CARLSON WIRELESS TECHNOLOGIES, INC.

Leading the Charge Across the Digital Divide

Installation & User's Manual

FT-512 Trailblazer

Multifunctional Digital Radio

Optional ADD-ONS Include:

4, POTS lines voice plug-in card

8, POTS lines voice plug-in card

1, Ethernet on-board port activation

3 Additional V.35 port plug-in card

Part Number 490-1600
Rev 1.09
Oct 2002

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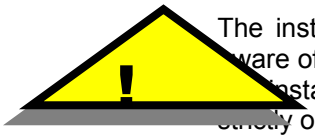
SAFETY WARNINGS

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



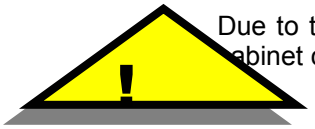
The installation procedures described in this manual must be performed by qualified personnel aware of the hazards involved. The personnel involved in equipment installation must be trained in the installation of telephone equipment and associated power systems; these personnel must strictly observe 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 PRECAUTIONS REQUIRED.

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 such that the cabinet containing the antenna can be closer than 2 Meters (6.7 Feet) to any person.

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

The 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 this equipment. You must, upon request, provide this information to your telephone company.

The REN is useful 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 REN's 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. If possible, they will notify you in advance. But if advance notice is not practical, you will be notified as soon as possible. You will be informed of your right to file a compliant with the FCC.

Rights of the Telephone Company

Your telephone company may make change in its facilities, equipment, operations or procedures that could affect the proper functioning of your equipment. If they do, 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

CERTIFICATIONS AND REGULATORY

FCC Reg No., Part 68	BMD8 USA – 27773-PT-E
FCC Reg No., Part 15	OPA-FT-512
Industry Canada CS-03	3448-10241A
Industry Canada RSS-210/139	3448-FT-512

RADIO INTERFERENCE

Carlson Wireless USA Model: FT-512-Trailblazer
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 operation. 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: 1180–B Evergreen Rd.
Redway, CA 95560
USA

Declares that the product:

Product Name: **FT-512 Trailblazer**

Conforms to the following standard(s) or other normative document(s):

EMC:
FCC Part 15.247

Safety:
UL 1950

Supplementary Information:
Published Specifications

Redway, CA
July 20, 2002

Damon Siska
Director of Quality

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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 to plan and install the FT-512 Trailblazer Digital Microwave Radio. To avoid harm to persons or damage to the product please ensure that you have read through the safety, unpacking and installation sections before proceeding.

1.2 Functional Overview

The FT-512 provides a reliable, wireless voice and high-speed data connection up to a distance of 50 km. This radio is specifically designed for easy integration with our voice and data multiplexer cards, or any standard V.35 serial device. In addition, Carlson Wireless Technologies Inc. (CWT) also offers a multipoint card cage that will link together the serial data through our network interface card allowing up to 4 E1's/T1's connection into the public switched telephone network. CWT can provide excellent price/performance solutions for many of the worlds telecommunication needs both in a point to point or point to multipoint topologies.

The initial release is using a 2.4 GHz radio frequency band, however others are scheduled to follow in the 3.5 and 5.7 GHz radio bands in 1Q2003.

1.2.1 Main Features

512 or 256 kb/s Synchronous Data Stream with Frame Sync – Structured for high quality PCM voice use, V.35 serial data peripherals, or optionally an 10 MB/s Ethernet network port.

Full configurable through a PC – Simplify the setup using our Graphics User Interface application – Data speed, CDMA code, Clocking, Master/Slave and selection of the user frequency pool are configurable in minutes with a serial Com port.

Repeater – This product can act as a repeater by just connecting the serial data port back to back with another unit and setting the external clock to yes on the master side.

Standard ISO 2593 V.35 DTE port – plugs right in to most V.35 devices

Low Power Draw – The FT-512 uses between ½ to 2 watts of power and accepts any voltage between 12 and 48 VDC.

Very Expandable- You can start out with only one link and, utilizing a card cage, continue to add cards linking together the data and thus gain the features of a point to multipoint topology. Thus you can continue expanding without loosing any of your original investment.

Private and Secure – Encrypted CDMA spread spectrum modulation, proprietary framing, structure and packet size assures complete privacy.

Wire-line Quality Voice and Data – Data speeds are selectable up to 512 kb/s. Designed to integrate seamlessly with our full bandwidth 64kb PCM POTS cards for high quality voice line/trunks.

