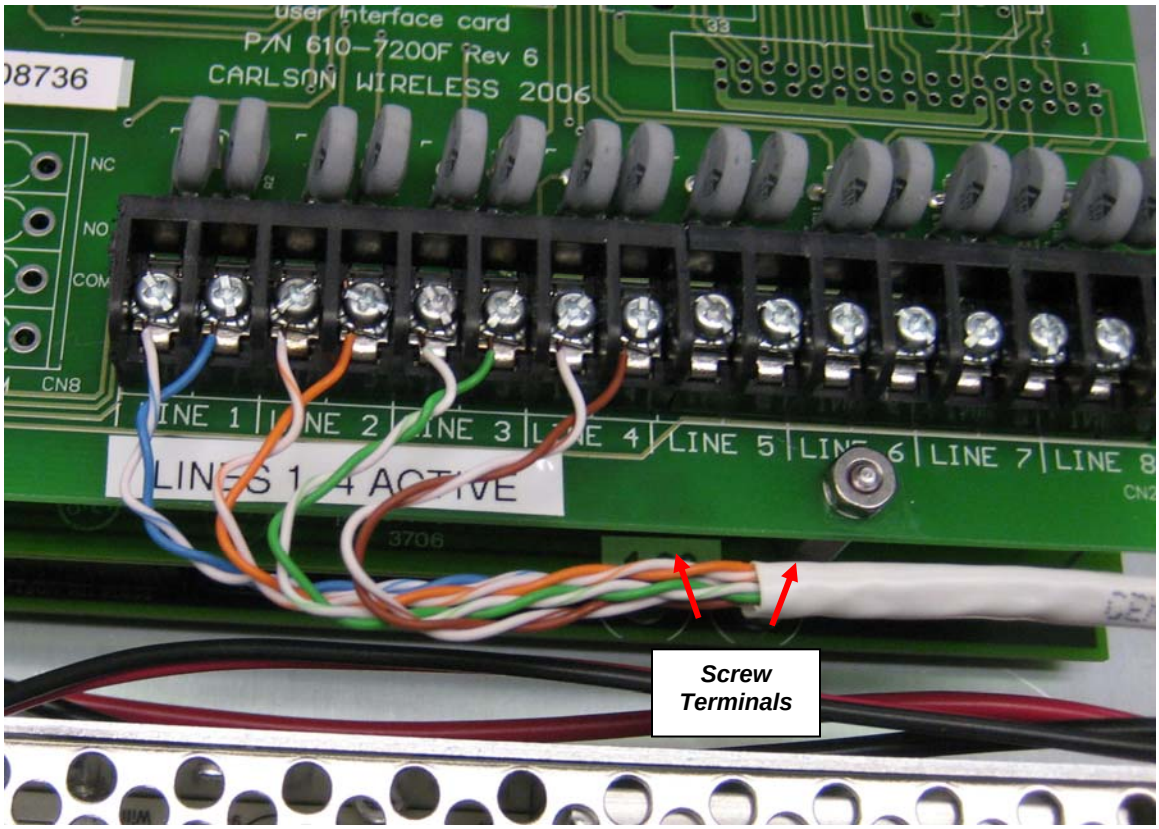


Figure 5: Telephone Line Connections

To connect POTS lines with a rack mount enclosure, see figure 5. Pins 4 and 5 on the RJ-45 connector are used for POTS lines.

2.3.4 Connecting Leased Lines

The Leased Line interface is provided for up to (8) RJ45 connectors on the User Interface card. See photo below.

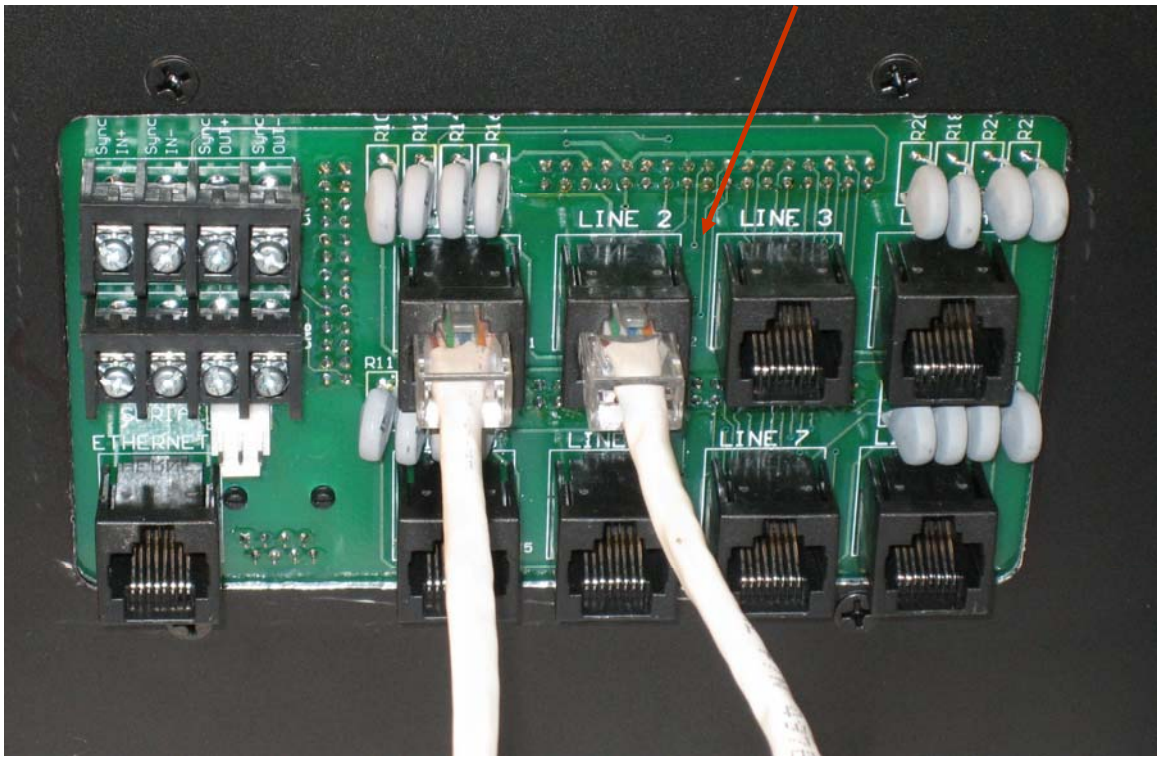


Figure 6: Telephone or Lease Line Connections

See figure below for pin out information:

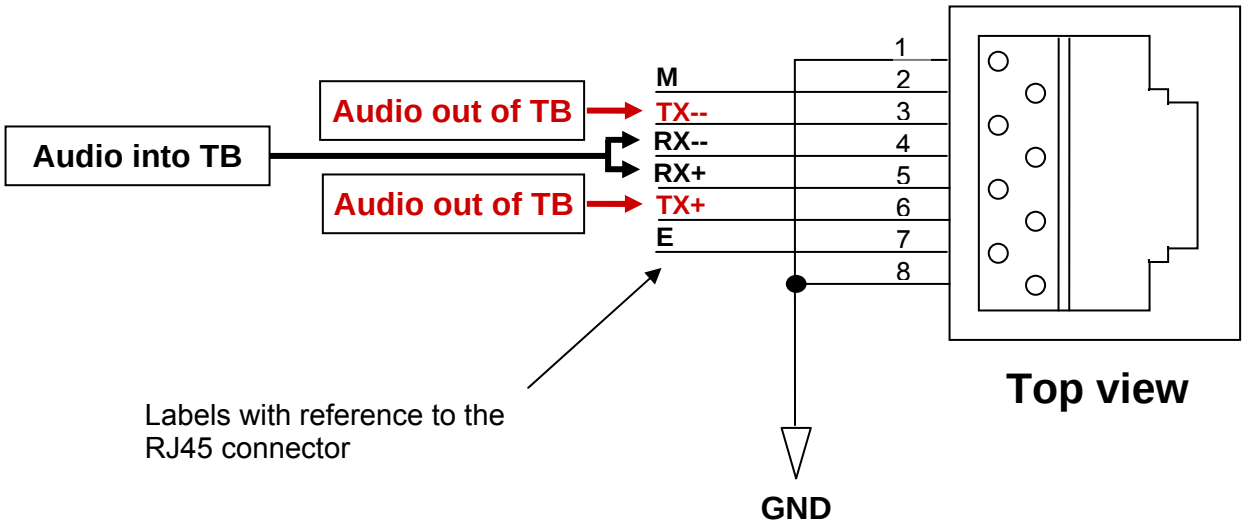


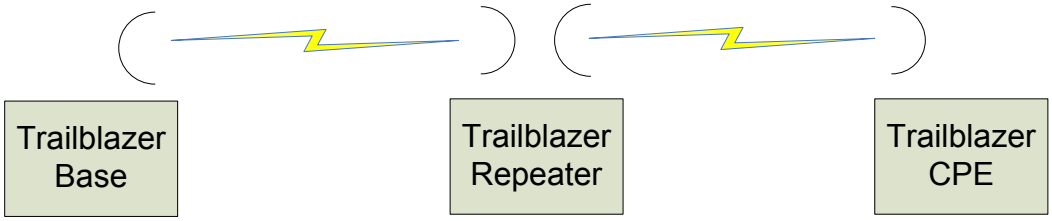
Figure 7: Pin Out Information

E&M Signaling

The Leased Line interface is equipped with Type IV E&M signaling. If the M lead is grounded on one end of the link, the E lead will go to ground on the other end of the link. The E lead can be used to activate push-to-talk circuits or change frequencies on 2-way radios, turn on lights or alarms, or activate functions on remote equipment. Each leased line carries one E&M circuit. The E lead floats at +5VDC and the driving circuit must sink 3 mA. The M lead can sink 75 mA at +/- 60V.

2.3.5 Repeater Operation

The repeater is used to work around obstructions or to extend the range of the Trailblazer. It consists of two radio cards (a master and a slave) connected digitally. More than one repeater may be used if necessary.



The repeater slave radio links with the base radio of the system and the master radio links with the CPE.

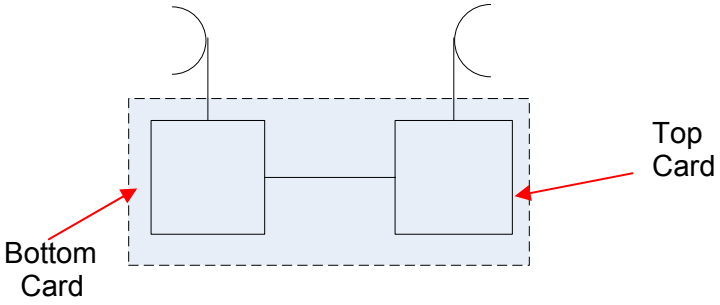


Figure 8: Repeater Operation

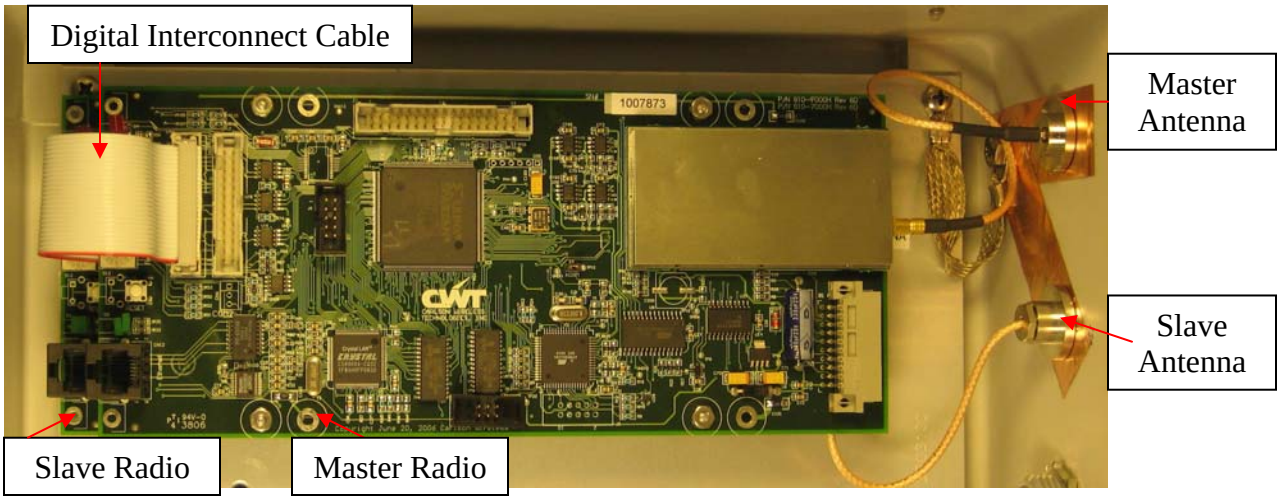


Figure 9: Repeater

The repeater timing is such that both the master and slave radios transmit and receive simultaneously. Therefore the repeater radios will not interfere with each other. It is important that both the master and slave radios have the same SFD code. The repeater cards are powered by 5V and a DC converter is used in 12V operations.