Optional 10 MB/s Ethernet port on-board - For simultaneous LAN / IP data and PCM voice needs

Affordable – The “per pair” pricing of the FT-512 is comparable to the “single unit” of other data radios not designed for voice and PSTN integration.

1.3 Optional Add-on Boards

1.3.1 Point to point

The FT-512 is a powerful voice and/or data machine that can operate as a stand alone point to point microwave link. Optional voice and data plug-in cards are also available for your **current and future** growing needs:

4, POTS lines voice plug-in card

Four, full bandwidth 64kb PCM, POTS lines can be extended to one location, eliminating the need for external multiplexers.

8, POTS lines voice plug-in card

Eight, POTS lines can be extended to one location, eliminating the need for external multiplexers and can be configured as full bandwidth 64kb PCM or 32kb ADPCM to accommodate your data needs as well!

1, 10BaseT, Ethernet bridge port

With this unique option, line quality circuit switched voice can be used along with high-speed LAN data traffic, possibly eliminating the need of a router!

4, port, shared V.35 data plug-in card

Why set-up several individual data links when you can extend four data ports to one location and share the cost between customers?

1.3.2 Multipoint

18 Slot Card Cage with 100 watt power supply

You can have up to 15 villages, each served with up to 8, 64 kb PCM non blocking telephone lines/trunks integrated into one card cage along with an E1 or T1 direct digital connection. 1 or 2 time slots can be used for providing Internet.

4 E1, V52, Network Interface Card

With this optional Card Cage and 4 E1, Network Interface Card, you can provide up to 120 users with high quality voice and high speed Internet connectivity along with remote monitoring and diagnostics.

4 T1, GR303, Network Interface Card

With this optional Card Cage and 4 T1, Network Interface Card, you can provide up to 96 users with high quality voice and high speed Internet connectivity along with remote monitoring and diagnostics.

1.4 Application and System Design Considerations

1.4.1 Point to Point Microwave Link

Security Monitoring Cameras
Public Safety Data Links
Point to Point Commercial Data Links
Cellular Backhaul Data Needs
Permanent or Temporary Telephone Service
Emergency and Disaster Relief
Public Calling Phones
Leased Line Emulation
Islands and other Isolated Areas

1.4.2 Multipoint Microwave Link

Internet Café and Telephone Calling Centers
Wireless Digital Local Loop (Rural Telephone)

1.5 General Specifications

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

Data Interfaces	
Primary Serial Data Port	V.35 using a DB 25 Connector (RS-422/RS-232)
Data Rate and Type	256/512 kbps, Synchronous
Command Port	RS-232, 9600 bps, N,8,1
Latency	less than 5 ms.
Power Requirements	
Input Voltage	12 to 48 Vdc
Power Consumption	2 Watts in full operation (does not include add-on cards)
RF Specifications	
RF Frequency Band	2.400 to 2.4835 GHz 2.350 to 2.500 Optional for export only!
RF Channels	Programmable in 1 MHz steps
RF Signal Bandwidth	12 MHz (7 non overlapping channels)
PN Code Rate	11 M chip/sec
PN Code Length	16
Spreading codes	4 programmable non orthogonal codes
Processing Gain	12.04 dB
Modulation Type	BPSK (256) or QPSK (512kbs) DSSS
Transmitter Output Power	+17dBm, set to allow CDMA operation
Receiver Sensitivity (10^{-6} BER)	-93 dBm @ 256 kbps, -90 dBm @ 512 kbps
Operating Temp	-30 to +60 Degrees C with solar shielding
Mechanical	
PCB dimensions	5 in. x 6 in. x 1 in.
PCB weight	0.5 lbs