3 Operation

3.1 Configuring and Accessing the Trailblazer Unit

3.1.1 Connecting the Serial Cable

You can access your Trailblazer with the GUI program, included on the Carlson Wireless product CD, and the included serial cable. Simply plug the DB 9 connector of the serial cable into the serial port on your computer and the three pin connector to the three pin connector (COM1) on the radio board (bottom board) as shown.

NOTE: Unpredictable results may occur if you are using a USB to serial COM Port adapter!

If you find that you need to replace the serial cable contact Carlson Wireless directly, or see *Section 6.3.1* in the Appendix, for a pin-out and description on how to make one the serial cable.

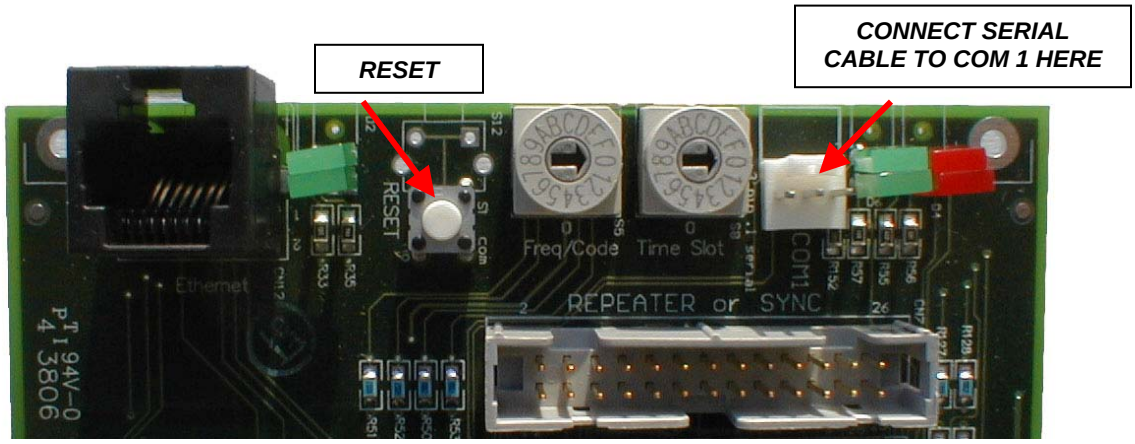


Figure 10: Connecting the Serial Cable

3.1.2 Installing the Carlson Wireless GUI on Your PC

The CD included with your system contains a folder called "GUI" with the self executing file ***Carlson Wireless Trailblazer GUI 1.0x.xxxx [ALL-OS].exe***. Browse the CD and open the file to install the GUI program on your PC. After you have successfully installed the GUI, start the program by either double clicking the ***Carlson Wireless Trailblazer GUI ver. x.xx*** file on your desktop or browse to the following: start-> programs-> Carlson Wireless Technologies Inc-> ***Carlson Wireless Trailblazer GUI ver. x.xx***

3.1.3 Using the GUI

Double click the Carlson Wireless icon and choose the appropriate COM port connected to your serial cable.

After you have selected the correct COM port, the software will display the connected unit's current configuration data.

The screen will look slightly different depending on whether you are connected to the CPE or Base unit. The box highlighted in green will display the type of unit that is currently communicating with the software. **All systems are shipped pre-configured. Do not change any parameters unless advised to do so by a Carlson Wireless technician.**

The integrated V.35 data port can be enabled and disabled here as well.

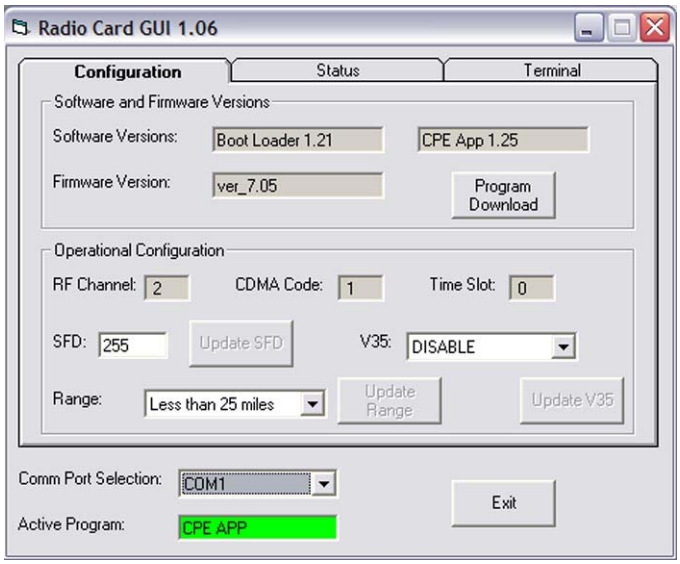


Figure 11: GUI Configuration Screen

Select the *Status* tab to view the current status of RF link, signal strength, line "hook" state, SFD loss count and an on-board temperature reading. Select DISCONNECT in the COM Port selection box before moving the serial cable to another radio card. Resume connection and status readings by selecting the active COM port. The battery voltage status only applies to CPEs equipped with solar power and connected to the solar system by a special cable. The signal strength is a relative value. A conversion table is available in Appendix 6.4.

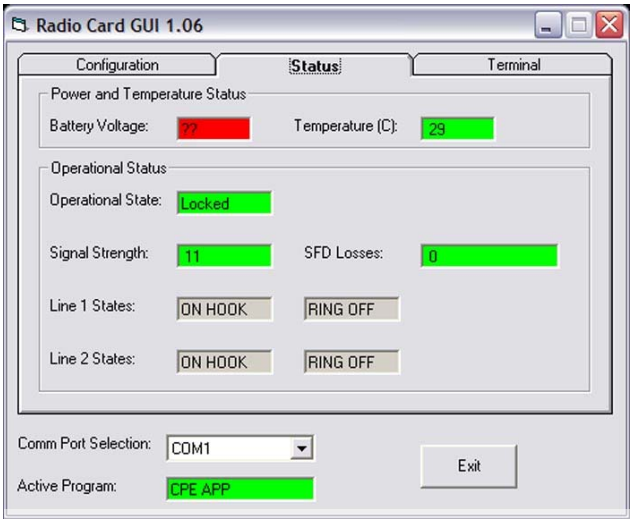


Figure 12: GUI Showing Status of a CPE

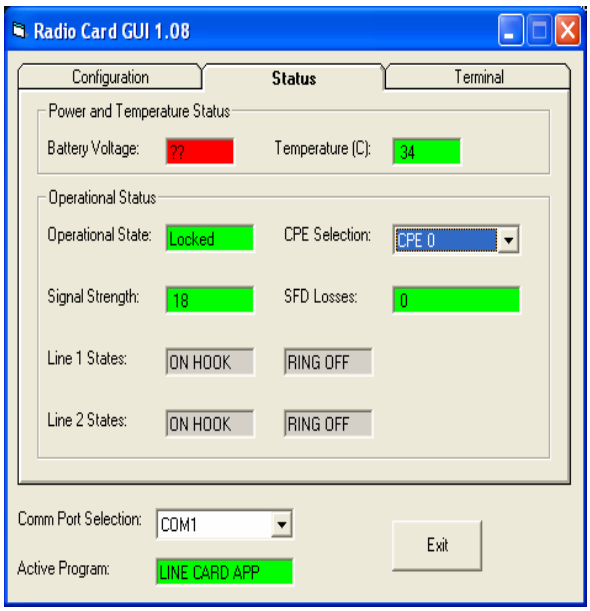


Figure 13: Base Unit Selections

The figure to the left, Figure 13, shows what the screen will look like for a base unit. Select 'CPE O' for Point-to-Point.

Click on the Terminal tab to monitor status, view and log real-time link quality reports and manually interface with the Trailblazer radio cards via the Terminal screen. In the middle of the terminal screen you will notice a command line box. One command at a time may be entered and sent to the radio card via this terminal interface or by using terminal software. If necessary, a Carlson Wireless technician may have you enter commands to aid in trouble shooting or special configurations.

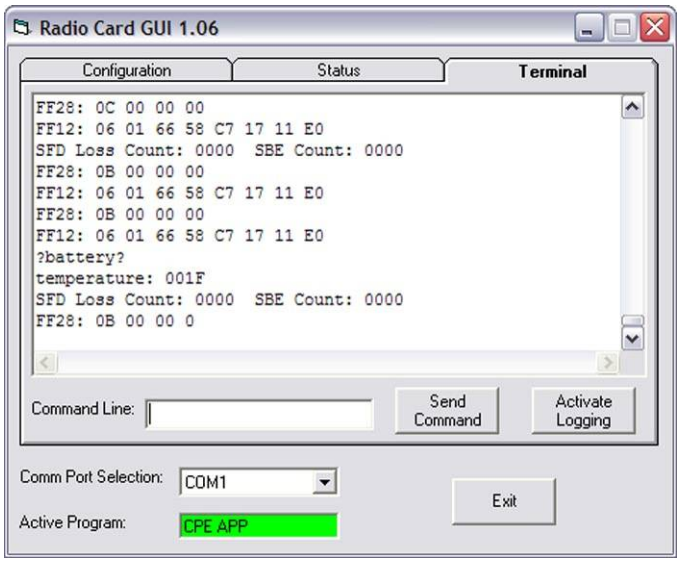


Figure 14: GUI Terminal Screen

Software Downloads Using the GUI

To download new software, (**only** if instructed by a Carlson Wireless technician) click on the "Program Download" button on the *Configuration* tab and browse to the location of the file as shown to the right. For the CPE units, use the firmware "***station_xxx***" file and the software ***CPE APPxxx.hex*** file. For the Base unit, use the firmware "***station_xxx***" file and the software ***LINE CARD APPxxx.hex*** file. Select the file, and click "Open" to start downloading.

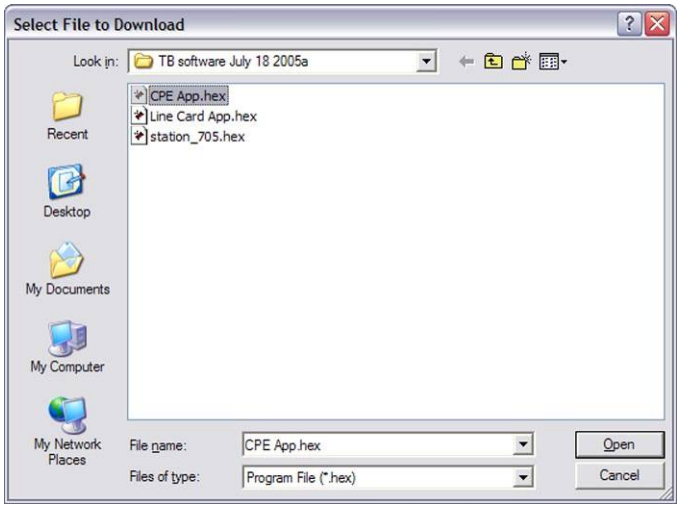


Figure 13: GUI Showing File Browser

The new CPE and Base unit software will take about one minute to download. The firmware takes about 3 or 4 minutes to download. To the right you will see a sample of what you should see during the download.

Do not interrupt the download!

When the download is complete the unit will automatically reboot and update the version. Once the "Program Download" button reappears, you can select another file to download.