1.5.1 Block Diagram

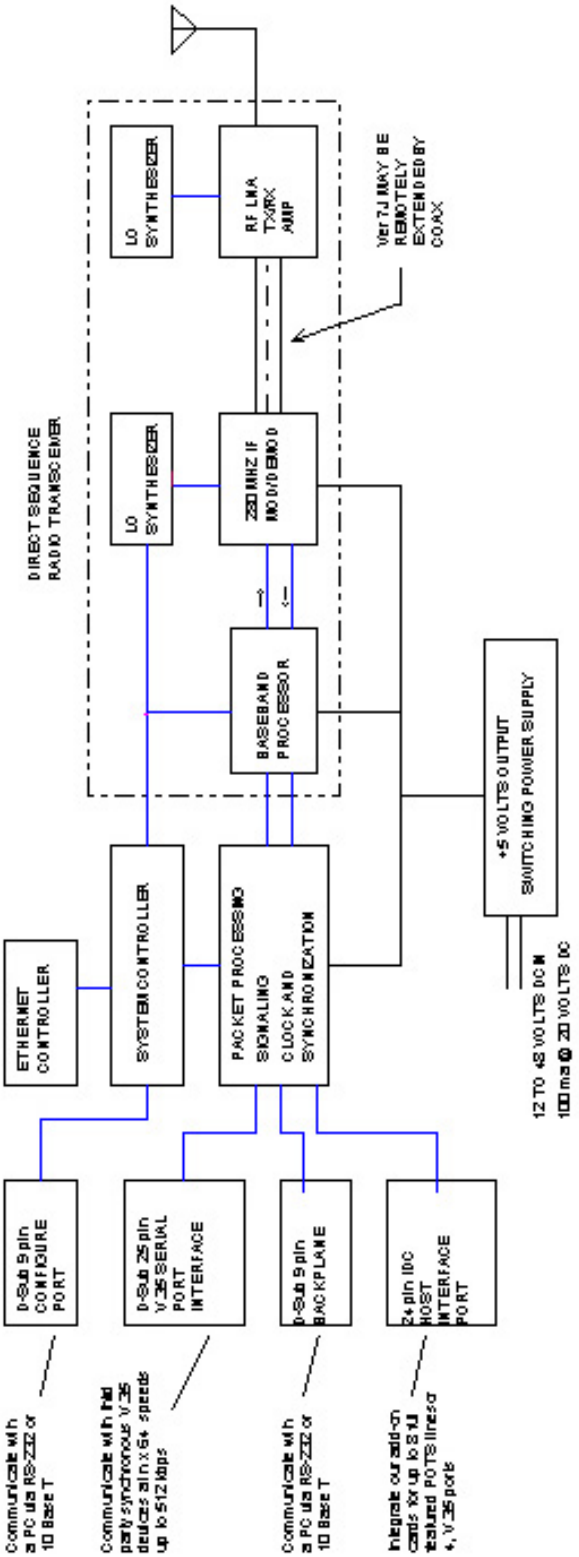


Figure 1: Block Diagram

2 Installation

2.1 Unpacking

The FT-512 Trailblazer radio will arrive in one box approximately 19 x 15x 13 inches (47 x 37 x 32 cm). Small amounts of feed cable and/or power supplies may also be included in this box if ordered.

Caution! Observe static precautions when wiring or handling circuit boards.

There are nylon standoffs holding the antenna element to the reflector plate. These are fragile and can easily be over-tightened. They are set to a specific torque and if over-tightened may fail.

2.2 Site Requirements

2.2.1 Lightning Protection

The FT-512 is equipped with secondary lightning protection only. If your feed cable is more than 10 Meters (35 ft) in length or extends beyond the existing building you will need a primary gas discharge type lightning protector. Contact your sales representative for more information.

2.3 System Planning

2.3.1 Line of Sight, How to Tell for Sure?

Microwave engineers will use a variety of ways to calculate the losses in a radio path. Determining line of sight is easy if the path has a visible landmark at one end. If that is not the case then one can resort to topographical maps and plot a path. If this is marginal you still may have to prove the maps accuracy. We have used a mirror as a reflector if a sunny day or if at night a bright spotlight. Even with line of sight proven there are two more things you must know, distance and clearance of first Fresnel zone.

2.3.2 Fresnel Zone, What is it, in plain English?

In plotting terrain profiles for microwave frequencies, there are both direct and deflected waves that converge upon the receiving point. The direct path has a predictable behavior. Calculating losses from indirect or “deflected” signals however requires a different approach.

To calculate the losses of the indirect signals, let us look at what occurs. As the signal cone spreads outward from the transmitting point, it becomes increasingly delayed from the original. That delay will show up as a phase change from the original. As that phase approaches 180 degrees, this delayed signal will have a significant phase-canceling effect on the direct signal. As the signal continues to widen, peaks and troughs in reception strength similar to a sine wave occur. Each peak and trough is called a Fresnel zone.

The first Fresnel zone is the radius of the signal cone in which the phase angle of the signal can be delayed from 0 to as much as 90 degrees. This is where the majority of the signal power is supposed to exist. The second Fresnel zone will cover from 90 to 270 degrees and is undesired as it only causes the negative effect of phase canceling. The third zone will have signal delays from 270 to 450 degrees. The effect is that odd number zones will add to the direct signal and even number zones will subtract.

Zone	Frequency	Wavelength	Distance to start		Distance to end		Fresnel Radius		60% of Zone	
	(MHz)	(feet)	(miles)	(km)	(miles)	(km)	(feet)	(m)	(feet)	(m)
1	2400	0.41	2.0	3.2	2.0	3.2	46.53	14.18	27.92	8.51
2	2400	0.41	2.0	3.2	2.0	3.2	65.80	20.06	39.48	12.03
1	2400	0.41	1.5	2.4	4.5	7.2	49.35	15.04	29.61	9.03
1	2400	0.41	3.0	4.8	3.0	4.8	56.98	17.37	34.19	10.42
1	2400	0.41	4.0	6.4	10.0	16.0	78.65	23.97	47.19	14.38
1	2400	0.41	6.0	9.6	6.0	9.6	80.59	24.56	48.35	14.74
1	2400	0.41	12.0	19.2	12.0	19.2	113.97	34.74	68.38	20.84

Table 1: Fresnel Zone Chart

Some examples are given in the table above. Download the MS Excel file located on the CWT web site at www.carlsonwireless.com/support.html to calculate your own path. Remember, 60% or more of the first Fresnel zone needs to be clear from obstructions for the calculation of free space losses to be accurate.

You can set the Fresnel zone to even numbered values when plotting a profile to see potential areas of destructive signal reflection present on the path. One can now see how it is possible to improve your path by optimizing the height of

antennas so that the first Fresnel zone signal path is clear and the second is obstructed.

2.3.3 Radio Path Losses

After confirming not only line of sight and adequate Fresnel zone clearance, it is then time to look at the Free Space Loss of the radio signal, RF cable losses, and antenna gains to determine how much is left over. The remaining signal is called the "Fade Margin".

Distance in miles	Distance in km	Ant Gain in dBi	Ext RF Cable(s)	Path Loss in dB	RF power in dBm	ERP in dBm	Link Margin in dB
1.5	2.4	14.0	0.0	108	17	31	28.0
2.0	3.2	14.0	0.0	110	17	31	25.5
5.0	8.0	14.0	0.0	118	17	31	17.6
8.0	12.9	14.0	0.0	122	17	31	13.5
10.0	16.1	14.0	0.0	124	17	31	11.5
12.0	19.3	14.0	0.0	126	17	31	10.0
14.0	22.5	14.0	0.0	127	17	31	8.6
20.0	32.2	24.0	1.4	130	17	41	24.1
35.0	56.3	24.0	1.4	135	17	41	19.3
50.0	80.5	24.0	1.4	138	17	41	16.2

Table 2: Fade Margin Chart

The above chart shows various antenna and distance combinations. A changeable Excel spreadsheet is available on the world wide web at www.carlsonwireless.com/support.html The 24 dB gain external antenna option is only available through factory trained dealers.

What's an acceptable "Link Margin"? A rule of thumb theory is that 10 dB of fade margin will deliver about 90% reliability and 20 dB will deliver about 99% reliability, etc. Multi-path and polarization will affect the link as well. At 2.4 GHz there is only a small ground wave component involved in the radio propagation, hence the above numbers presume both clear LOS (line of sight) and clearing at least 60% of the first Fresnel zone. Multi-path degradation is the reason why a minimum of 16 to 20 dB of margin is required for the link.

2.3.4 Consideration of other devices in the 2.4 GHz ISM band

The ISM (Industrial, Scientific, and Medical) band at 2.400-2.483 GHz is an unlicensed band shared for many uses. Any of these devices could become a source of interference for the Trailblazer products. Some examples are described here:

Video Transmitters

These devices use analog radios which are usually fixed in frequency, 6 to 10 MHz bandwidth, low power with an ERP* of less then +10dBm.

Cordless phones

These devices are narrow band and fixed in frequency (during each use), a 1 to 2 MHz bandwidth, low power with an ERP of less then +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

These devices are true spread spectrum devices, either a 1 MHz bandwidth frequency hopping (FH) over the complete band or a CDMA type of a 16 MHz bandwidth and stationary. ERP's can range up into the +30's (dBm).

Microwave ovens

Microwave oven outputs have been measured at levels up to +20dBm ERP. This power consists of narrow pulses sweeping wildly in frequency due to the circulators built into the ovens. The higher power spikes are mostly concentrated in the upper half of the band between 2450 and 2485 MHz.

Fortunately few users of 2.4 GHz products are located in rural areas, leaving sharing concerns down to consumer microwave ovens, LAN's and other rural telephone users. The functionality of the FT-512 Trailblazer system depends on the existing and forecasted spectrum usage in the radio path. Due to the characteristics of the spread spectrum radio, the ITU (International Telecommunication Union) was able to coordinate this band globally for unlicensed use. All users in the band must accept all other signals within the band, interfering or not.