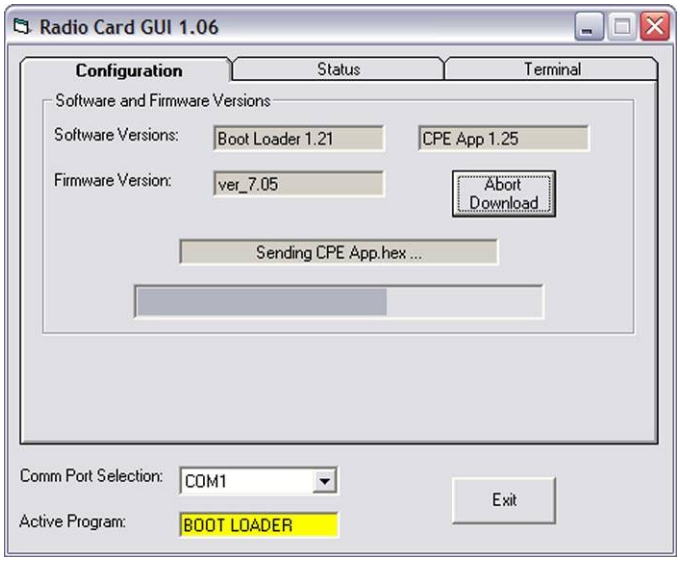


Figure 16: Loading Software with the GUI

3.2 Setting the Radio Frequency and Scrambling Code

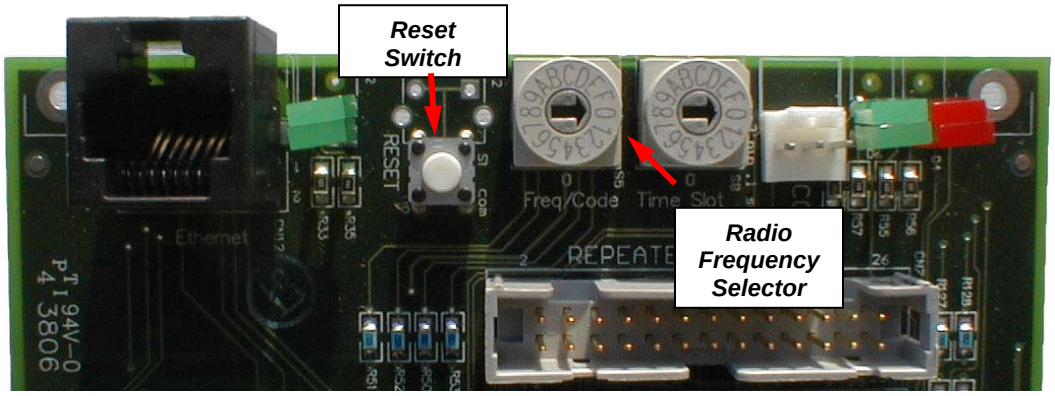


Figure 17: Frequency/Code Switch and Reset Button

The radio frequency and scrambling code of the Carlson Wireless radios operate on numerous band selections based on purchased configuration. Within the selected operational band, multiple frequencies are provided in combination with code variations. Selections within the offered band are provided using the 16 position rotary switch located between the 10BaseT port and the white three pin connectors. The tables below show the switch settings for the 16 frequency/code combinations for each band currently offered.

Channel ↘	2.412 GHz	2.432 GHz	2.452 GHz	2.472 GHz
code 0	0	1	2	3
code 1	4	5	6	7
code 2	8	9	A	B
code 3	C	D	E	F

Table 3: 2.4G International Band – Frequency/Code Switch Matrix

Channel ↘	2.414 GHz	2.430 GHz	2.446 GHz	2.460 GHz
code 0	0	1	2	3
code 1	4	5	6	7
code 2	8	9	A	B
code 3	C	D	E	F

Table 4: 2.4G Domestic Band – Frequency/Code Switch Matrix

Channel ↘	4.950 GHz	4.960 GHz	4.970 GHz	4.980 GHz
code 0	0	1	2	3
code 1	4	5	6	7
code 2	8	9	A	B
code 3	C	D	E	F

Table 5: 4.9G Public Safety Licensed Band – Frequency/Code Switch Matrix

Channel ↘	5.735 GHz	5.765 GHz	5.795 GHz	5.825 GHz
code 0	0	1	2	3
code 1	4	5	6	7
code 2	8	9	A	B
code 3	C	D	E	F

Table 6: 5.8G Low Band – Frequency/Code Switch Matrix

Channel ↘	5.750 GHz	5.780 GHz	5.810 GHz	5.840 GHz
code 0	0	1	2	3
code 1	4	5	6	7
code 2	8	9	A	B
code 3	C	D	E	F

Table 7: 5.8G High Band – Frequency/Code Switch Matrix

3.2.1 Selecting the CPE Time Slot

Up to (4) CPE units can communicate with each Base unit when used in a STAR topology. To distinguish between the four CPEs, a different time slot is allocated to each CPE using the rotary DIP switch located immediately behind the LEDs as shown in the figure below. Use a **non-conductive** trim tool to select time slots 0, 1, 2 and 3 to avoid shorting any components. Reset the unit to put your selection in effect by pressing the reset button located behind the second white three pin connector as shown.

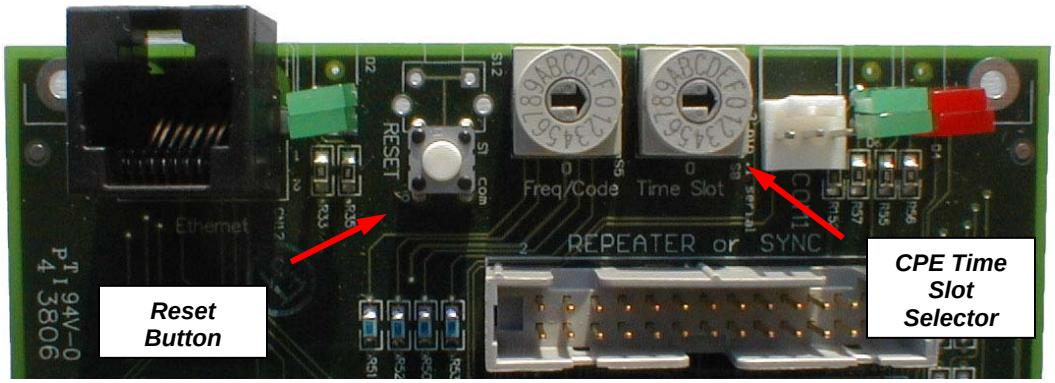


Figure 148: CPE Time Slot Selection Switch

4 Field Installation Options

4.1 Mounting the Enclosure

The versatile mounting bracket assembly (PN: 900-7200) allows the Trailblazer enclosure to be properly mounted on a pole up to 2.25" in diameter. The mounting bracket assembly also converts to a wall mount for mounting the Trailblazer enclosure on a flat surface. See below for details for the two different mounting applications.

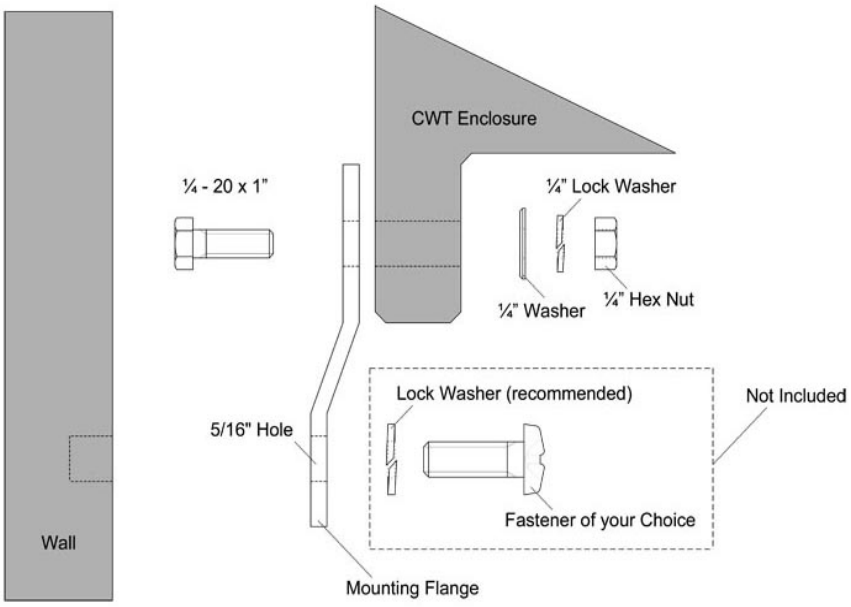


Figure 19: Wall mounting the Trailblazer enclosure

Wall Mounting Instructions:

- Attach the mounting flanges to the enclosure using the ¼ -20 x 1" bolts, ¼" flat washers, ¼" lock washers and ¼" hex nuts.
- Tighten the ¼" nuts to maximum of 25 in-lbs (2.1 ft-lbs). **Do not over tighten!**
- Position the enclosure on the wall.
- It is recommended that you attach the enclosure to the wall using a lock washer and fasteners of your choice as shown in figure 18 above.
- Tighten the fasteners of your choice. **Do not over tighten!**

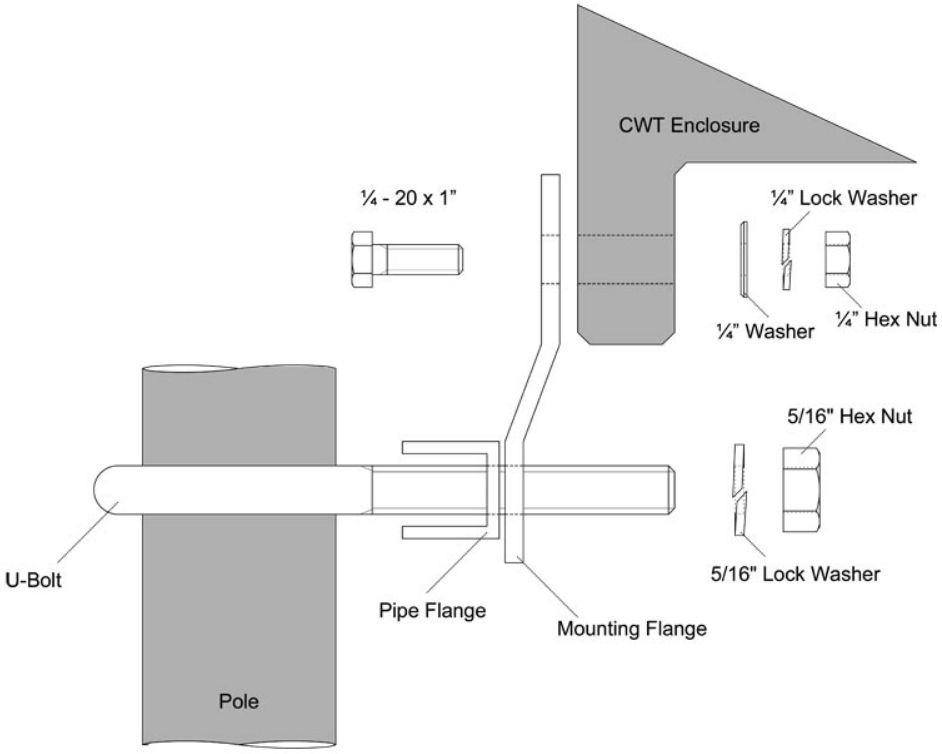


Figure 20: Pole Mounting the Trailblazer Enclosure

Pole Mounting Instructions:

- Attach the mounting flanges to the enclosure using the ¼ -20 x 1" bolts, ¼" flat washers, ¼" lock washers and ¼" hex nuts.
- Tighten the ¼" nuts to maximum of 25 in-lbs (2.1 ft-lbs). **Do not over tighten!**
- Position the enclosure on the pole.
- Place the U-bolts around the pole, and slide the pipe flanges over them with the serrated sides facing the pole. See figure 19 above.
- Apply an anti-seizing compound to the threads of the U-bolts.
- Slide the mounting flanges (now attached to the enclosure) over the U-bolts and secure using the 5/16" lock washers and 5/16" hex nuts.
- Tighten the 5/16"nuts. **Do not over tighten!**

4.2 External Antennas

The use of an external antenna with a Trailblazer system mandates professionally trained personnel to ensure compliance with FCC rules and regulations. Specifically the installer must ensure that the EIRP of the transmitting antenna does not exceed the requirements of the Code of Federal Regulations, Title 47, paragraph 15.247.

This device has been designed to operate with antennas having a maximum gain of 26 dB. Antennas not having a gain greater than 26 dB are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

WARNING! YOU CAN BE KILLED!

The Trailblazer system is designed to be installed by professionally trained installers only! Failure to follow basic installation procedures and safety precautions can result in one or all of: damage to tools and/or equipment, interference with and/or damage to other equipment or accessories, violation of safety code, local laws and/or building codes, personal injury or even death.

Detached antennas, whether installed indoors or out, should ONLY be installed by experienced antenna installation professionals who are familiar with local building and safety codes and, wherever applicable, are licensed by the appropriate government regulatory authorities. Failure to do so may void the Carlson Wireless product warranty and may expose the end user to legal and financial liabilities.

Regulations regarding maximum antenna gains vary from country to country. It is the responsibility of the end user to operate within the limits of these regulations and to ensure that the professional installer is aware of these regulations, as well.

Installations of the Trailblazer System require topographic analysis, site survey and link budget calculation; therefore trained professionals are required to perform the installation.