How this impacts the CDMA/FDMA technology used in the FT-512:

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 that channel(s) unusable. If the interfering signal is hopping from frequency to frequency 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.

2.3.5 RF Cable Sizing and Recommendations

Coax Cable Attenuation (dB per 100 feet)

Cable Type	at 2.5 GHz	at 5.8 GHz
LMR 400	6.8 dB	10.8 dB
LMR 500	5.5 dB	8.9 dB
LMR 600	4.4 dB	7.3 dB
1/2 inch LDF Heliax	3.9 dB	7.0 dB
LMR 900	3.0 dB	4.9 dB
7/8 inch LDF Heliax	2.3 dB	3.7 dB

Table 3: Coax Cable Loss Table

2.3.6 Data Cable Recommendations

The following are the requirements for the communication cable used to connect to the data port for either V.35 serial data or for connecting FT-512 units together to act as a repeater. The cable must be: twisted pair, 24 ga. (0.51mm) stranded, tinned copper, low capacitance (12.5 pF per foot), 100% shield coverage, PVC jacket. We use Belden 8110 paired low capacitance computer cable or equivalent.

2.3.7 General Tools

The following lists the installation tools that are normally needed:

- ½ inch box end wrench for the pole clamp
- 7/16 inch box end wrench for the mounting brackets
- ¼ inch (6mm) wide flat blade screwdriver for the cover and backplane screws
- 1/8 inch (3mm) wide flat blade for the power binding posts
- Needle-nose pliers for the grounding wire and nut
- Multimeter for measuring voltage drop, etc.
- Wire Strippers for 22AWG (.64mm)
- Wire cutters
- Sealant and Sealing Tape for external antenna RF connections

And other General Purpose tools such as:

- Drill motor

- Drill bits - masonry drill bits
- Standard pliers
- Staple-gun
- Tape measure
- Carpenter's level

2.4 Quick Start Instructions

Unless you have ordered a spare, the FT-512 as a pair, come with a basic configuration, ready to operate. The remaining part of this section will show you how to get started with that basic configuration.

2.4.1 Power connections to the FT-512

The FT-512 will accept DC power between 12 and 48 volts Negative ground. There are special provisions for using Positive ground, please contact the factory for specific information.

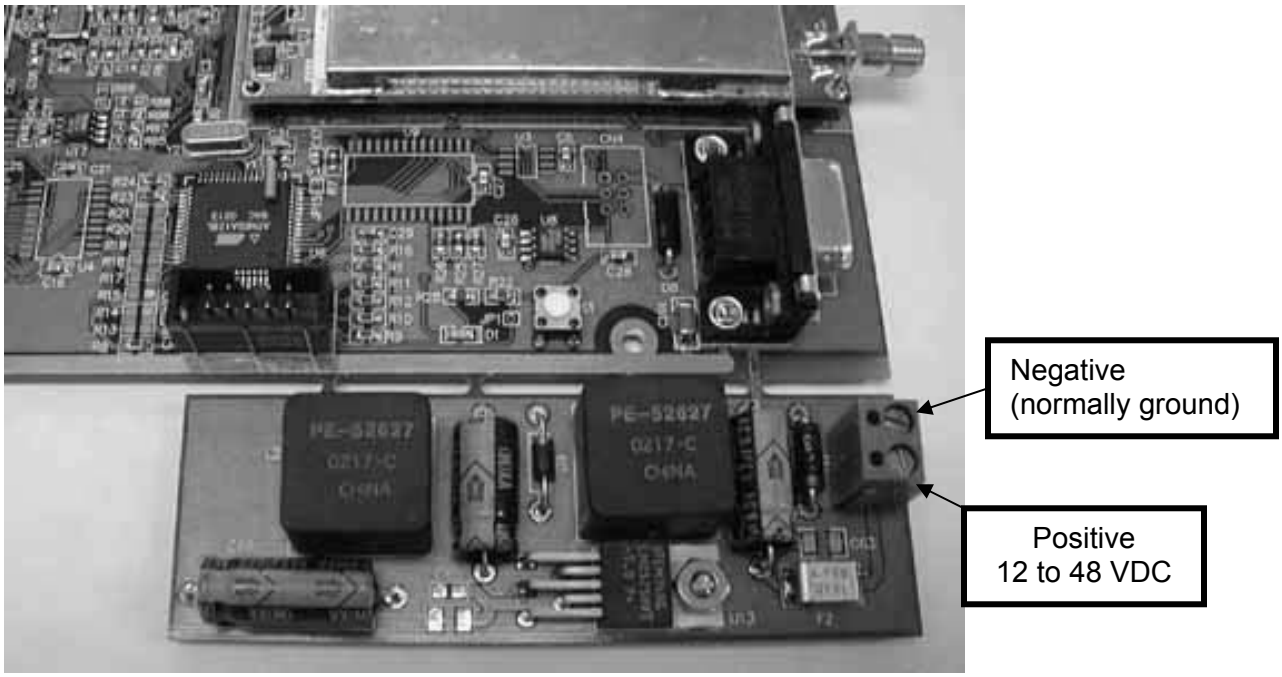


Figure 2: Close up of Power Connections

Be sure to size the power supply adequately. CWT recommends at least 4 times the consumption. This product alone will consume about 2 Watts. Using Ohms law, if you provide 12 volts DC you would be consuming 2/12 of an Amp or ~ 167 ma. If you provide 24 volts DC you would use ~ half of that or 85 ma. The power supply with battery backup sold by CWT is rated at 13.8 volts DC @ 1 Amp or 14 watts.

When the power is connected and turned on you should see the LED D1 (heartbeat) flashing at a rate of 1 per second.

2.4.2 Power Supply Feed Cable

Most users can simplify the powering of the radio by using several of the unused voice/data pairs in a standard 6 pair buriable telephone feed cable. Don't forget to allow for additional current if add-on card options are selected.

The standard 6 pair buriable telephone feed cable is a 22 AWG size copper. This means that both legs will have 3.2 ohms of resistance per 100 feet. Ohms law can be used to calculate the voltage drop in the feed cable. For example, using 200 feet of 22 AWG, and doubling up on a pair would cause an effect of 3.2 ohms of resistance. If you were providing 13.8 volts than you would have a current demand of ~150 ma x 3.2 ohms = or 0.5 volt drop. To calculate the power loss you square the current and multiply by the resistance i.e., 0.150 x 0.150 x 3.2 = 70 mWatts. Good design will keep the power losses below 10% off the consumption.

Cable Size		Ohms/100	feet per Ohm	if feeding 13.8,	if feeding 24,
A.W.G.	mm.	both legs	both legs	distance with 5% voltage loss 2pr.	distance with 5% voltage loss 2pr.
14	1.63	0.516	194	1783	6202
16	1.29	0.818	122	1125	3912
18	1.09	1.302	77	707	2458
19	0.91	1.642	61	560	1949
22	0.64	3.3	30	279	970
24	0.51	5.24	19	176	611
26	0.41	8.32	12	111	385

Table 4: Feed Cable Sizing and Distance - FT-512 alone

The above table shows the distance at which you have a 5% maximum recommended voltage drop using 2 pairs of wires paralleled together.

2.4.3 Connecting the optional CWT Battery Backed-up Supply

The *FT-512* Trailblazer operates on a DC voltage of 12-48V. Commonly, AC line voltage is readily available. In these cases, the model 640-3600 Power Converter is available as an option for powering and providing an 8 hour backup in case power is lost.

Accepting any international AC voltage (90-264 VAC, 50-60 Hz), this Power Converter provides an output voltage of 13.8V with 14 Watts of power available. This power is sufficient to supply power to one *FT-512* Trailblazer device and

charge a 2.2 amp sealed lead acid battery. Connection to line voltage is via a standard IEC line cord. Termination of the low voltage DC is by screw terminal.

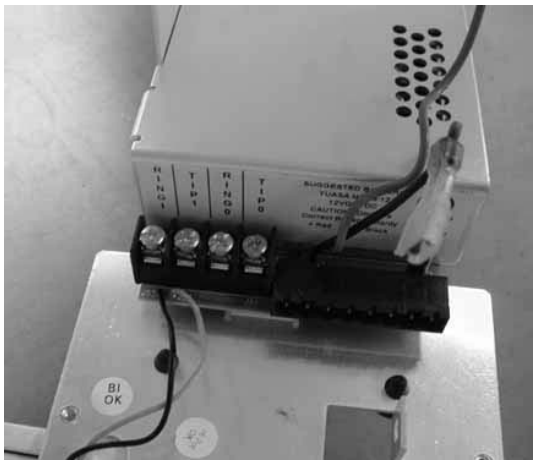


Figure 3: Power Supply Connections

The 2-Line RAU connects to the power supply through a standard 6-pair shielded cable. The cable is terminated at the power supply end with a “removable” terminal strip. This is a single-row connector with screw terminal connections for the cable wires.
The best procedure to follow in assembling this cable is as follows:

1. Strip back about 35 centimeters of the cable outer jacket and shield. Remove the white streamer and clear plastic covering. This reveals the pairing of the wires.