4.2.1 Marketing and Sales Channels

Carlson Wireless DOES NOT sell the Trailblazer PRO direct to end users. iWLL Trailblazer PRO System will be sold only to Carlson Wireless' Authorized Resellers. Those authorized resellers are technically trained by Carlson Wireless' Engineers on a periodic basis and must follow the rules set by Carlson Wireless. The Trailblazer PRO system is designed for Long Range (15-35 miles) applications and it involves a complicated mandatory site survey, roof top mast installation, high gain antennas, accurate antenna alignment, etc. Those activities can ONLY be performed by professional installers that are familiar with the FCC regulations. Carlson Wireless does not sell the Trailblazer PRO in the consumer market. Carlson Wireless has no resellers in this market and we do not advertise in consumers based publications or attend consumer oriented trade shows. The system will be advertised ONLY in technical trade shows and magazines.

4.2.2 Calculating the EIRP of an External Antenna

For all frequency bands of the Trailblazer TB series digital radio, the peak power is calibrated at the factory to be at maximum +17dBm.

Using this example one can calculate the following:

Note that the radio is calibrated for a maximum output power of +17dBm.
Subtract the interconnecting cable and lightning protection losses of 2dB = total power arriving to antenna of 15dBm. Now add the 2.4 GHz panel antenna gain of 18dBi and this will give the total Effective Isotropic Rated Power of 33dBm.

For 2.4 GHz, the FCC uses a “3 for 1” rule. The “3 for 1” FCC rule states that for every 3dB above 6dB of antenna gain you must lower the maximum RF power available to the antenna from +30dBm (1 watt) by 1dB. In this example the antenna gain is (18 – 6) 12dBi above 6 or (12 / 3) or 4 times 3dB above 6dB. Checking to see if the transmit power meets the rule is done by subtracting 4 from +30dB equaling +26dBm. This transmitter output RF power is set to +17dBm so it is below the limit.

For 5.8 GHz, the FCC allows a maximum EIRP of 50dBm. This would mean that an antenna with a gain of 33dBi would be acceptable with no cable losses.

For 4.9 GHz, the FCC allows a maximum EIRP of 42dBm. If you had no losses in between the radio and were using the supplied 22 dBi gain panel antenna you would have an ERP of 39dBm which is under the maximum of 42.

Following this guideline ensures compliance with the maximum transmitter ERP allowed with the antenna provided as a system.

4.2.3 RF Safety Hazard Warning

Due to the substantial amount of energy radiated from these antennas, it is imperative that the antenna never be mounted closer than 2 Meters (6.7 Feet) from any persons.

4.3 18dBi 2.4 GHz Directional Flat Panel Antenna

This section is designed to support the installation, operation and maintenance of the 18dBi directional flat panel antenna. CWT recommends this antenna because of its small size, ease of mounting and low maintenance. To avoid harm to persons or damage to the product please ensure that you have read the safety, unpacking and installation sections before proceeding.

4.3.1 Product Overview

Refer to the "Product Specifications" Section for exact specifications and characteristics.

Key Features and Benefits:

- Small size
- Patented printed circuit board design with best performance-to-price ratio
- Attractive, low profile UV stable housing that requires minimal maintanace and blends well with indoor and outdoor environments where aesthetic considerations are important
- Corner exit RG-58/U pig-tail design permits the panel to be mounted in vertical or horizontal polarity
- Adjustable, heavy-duty mounting brackets provide maximum flexibility, stability even in high wind conditions and easy mounting

4.3.2 Unpacking

The 18dBi directional flat panel may be packaged and shipped with other items included. Thoroughly inspect the package and the antenna for damage and immediately report any damage to the shipper.

4.3.3 Mounting

The MPAB8 tilt mounting bracket, included with the antenna, is used to provide down or up-tilt mounting to a mast up to 2.88 inch O.D. (2.5inch schedule 40 pipe).

Recommended tools for installation:

- (1) 7/16" wrench or #2 Philips screw driver
- (1) 9/16" open end wrench
- Vapor wrap and electrical tape for weatherproofing. See section 4.5
- Cable ties

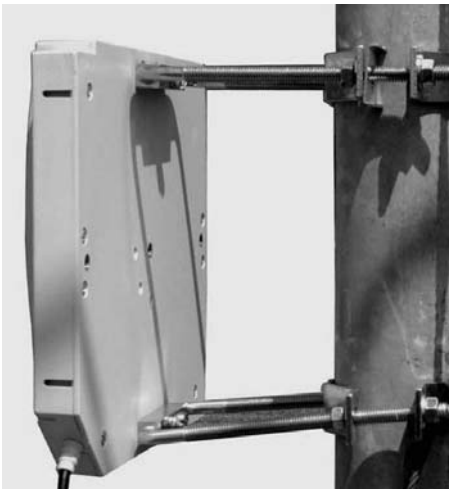
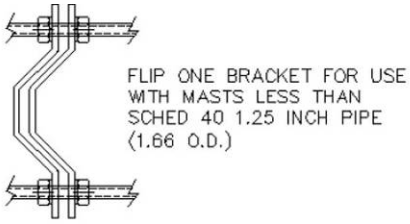


Figure 21: MPAB8 Tilt Mounting Bracket

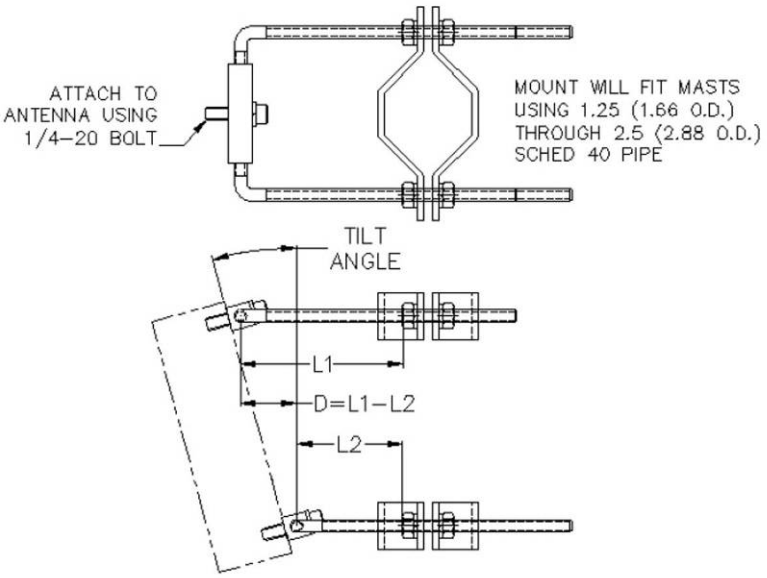
This is a properly mounted panel antenna. Note the ability of the mount the aim the antenna up tilt or down tilt.

Figure 22: Assembly

1. Assemble the mount to the antenna using the hardware provided as described in the diagram to the right.



2. Adjust the nuts nearest the antenna to positions that will provide the tilt angle required. Use the mounting diagram *(right)* with the table below to roughly align the antenna to your position requirements.



3. Assemble the antenna to the mast as shown at left. Fine adjustment to the tilt angle can be made after the antenna has been mounted to the mast. Spacing references for **downtilt** (L1, L2) will be as shown *(left)*. Spacing references for **uptilt** (L1, L2) will be ***opposite*** as shown.

Once the antenna has been mounted, aligned and tested be sure to properly complete the installation by weatherproofing the cable connections. See Section 4.5 23dBi 5.8GHz Directional Flat Panel Antenna. This antenna is similar to the 18dBi 2.4GHz antenna except that it is properly polarized when the arrow on the back indicates a vertical line.

4.4 22dBi 4.9 GHz Directional Flat Panel Antenna

This antenna is similar to the 18dBi 2.4 GHz antenna except that it is properly polarized when the arrow on the back indicates a vertical line. This alignment results in a diamond shape presentation.

4.5 23dBi 5.8 GHz Directional Flat Panel Antenna

This antenna is similar to the 18dBi 2.4 GHz antenna except that it is properly polarized when the arrow on the back indicates a vertical line.

4.6 24dBi 2.4 GHz High-Gain Parabolic Grid Antenna

This section is designed to support the installation, operation and maintenance of the 24dBi high gain parabolic grid antenna used for extended range or improved fade margin and/or adjacent signal rejection with the Trailblazer. Carlson Wireless recommends this antenna because it has been used in many successful field installations over the years. To avoid harm to persons or damage to the product please ensure that you have read the safety, unpacking and installation sections before proceeding.

4.6.1 Product Overview

Refer to the "Product Specification" Section for specifications and characteristics.

Key Features and Benefits:

- Welded, galvanized steel with a gray epoxy powder coat that blends well with any background
- 50 Ohm patented passive feed dipole
- Includes reflector
- Horizontal or vertical mounting
- Type N female connector
- Rugged, lightweight and waterproof
- Heavy-duty adjustable mounting brackets for 1 to 2.5 inch diameter poles that provide stability even in high wind conditions

4.6.2 Unpacking

Despite careful packaging, the size of these antennas invites mistreatment by shippers. Please inspect the packages thoroughly and report any damage to the box to the shipper before opening. The 24dBi high gain parabolic grid antenna will arrive in one box approximately 36 X 30 X 8 inches (92 X 76 X 20 cm). Small amounts of feed cable may also be included in this box if ordered.

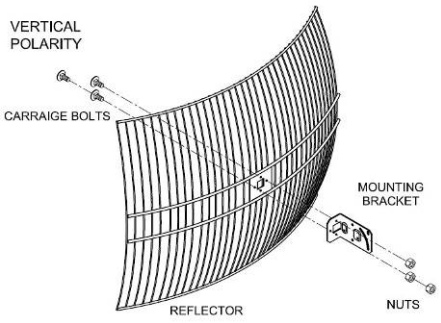
The N-Female to N-Male 36" coax cable is taped to the grid reflectors whose corners are padded. Another box containing the mounting bracket, clamp and hardware, extension tube, and dipole is taped to the bottom.

4.6.3 Mounting

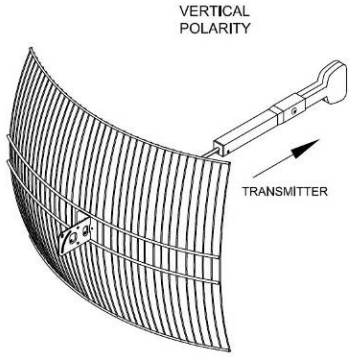
Recommended tools for installation:

- (1) 7/16" wrench
- #1 Philips screw driver
- (1) 9/16" open end wrench
- Vapor wrap and electrical tape for weatherproofing. See section 4.5
- Cable ties

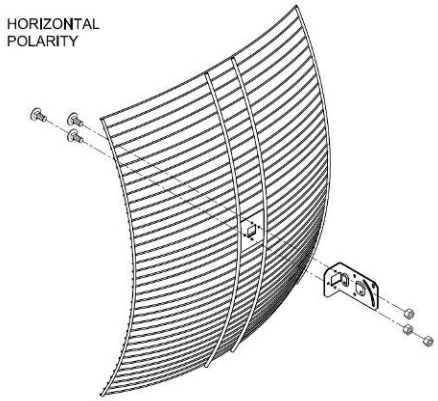
NOTE: *We recommend assembling the antenna, except for tightening the U-Bolts, while* ***on the ground!***



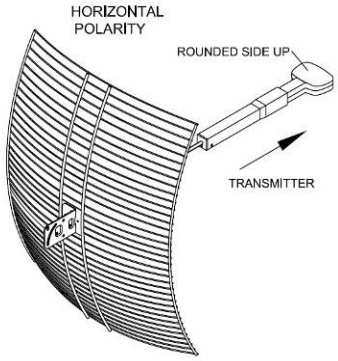
Installing the mount for Vertical Polarity



Installing the dipole for Vertical Polarity



Installing the mount for Horizontal Polarity



Installing the dipole for Horizontal Polarity

Figure23:

Mounting of 24dBi High-Gain Parabolic Grid Gain Antenna (horizontal or vertical)

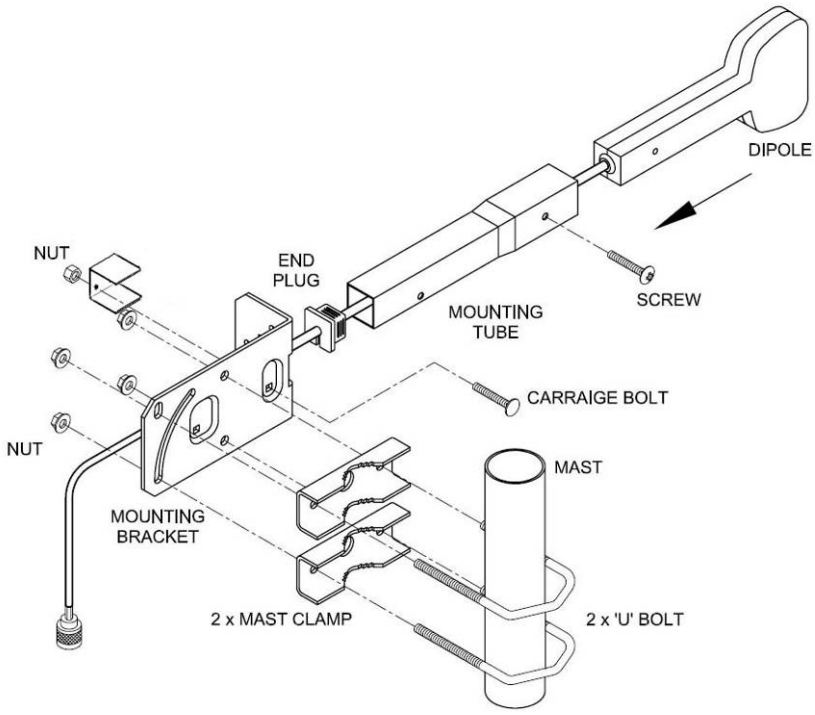


Figure 24: 2.4 GHz 24dBi Dipole Assembly Procedures (Vertical Polarity)

4.7 Weatherproofing RF Connections

Once you have mounted and secured your antenna, we recommend completing the installation by properly weatherproofing the RF connector. The connector will be waterproof, durable, and easy to service if it needs to be removed. You will need:

- Electrical tape
- Rubber tape (butyl), a thick, sticky sealing tape commonly known as "vapor wrap". We recommend 3M 3339 tape.