2. Install the Scotchlok™ 4460-D shield connector to the cable shield. Follow the instructions included with the shield connector.

3. Separate the wires for termination to the connector as described below:

The standard cable pairs are colored as follows:

White/Blue
White/Orange
White/Green
White/Grey
White/Brown
Red/Blue

NOTE: It is important to keep this pairing intact since all the white wires look the same. The wire color assignment is as follows:

Wire color	Function	Connector Pin Number

Blue (from the White/Blue pair)	Tip 0	1
White (from the White/Blue pair)	Ring 0	2
Orange	Tip 1	3
White (from the White/Orange pair)	Ring 1	4
Red/Blue(both wires)	Battery back-up signal	5
	Not used	6
White/Green	+12V	7
White (from the White/Brown pair)	+12V	7
White/Grey (both wires)	Ground	8
Brown	Ground	8

Table 5: Pin out for Battery Backed up Power Supply

Pin 1 on the connector is identified as “PCD” shown in the diagram below. Note that the surface of pin 1 is slightly darker and appears shiny.

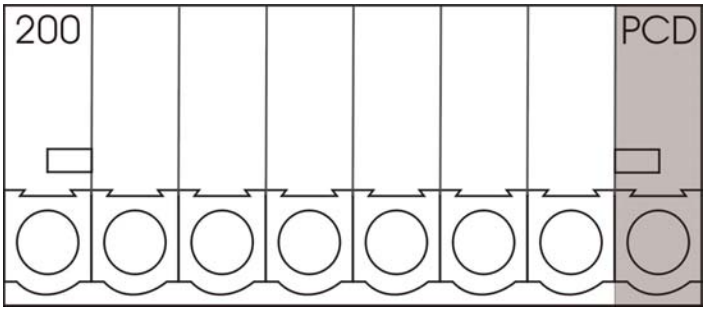


Figure 4: Main 6 Pair Cable Connector

5. With the wires identified, cut them to a length of about 10 centimeters from the cable jacket. Strip the end of each wire back about 1 cm from the end.