Step 1. Connect Cable Assembly to Antenna or Enclosure

Attach the RF cable to the enclosure by fastening the N-type Male connector to the N-type Female connector. Note: Ensure both connectors are clean and dry, the hand-tighten the connector firmly.

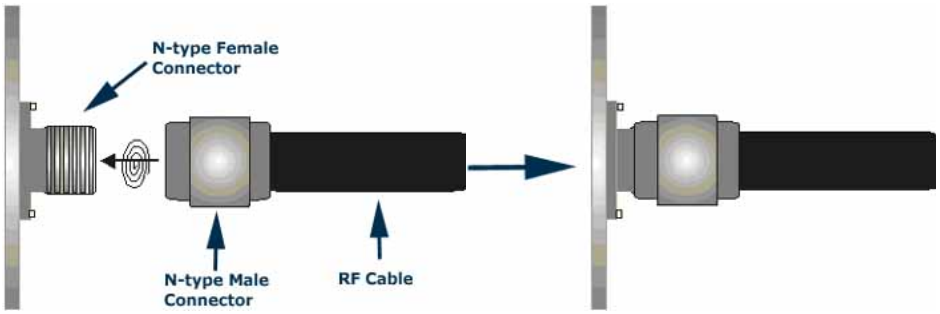


Figure 25: Connect Cable to Antenna

Step 2. Sealing the Connector Assembly

1. Tightly wrap the connectors with one layer of electrical tape and extend 0.5 inch beyond the N-type Male connector. This step is highly recommended, as it will make removal of the weather proofing much faster, easier and less messy.

2. Tightly wrap the connectors with two layers of vapor wrap. Note: The vapor wrap should seal entire connection and extend 1.5 inches beyond N-type Male connector (1inch beyond electrical tape). It is important to cover all of the underlying electrical tape or water could creep in underneath the vapor wrap.

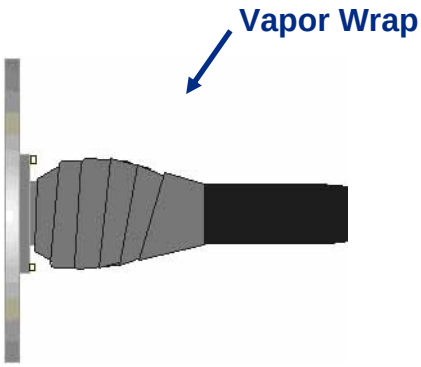


Figure 26: Sealing the Connector Assembly

Step 3. Covering Rubber Tape with Electrical Tape

Tightly wrap the rubber tape with 2 layers of electrical tape to protect the vapor wrap. Note: The electrical tape should extend 1 inch beyond the vapor wrap to ensure full coverage. You can easily remove the weatherproofing by cutting down one side of the wrap and peeling it away.

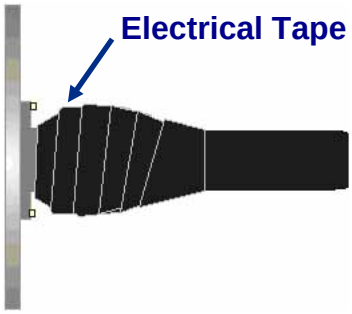


Figure 27: Covering Rubber Tape with Electrical Tape

4.8 Antenna Alignment

Rough alignment: This is fairly straight forward. Since it is a prerequisite that you have line of sight between the two points, here are several ideas that have worked for installers:

- Aim the units towards each other
- During midday, use a mirror or compact disk to create a reflection directed towards the other site while someone watches for the flash
- Plot out the path on a topographical map and set the antennas using a compass

How close in alignment do the antennas need to be? +/- 10 degrees will be adequate for most paths using a 14dBi gain antenna. With high gain antennas, +/- 1 degree may be necessary.

Alignment indicators: Due to the nature of digital modulation and the associated circuitry, there is no analog test point at which the signal strength can be monitored. You must have the GUI hooked up so that the signal strength can be seen. Align the antennas, one at a time, both vertically and horizontally, until the maximum signal strength is attained.

4.9 Interference Solutions

Sometimes, after installation, interference problems develop with external devices, and/or external devices are later installed that affect the Trailblazer. To determine if the Trailblazer is an interferer, power down the radio unit and check if the interference is eliminated. To determine if an external device is interfering with the Trailblazer, shut down suspected devices while listening to an audible tone (such as dial tone) on a phone connected to the Trailblazer.

Common Interferers: Microwave ovens, wireless household controls, cordless telephones, wireless video products, wireless LANs, laptops with wireless LAN capability, etc.
(Refer to Interference Section 2.1.6 for additional information)

Before calling the manufacturer, the installer is encouraged to try correcting the problem by trying one or more of the following suggestions:

- Slightly reorient or move the Carlson Wireless antenna to a new position
- Change the frequency of the Carlson Wireless radio or offending device
- Relocate the offending/offended device
- Separate power sources, or filter sources between the offenders
- If not an installer, please consult the dealer or experienced technician
- Inquire about switching to a different frequency band (2.4Ghz to 5.8GHz or vice versa)

4.10 Lightning Protection

The most common source of damage to the Trailblazer products is lightning induced power surges. Almost all failures in the field can be attributed to these surges. A lightning strike generates tremendous currents whenever it touches down. These currents travel through towers, pipes, telephone and power wires, trees, lakes, rivers and the ground. The Trailblazer (and any other equipment connected to the telephone network) must be protected from these current surges by a two stage protection network—primary protection and secondary protection. The secondary protection is internal to the Trailblazer and is intended to protect the equipment only from the residual surges that make it through the primary protection. The installer is responsible for the installation of primary protection. Primary protection must be installed on the power, telephone, data and antenna lines.

Telephone lines from the phone company often run for many miles on telephone poles or under ground.

Protecting the Trailblazer from in-coming surges from the antenna line, Carlson Wireless stocks both in-line gas-tube and shorted stub style coaxial lightning surge suppressors as primary lightning protection. These are sold as optional items.

In-line protectors mount in series with the coaxial cable or telephone line which provides an excellent solution for a retrofit application. The protector is grounded through an external ground screw that is attached to the body of the surge protector.

4.10.1 Antenna Port Protection

The antenna is normally mounted high on a tower and is subject to lightning surges when lightning strikes the tower. Alternately, lightning can strike near a tower and a momentary potential difference of thousands of volts can exist between the tower ground

and other nearby ground systems causing current surges through ground and antenna wiring.

To protect against these current surges, a coaxial lightning protector must be installed in the antenna line as primary protection. The coaxial protector is installed at the Trailblazer antenna port (if the Trailblazer is mounted outside) or at the grounded antenna entry point of the building (if the Trailblazer is mounted inside.) There are two types of coaxial protectors, the gas discharge type and the shorted stub type. Shorted stub protectors are more reliable and capable of protecting against more powerful surges. Gas discharge protectors are more delicate and can fail with no visible damage. Gas discharge protectors should only be used if an RF preamp is used at the antenna because, unlike shorted stub protectors, they pass the DC power that is used by the preamp.

The coaxial lightning protector must be grounded by connecting a ground wire (usually #8 AWG solid) to the ground screw on the body of the surge protector. The other end of the ground wire must tie into the tower ground system. In-line lightning protectors need to be sealed from moisture which can enter them through the grounding screw. Carlson Wireless recommends wrapping the lightning protector in vapor wrap as previously discussed.

RF Gas Discharge Lightning Surge Protector Specifications (2.4 GHz)	
CWT Part number	640-6600
Description	High Frequency co-axial surge protector (Gas tube)
Maximum power (50 Ohms)	70 W
Breakdown Voltage (100 V/s)	90-130 V
Residual Voltage (1 kV/µs)	< 600 V
Power Handling (8/20 µs waveform) 10 shocks 1 shock	 10 kA 20 kA
Return Loss and Attenuation @ 0.5 GHz @ 1 GHz @ 4 GHz	 < -25 dB < -25 dB < -20 dB
Insertion Loss @ 0.5 GHz @ 1 GHz @ 2.5 GHz @ 4 GHz	 < 0.05 dB < 0.03 dB < 0.067 dB < 0.29 dB
Connector Type	"N"
Housing Material	Copper alloy with CuZnSn finish
Contact Sockets Material	Gold Plated Copper alloy
Insulation Material	Teflon per ASTM-D-170

Table 8: Gas Discharge Protector Specifications

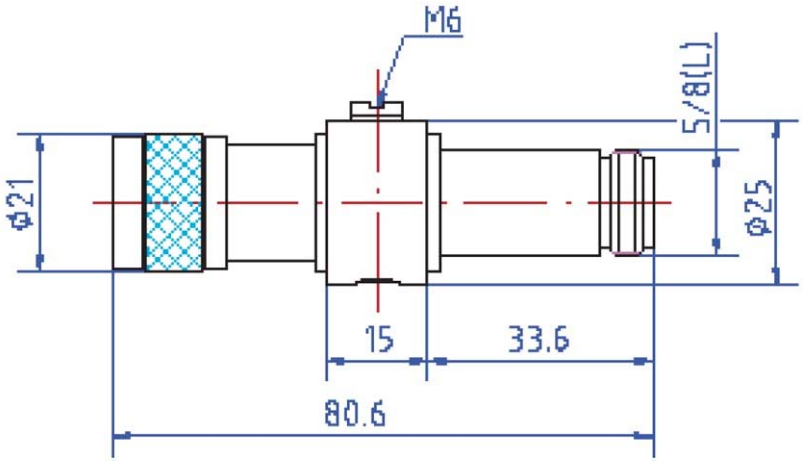


Figure 28: Gas Discharge Protector Dimensions

RF Shorted Stub Lightning Surge Protector Specifications	
CWT Part number	640-6549, 640-6558
Description	High Frequency co-axial surge protector (shorted stub)
Maximum power (50 Ohms)	100 W
Power Handling (8/20 µs waveform)	50 kA
Power Handling (1.2/50 µs waveform)	70 kA
VSWR (4.2 – 5.0 GHz)	< 1.3:1
VSWR (5.6 – 6.0 GHz)	< 1.2:1
Impedance	50 Ohms
Frequency Range	4.0 – 6.0 GHz
Connector Type	"N"
Housing Material	White Bronze

Table 9: RF Shorted Stub Lightning Surge Protector Specifications

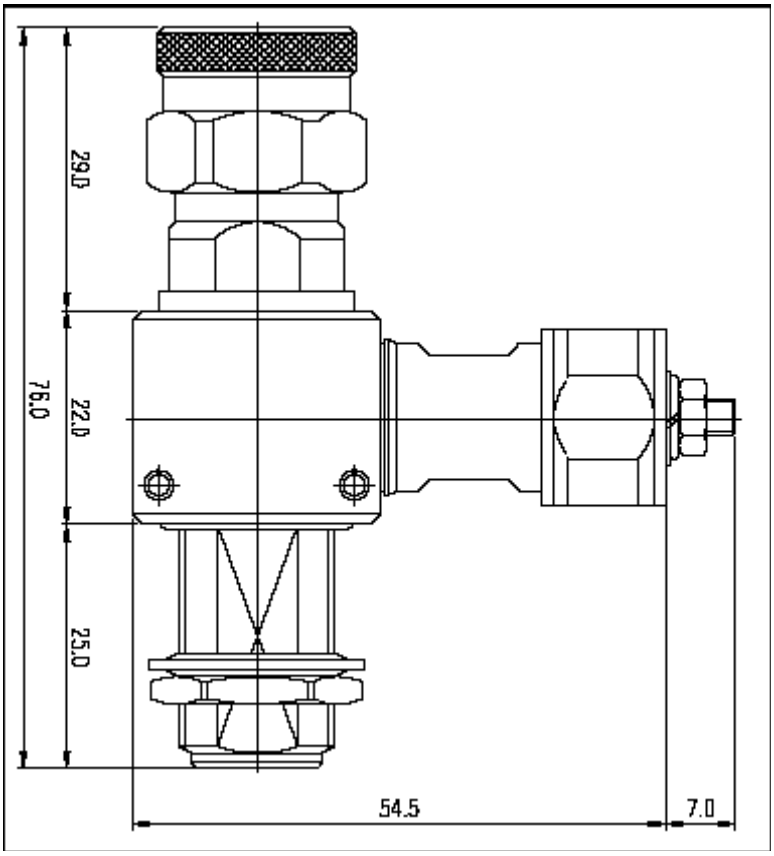


Figure 29: Shorted Stub Protector Specifications

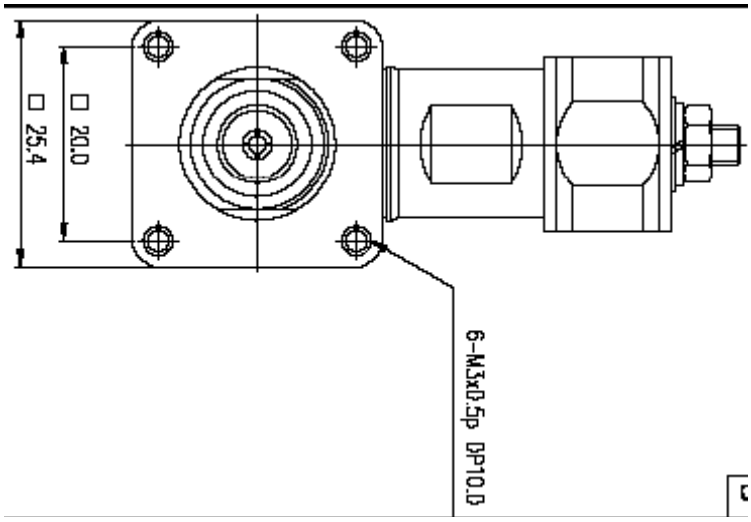


Figure 30: Shorted Stub Protector Dimensions

4.10.2 Telephone Line Surge Protection

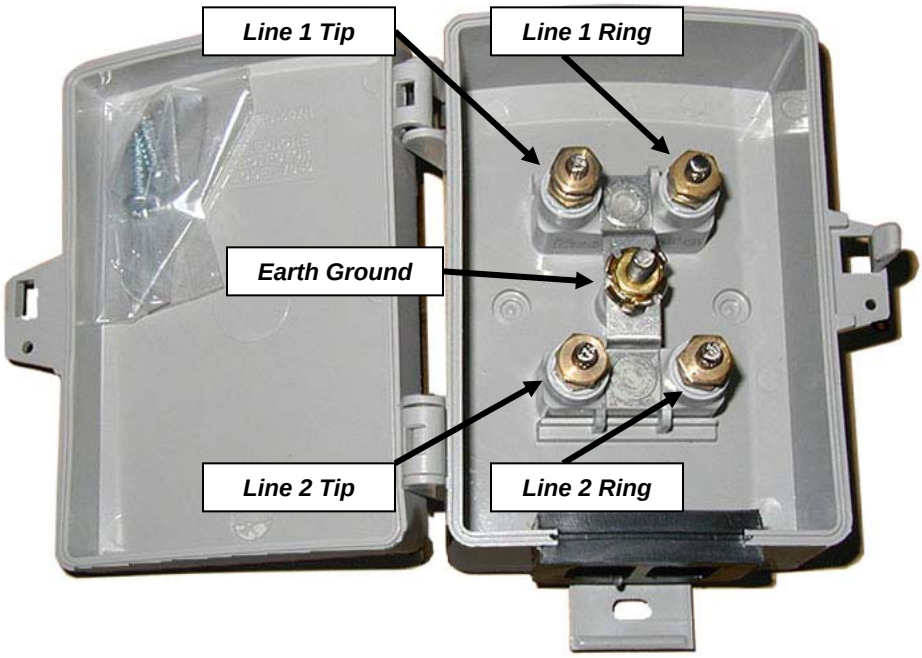


Figure 31: Primary Telephone Line Transient Protection

The most common entry point for lightning induced power surges is the phone line coming from the telephone company. These lines often travel above ground for many miles and are subject to lightning strikes along their entire length. The CPE should also have primary lightning protection installed at both ends of the line if the wiring travels outside or between buildings. It is critical to always install primary protection at the customer end of the wiring to prevent possible electrocution of the customer when lightning strikes near the equipment. It is also important to note that the secondary protection on the CPE is active protection and only works when the CPE is powered up. If the CPE is ever left un-powered, the phone, antenna and power lines should all be disconnected to protect the circuitry in the CPE.

Carlson Wireless recommends using telephone line surge protectors for all active phone lines and leased lines. The telephone line surge protector is designed to be used as a primary station protector at both the base and the subscriber ends of a system and works with the secondary on-board lightning protection. Its plastic enclosure is weather and fire resistant and the surge protector provides protection against lightning surges, power/telephone line cross conditions and ground potential surges. Plated #10 brass studs, washers and hex nuts provide the connection to the two phone lines. There is also a sectionalized grommet for wire entry. See figure 12 for details on connecting the phone lines.

The surge protector element for each line consists of:

- Heavy-duty, (2) element gas tube
- External backup gap assembly
- Unique switch grade shorting mechanism

Telephone Line Gas Discharge Lightning Surge Protector Specifications	
CWT Part number	640-6500
Description	Sealed gas tube station protector
DC Breakdown@100V/s	300-500V
Impulse Breakdown 100V/µs 10kV/µs 100V/µs, vented	 600V 850V 1200V
Insulation Resistance@100V/leakage current	10e10 Ω
Capacitance@1kHz	<15pF
DC Extinguishing (Network applied) @52V, 135V, 150V	<150ms
Impulse Life Characteristics	>400x500A 10/1000µs 10kA 8/20µs
AC Life characteristics	>65A, 11 cycles
Enclosure Material	Weather and UV resistant , high impact, flame retardant plastic.
Dimensions	5.7”H x 3.4”W x 2.2”D

Table 10: Telephone Line Surge Protector

5 Test & Maintenance

5.1 Diagnostics

5.1.1 Trailblazer Operation

When the Trailblazer is first turned on, the microprocessor boots up and loads the FPGA and sets the radio parameters. The base unit begins transmitting while the CPE (or slave unit in an LL system) waits to receive a signal from the base. When the CPE receives a signal it checks to ensure that the SFD code matches its own SFD code. If the codes match, the CPE begins adjusting its oscillator frequency to exactly match the frequency of the base (if the oscillator later drifts due to temperature changes, the CPE will relock without affecting the link.) Once the CPE oscillator is locked, it transmits a short ranging packet back to the base. The base unit measures the delay in the return packet and calculates the approximate path length and sends a correction to the CPE. The CPE adjusts its timing and sends another short timing packet to the base. This process continues until the CPE data is arriving in its exact receive window. Then the CPE begins transmitting full data packets to the base and the link is fully functional. The base can support up to four CPEs and they are locked and ranged into their appropriate time slots as they come on line. If a link is broken, the CPE will reset and begin the process again. If the CPE does not see a signal from the base, it will reset periodically but will not transmit until it receives permission from the base.

5.1.2 LED Function

The Trailblazer units' are equipped with multifunction status indicator LEDs on the top and radio card. There are no LEDs on the interface card. You can read the link and alignment status as well as packet loss information quickly, without using a PC. The rack mount unit has remote front panel LEDs with different information (see below.) Use the table below for translating the on-board LED patterns.

	CPE Unit			BASE Unit			Description
	D4A	D4B	D6B	D4A	D4B	D6B	
NO POWER	*Off*	*Off*	*Off*	*Off*	*Off*	*Off*	Power system failure or no power applied
POWER ON	*Off*	*Off*	*Solid*	*Off*	*Off*	*Solid*	Initial Power up, FPGA not loaded by CPU
CPE ACQUIRING	*Solid*	*Solid*	*Flashing*	*Off*	*Solid*	*Flashing*	CPE – receiver on, looking for valid signal. Base - FPGA loaded, radio transmitting
CPE RANGING	*Solid*	*Off*	*Flashing*	*Off*	*Solid*	*Flashing*	CPE acquired and locked, CPE begins transmitting locator beacon
BASE RANGING	*Solid*	*Off*	*Flashing*	*Solid*	*Off*	*Flashing*	Base accepts CPE locator beacon and begins ranging operation
ALIGNMENT	*Off*	*Blinks*	*Solid*	*Off*	*Blinks*	*Solid*	Final alignment, minimizing bit errors
LOCKED	*Off*	*Off*	*Flashing*	*Off*	*Off*	*Flashing*	Units locked and aligned, ready for service
PACKET ERRORS	*Off*	*Blinks*	*Flashing*	*Off*	*Blinks*	*Flashing*	D5 blinking indicates packet errors, weak signal or interference

Table 11: System Status LED Information Table

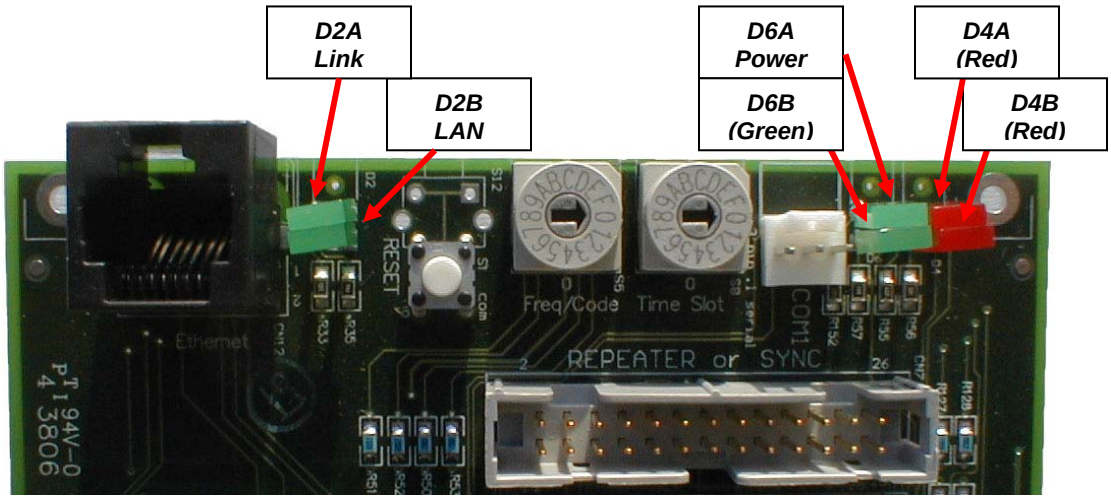


Figure 32: Trailblazer Radio Card LEDs

Set your units next to each other on your bench with the test antennas attached to the N female connectors on the enclosure. The rack mount enclosure has LEDs on the front of the panel that will indicate the status of the link, so you don't need to look at the LEDs on the boards. The onboard LEDs will indicate from top to bottom in the preceding table, from the *No Power* to the *Final Alignment and Errors* state. The Trailblazer system should reach the *CPU Operational* state within 20 seconds after power is applied. The *Acquired* state completes when the CPE terminal has detected and locked to the radio signal from the base unit. The *Ranged* state is complete when the CPE terminal has

turned on the radio transmitter and is aligned with the base unit. After ranging both units you will do an *Alignment* to minimize bit errors. During the *Operation and Diagnostics* stage, any bit errors are occurring will be indicated by D5 blinking or flashing depending on the severity of the errors. This condition may also be caused by interference or misalignment of the antennas (or weak signal). ***If D4A and D4B are OFF, D6A is on and D6B is FLASHING, the unit is ready for service!***

5.2 Maintenance

5.2.1 Installation of Software/Firmware Upgrades

Most maintenance and upgrading of the system can and should be performed with the included GUI software. See Section 3 for operating instructions for the GUI. If for some reason you are unable to use the GUI software, you may alternately use the Terminal Interface. See the Appendix for advanced programming and diagnostics details.

6 Appendix

6.1 About Carlson Wireless

6.1.1 Mission

Carlson Wireless Technologies, Inc. (CWT) is dedicated to designing, manufacturing and marketing innovative, low power digital WLL (wireless local loop) telephone systems that provide high-quality voice and data links for rural and remote telephone users worldwide.

6.1.2 History

Carlson Wireless Technologies, Inc. was founded in 1999 by James Carlson and is a privately held California “C” corporation headquartered in Arcata, California. Carlson Wireless purchased the assets of Adicom Wireless, Inc. formerly of Pleasanton, CA in 2002. Adicom Wireless had spent 4 years and over $40 million in development of a CDMA multipoint system. The designs and patents are being used with this newer Trailblazer RC Point-to-Point and Point-to-Multipoint product line.

6.1.3 Summary

Carlson Wireless is marketing the Trailblazer product through established telecom and wireless equipment distributors. Please contact our Sales Department +1.707.822.7000, or email sales@carlsonwireless.com for more information.

6.2 System Specifications

Air Interface	*Proprietary DSSS CDMA using a negotiated QOS with Time Division Duplexing
Data Throughput Rate	512, 256, 128, 64 kbps, Configurable with GUI
End-to-End System Latency	Less than 4.4 ms Depending on Speed Selected
Fax Compatibility	G3 (9.6kbps) and G4 (14.4kbps)
Modem Performance	V.34 (33kbps) via POTS, up to V.90 (56kbps) via RuralConnect™
RF Performance	
Frequency Range	2.4GHz Standard. 4.9 and 5.8 GHz Options Available
RF Channels	4 sub channels in 2.4 GHz band, 8 sub channels in 5.8 GHz
RF Output Power	17dBm typical in 2.4 GHz, 17dBm in 5.8 GHz
Receive Sensitivity	-93 dBm/256 kbps @10-6 BER -90 dBm/512 kbps @10-6 BER
External Antenna Port	"N" Type Female
Environmental Specifications	
Operating Temp	-30 to +60 Degrees C (Ambient with Solar Shielding)
Humidity	0 to 90% - Non-Condensing
Voltage Requirements	Filtered DC nominal 12 to 24 V Negative Earth Ground
Operating Current	2 Watts Minimum, 8 Watts Maximum Configuration
CPE Terminal (FXS) Specifications	
Regulatory	LSSGR, TR57, ITU Q.552, and G.712
Open Loop Voltage	36 to 48V
Loop Current	20 mA to 24 mA
Maximum Loop Length	1200 Ohms Including Instrument
Ringing Voltage	60 VAC RMS
Ringing Load	3 REN
Ringing Waveform	Balanced Sinusoidal, 20 Hz Standard, Factory Programmable 16 to 33Hz
Nominal Transmit Level	0.0 dBm0, Factory Programmable
Nominal Receive Level	-2.0 dBm0, Factory Programmable
2 Wire Port Return Loss	24 dB min.
Voltage Requirements	Filtered DC Nominal 12 to 24V
Operating Current: No Load, Full Load	1.4 Watts (i.e. 24v @ 60ma) Idle, 4 Watts (i.e. 24v @ 200ma) max Including Radio
Base Unit Specifications	
Regulatory	TIA/EIA/IS-968 (FCC), UL 1950, UL 60950, EN 60950, IEC60950, EN55022B
Maximum Loop Length	1500 ohms or 18 ma.
Ring Equivalent Number	0.3B per line
Ring Detect Threshold	24-110Vrms, 17-34 Hz
2 Wire Port Return Loss	24dB min.
Operating Voltage	Filtered DC Nominal 12 to 24V
Operating Current: No Load, Full Load	Less then 2 Watts (i.e. 24v @ 200ma) with 8 Lines Active Including Radio
Certifications	US, Canada, Brazil, Mexico, Philippians' Islands, Morocco
Warranty	1 Year Parts and Labor

6.2.1 Block Diagram

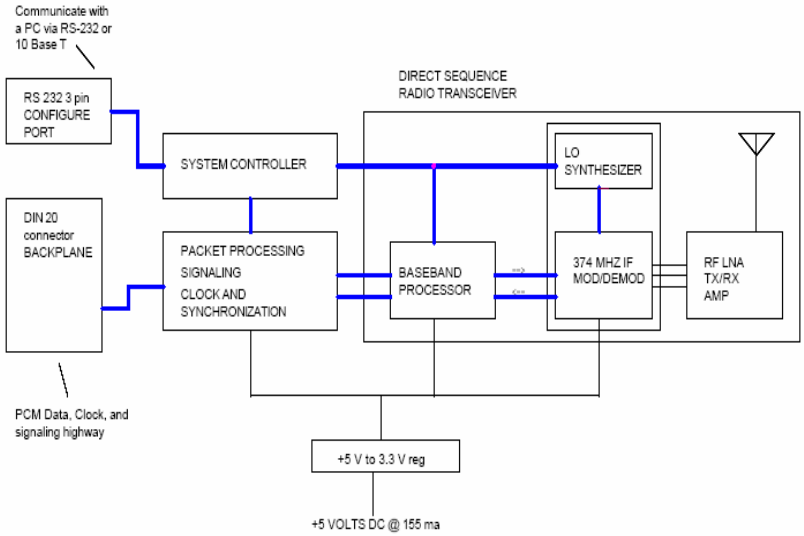


Figure 33: Block Diagram of Radio Card

6.3 Cable Pin Outs

Should you misplace or lose your serial programming cable, you can call Carlson Wireless and order a replacement or construct a new cable from a few simple parts using the diagram below.

6.3.1 Configuration Port Pin Out

Configuration Port Cable Construction Table	
A DB9 pin Female to be fit in the PC is wired with:	***A 3 pin, .100" spacing connector, female, connecting to the Trailblazer as shown:***
DCD on pin 1, (not used)	
TX Data on pin 2,	*TX Data on pin 1,*
RX Data on pin 3,	*RX Data on pin 3,*
DTR on pin 4, (not used)	
SG on pin 5, (signal ground)	*SG on pin 2, (signal ground)*

DSR on pin 6,	*(not used)*	
RTS on pin 7,	*(not used)*	
CTS on pin 8,	*(not used)*	
RI on pin 9,	*(not used)*	

Table 12: Configuration Port Cable Construction Table

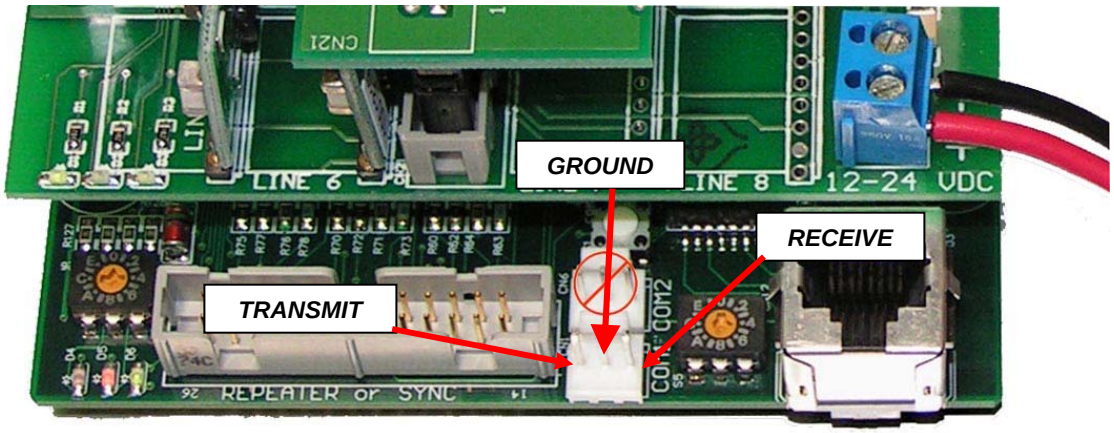


Figure 34: Serial Data Cable PinOut (PCB View)

Standard "AT" PinOut for a DB9 Connector

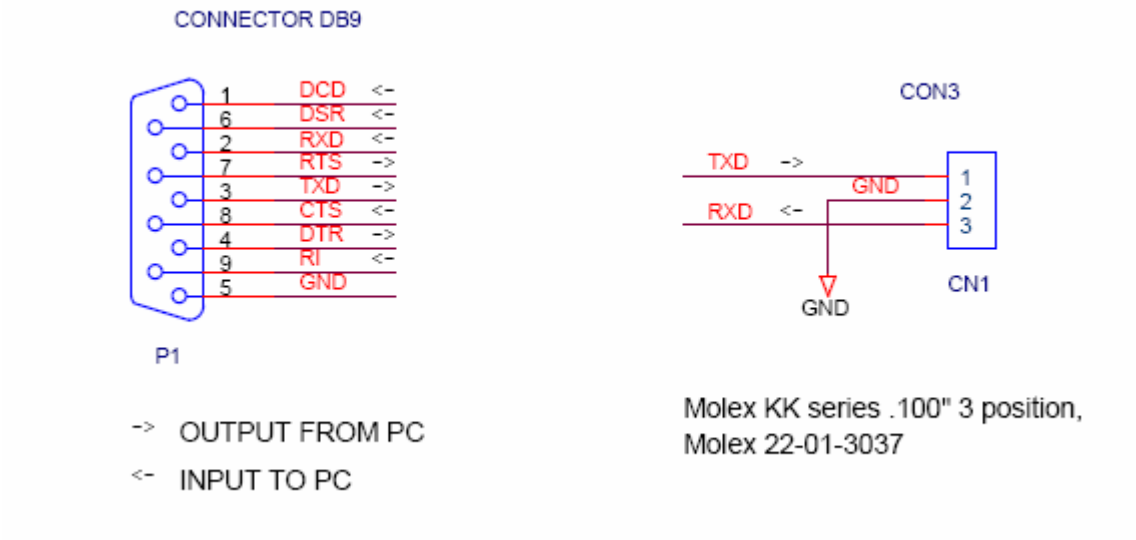


Figure 35: Serial Data Cable Schematic

Serial Data Cable Pin Out			
Pin	**Signal**	**Description**	**Direction**
1	DCD	Data Carrier Detect	To PC
2	RD	Receive Data	To PC
3	TD	Transmit Data	From PC
4	DTR	Data Terminal Ready	From PC
5	GND	Signal Ground	Common
6	DSR	Data Set Ready	To PC
7	RTS	Request to Send	From PC
8	CTS	Clear to Send	To PC
9	RI	Ring Indicator	To PC

Table 13: Serial Data Cable Pin Out

6.4 Signal Strength Conversion Chart

Carlson Wireless - Trailblazer Rev 6C Radios			**Radio threshold - 90 dBm @ 512 kbps**	**Radio threshold - 93 dBm @ 256 kbps**
GUI Signal Reading	Path Attn dB	Rx Level	Fade Margin	Fade Margin
3	125	-111	-21	-18
4	121	-107	-17	-14
5	115	-101	-11	-8
6	111	-97	-7	-4
7	109	-95	-5	-2
8	107	-93	-3	0
9	105	-91	-1	2
10	103	-89	1	4
11	101	-87	3	6
12	100	-86	4	7
13	99	-85	5	8
14	98	-84	6	9
15	97	-83	7	10
16	96	-82	8	11
17	95	-81	9	12
18	94	-80	10	13
19	93	-79	11	14
20	92	-78	12	15
21	90	-76	14	17
22	89	-75	15	18

23	88	-74	16	19
24	87	-73	17	20
25	86	-72	18	21
26	85	-71	19	22
27	84	-70	20	23
28	83	-69	21	24
29	82	-68	22	25
30	81	-67	23	26
31	80	-66	24	27
32	79	-65	25	28
33	78	-64	26	29
34	77	-63	27	30
35	76	-62	28	31
36	75	-61	29	32
37	74	-60	30	33
38	73	-59	31	34
39	72	-58	32	35
40	71	-57	33	36
41	70	-56	34	37
42	69	-55	35	38
43	68	-54	36	39
44	67	-53	37	40
45	66	-52	38	41
46	65	-51	39	42
47	64	-50	40	43
48	63	-49	41	44
49	62	-48	42	45
50	61	-47	43	46
51	60	-46	44	47
52	59	-45	45	48
53	58	-44	46	49
54	57	-43	47	50
55	56	-42	48	51
56	55	-41	49	52
57	54	-40	50	53

Table 14: Signal Strength Conversion – All Bands

6.5 Antenna Patterns and Specifications

6.5.1 18dBi Directional Panel Plots and Specs

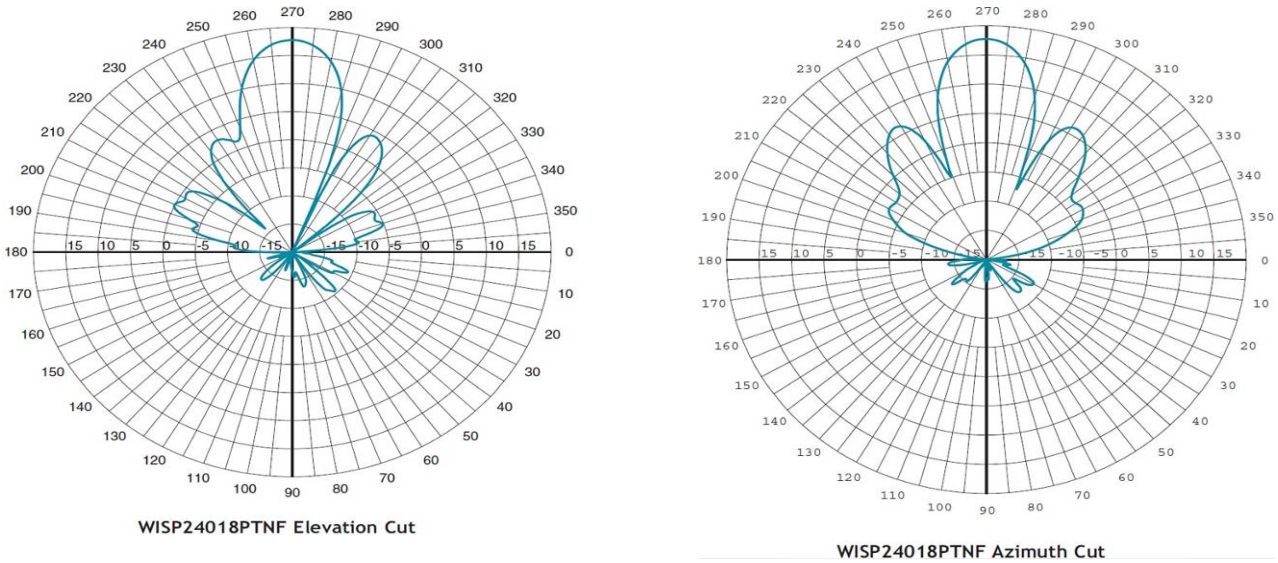


Figure 36: 18 dBi Antenna Patterns

18dBi Directional Panel Specifications					
Pole Size		1" (25)	to	2.88" (73)	In (mm)
Weight		3.9(1.76)			Lbs. (kg)
Dimension (W x L)		15.1 x 13.9 x 1.9 (384x353x48)			In (mm)
Wind Load		85			@100MPH
Frequency Range		2300-2500			MHz
3 deg beam width		19 vertical, 18 horizontal			deg
Front to Back		25			dB
VSWR		1.6:1			
Impedance		50			ohms
Input Power		20			watts
Operating Temperature		-40 to +70			Deg C.
Gain		18			dBi
Bracket Tilt		45			Deg

Table 15: 18dBi Directional Panel Specifications

6.5.2 24dBi High-Gain Parabolic Grid Plots and Specs

Properly Mounted Grid (Vertical Polarity)

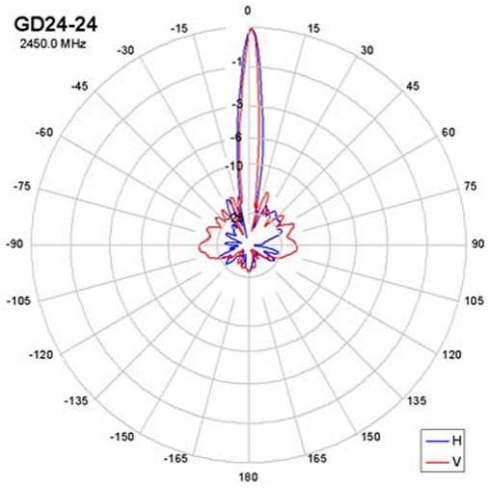


Figure 37: 24dBi Forward Plot

24dBi High-Gain Parabolic Grid Antenna Specifications					
Pole Size		*1" (25)*	*to*	*2" (50)*	*In (mm)*
Weight		*11 (5)*			*Lbs. (kg)*
Dimension (W x L)		*28.5 x 36" (724 x 914)*			*In (mm)*
Wind Load		*41*			*@100MPH*
Frequency Range		*2400-2485*			*MHz*
3 deg beam width		*8 vertical, 10 horizontal*			*deg*
Front to Back		*25*			*dB*
VSWR		*1.5:1*			
Impedance		*50*			*ohms*
Input Power		*100*			*watts*
Operating Temperature		*-40 to +70*			*Deg C.*
Gain		*24*			*dBi*
Bracket Tilt		*25*			*Deg*

Table 16: 24dBi High-Gain Parabolic Grid Antenna Specifications

6.6 Warranty

Limited Warranty, USA

Carlson Wireless Technologies, Inc. or Carlson Wireless USA, collectively referred to as "Carlson"), will repair this product with new or rebuilt parts, free of charge, in the USA or Puerto Rico for one (1) year from the date of original purchase in the event of a defect in material or workmanship. Mail-in service in the USA can be obtained during the warranty period from a Carlson Factory Service center by calling +1.707.822.7000 or online by visiting ***http://carlsonwireless.com/service/rma_request.php*** for a RMA (Return Materials Authorization) number. After receiving your RMA confirmation via telephone or email, ship your product adequately packed, postage paid and insured to the address provided. This warranty extends to the original purchaser only. A purchase receipt or other proof of the date of original purchase will be required before warranty services are rendered. This warranty only covers failures due to defects in materials or workmanship which occur during normal use. It does not cover damages incurred in shipment or failures caused by products not supplied by Carlson. It also does not cover failures which result from accident, misuse, abuse, neglect, mishandling, misapplication, alteration, modification, lightning, power line surge, introduction of sand, dust, humidity and/or liquids, or service by anyone other than a Carlson Factory Service Center or authorized Carlson Service Center, or damage that is attributable to acts of God.

Limits and Exclusions

There are no express warranties except as listed above.

CARLSON SHALL NOT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OF THIS PRODUCT OR ARISING OUT OF ANY BREACH OF THIS WARRANTY. ALL EXPRESS AND IMPLIED WARRANTIES, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED TO THE APPLICABLE WARRANTY PERIOD SET FORTH ABOVE.

Some states do not allow the exclusion or limitation of incidental or consequential damages or limitations on how long an implied warranty lasts, so the above exclusions or limitations may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from state to state. If a problem with this product develops during or after the warranty period you may contact your dealer or Service center.

6.7 Acronyms/Abbreviations

ANSI	American National Standards Institute
Async	asynchronous
CCITT	**C**omité **C**onsultatif **I**nternational **T**éléphonique et **T**élégraphique
CD	carrier detect
CPE	customer premise equipment
CS	clear to send
CSU	channel service unit
CTS	clear to send
CO	central office
dB	decibel
DCE	data communications equipment
DDS	digital data service
DSR	data set ready
DSU	data service unit
DTE	data terminal equipment
DTR	data terminal ready
EA	extended address
FR	frame relay
FSU	frame relay service unit
GUI	graphical user interface
HDLC	high-speed data link control
IP	internet protocol
ISDN	integrated services digital network
ITU	International Telecommunications Union
Kbps	kilobits per second
LAN	local area network
LED	light emitting diode
MIB	management information base
ms	millisecond
PPP	point-to-point protocol
RD	receive data
RDL	remote digital loop-back
RFC	request for comments
RIP	routing information protocol
RMA	return material authorization
RR	receiver ready
RTS	request to send
Rx	receive
SDLC	synchronous data link control
SNA	systems network architecture
SNMP	simple network management protocol
SW56	switched 56
Sync	synchronous
TD	transmit data
TR	data terminal ready
Tx	transmit
UNI	user-to-network interface
WAN	wide area network

6.8 Glossary

ANSI

Acronym for American National Standards Institute; devises and proposes recommendations for international communications standards.

asynchronous

A method of data transmission which allows characters, that are preceded by a start bit and are followed by a stop bit, to be sent at irregular intervals.

bandwidth

A range within a band of frequencies, or an amount of data, that can be transmitted in a preset amount of time. The bandwidth determines the rate at which information can be sent.

bridge

A connectivity advice that operates at the OSI Data Link Layer; it filters and forwards packets by physical addresses. See also router.

CD

Acronym for Carrier Detect; it is a signal generated by a modem or DSU/CSU and indicates the presence of a carrier signal on a communications link.

CSU

Acronym for Channel Service Unit; a device used to connect a digital phone line, from the phone company, to a multiplexer, channel bank or directly to another device producing a digital signal. A CSU performs line-conditioning and equalization functions, responds to loop-back commands sent from the central office, regenerates digital signals and monitors them for problems and provides a way of testing a digital circuit.

CLASS features

Acronym for Custom Local Area Signaling Services; consists of number-translation services, such as call-forwarding and caller identification.

clock

An oscillator-generated signal that provides a timing reference and generates periodic signals for the timing of certain functions in a transmission link.

CPE

Acronym for Customer Premise Equipment; it includes all telecommunications terminal equipment located on the customer premises, including telephone sets, PBXs, data terminals and customer-owned coin-operated telephones.

CTS

Acronym for Clear To Send; a signal on the DTE interface indicating that the DCE is clear to send data.

dB

An abbreviation for decibel, a logarithmic unit used to measure sound level or signal strength.

DCE

Acronym for Data Communications Equipment; a device that provides all the functions required for connection to telephone company lines and for converting signals between telephone lines and DTE. Also see DTE.

DSR

Acronym for Data Set Ready; a signal on the EIA-232 interface that indicates a connection and readiness to start handshaking control signals for communication to begin.

DSU

Acronym for Data Service Unit; a hardware component needed to transmit digital data over a hardware channel. It converts signals from bridges, routers and multiplexers into the bipolar digital signals used on the telephone company digital lines and ensures that voltage levels are correct.

DSU loop back

Is a Telco initiated test which loops the DSU back to the Telco and is used to test the DDS circuit as well as the DSU/CSU.

DTE

Acronym for Data Terminal Equipment. It is the end-user terminal or computer that plugs into the termination point (DCE) of a communications circuit.

gateway

Is a device which enables information to be exchanged between two dissimilar systems or networks.

HDLC

Acronym for High Level Data Link Control. It is a generic link-level communications protocol developed by ISO, that manages synchronous code-transparent serial information transfer over a link connection. See also SDLC.

host computer

The primary or controlling computer in a multiple computer operation.

in-band signaling

Is signaling over the same channel used for data.

IP

Acronym for Internet Protocol. It provides for transmitting blocks of data between hosts identified by fixed-length addresses.

ISDN

Acronym for Integrated Services Digital Network. It is a network architecture that enables end-to-end digital connections. It supports diverse services through integrated access arrangements and defines a limited set of standard, multipurpose interfaces for equipment vendors, network providers, and customers.

LAN

Acronym for Local Area Network. A privately owned network that offers high-speed communications channels connecting information processing equipment in a limited geographic area.

MIB

Acronym for Management Information Base. It is a database of network management information used by SNMP.

multi-point

Is a configuration or topology designed to transmit data between a central site and a number of remote terminals on the same circuit. Individual terminals are not able to send data to each other.

out-of-band signaling

Is signaling that is separated from the channel carrying information (voice, data, video, etc.) by a filter.

packet

Is a bundle of data that contains both control information and the data itself. The control information is used for routing the packet through a network to its final destination.

packet-switching network

Is a telecommunications network based on packet-switching technology, wherein a transmission channel is occupied only for the duration of the transmission of the packet.

parameter

Is a numerical code that controls an aspect of terminal and/or network operation. Parameters control page size, data transmission speed, and timing options.

ping

Is an internet protocol standard that provides loop-back on demand for any device in an IP network. One device "pings" another by sending a loop-back request to the device's IP address.

point-to-point

Is a type of communications link that connects a single device to another single device, such as a Base unit to a CPE unit.

remote configuration

A feature that allows the CPE unit to be configured from the Base unit or VT-100 compatible terminal.

router

Is a device that supports LAN-to-LAN communications. IT reads logical addressing information and directs data across a network to its destination. See also bridge.

SNMP

Acronym for Simple Network Management Protocol. It is a control and reporting scheme widely used to manage devices from different vendors and operates on top of the Internet protocol.

switched network

Is a network of dial-up telephone lines that uses circuit switching to provide communications services to network users.

synchronous

A method of data transmission in which timing information is sent along with the transmitted data. Synchronous communication is achieved when timing shares a single clock.

SDLC

Acronym for synchronous data link control. A link-level communications protocol that manages synchronous, code-transparent, serial information transfer over a link connection.

TELNET

The standard TCP/IP remote login protocol.

VT-100

A non-intelligent terminal or terminal emulation mode used for asynchronous communications.

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Rev. 1.04 Manual corrections
Setting the Radio Frequency and Scrambling Code

Rev 1.05 Manual corrections
Updated company address and phone numbers

Rev 1.06 Manual corrections
Updated pictures to 512-7000H radio interface boards