6. Attach the wires to the connector as in Table 4 above.

7. Don’t forget to connect the battery up as shown:

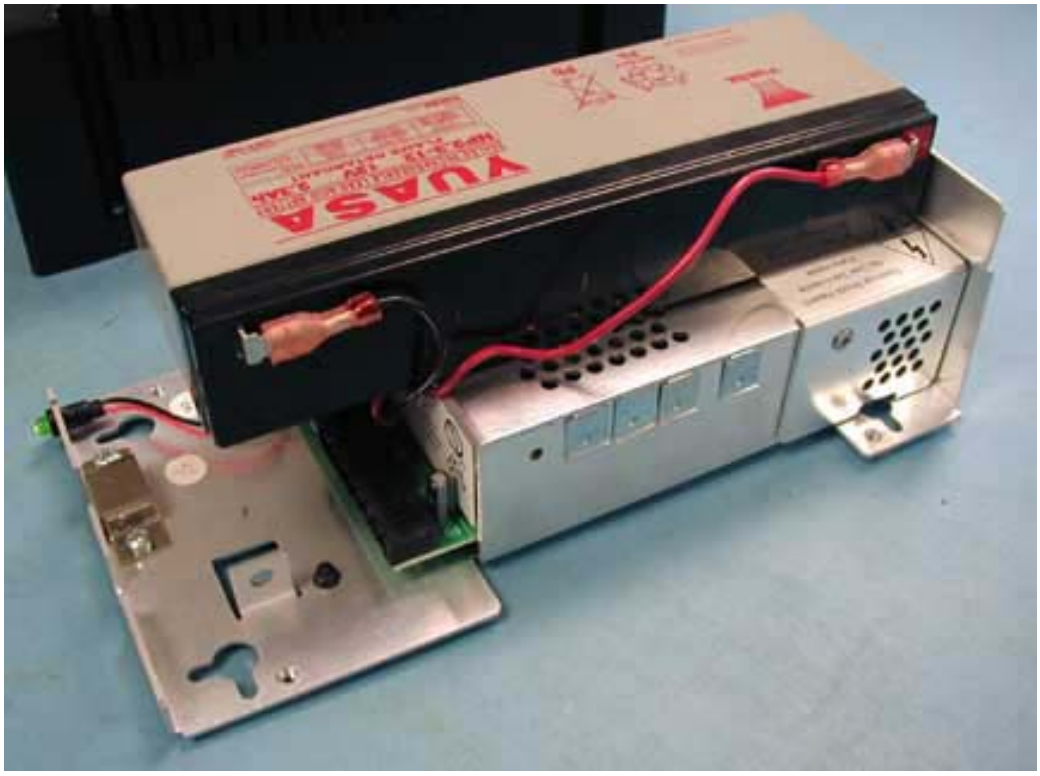


Figure 5: Battery Shown Connected to Power Supply

2.4.4 Channel Selection with the Manual Override Rotary Switch

A 16 position “0 through F” hex format rotary switch is located on the main digital PCB. This switch determines the channel selection(s) of operation. Both the Master and Slave in a point-to-point topology must utilize the same setting.

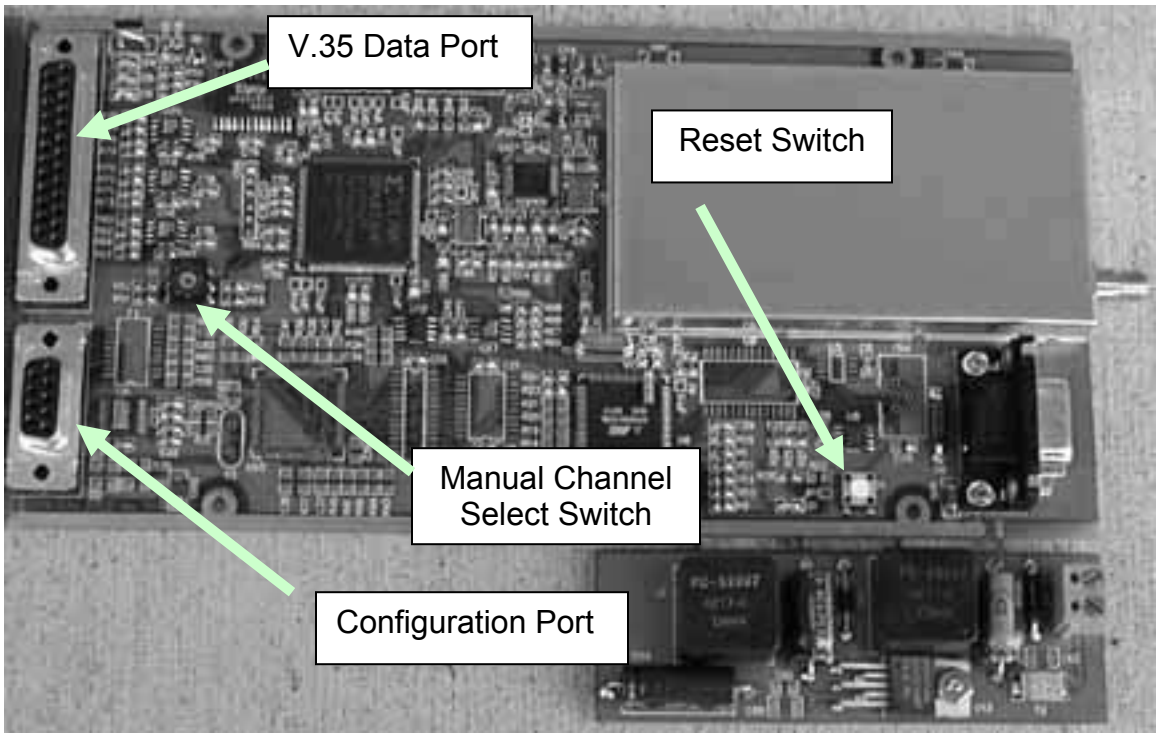


Figure 6: Channel Select Switch Location

There are sixteen positions, “0” through “F” available on the channel select switch. Note that in order for a changed switch setting to take effect, the device must be reset via the momentary pushbutton reset switch.

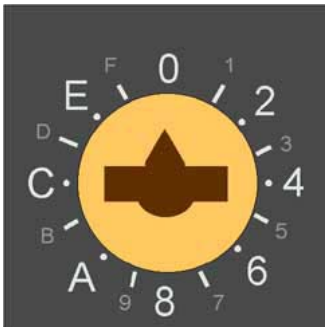


Figure 7: Rotary Switch Identification with Channel 0 setting shown

The switch numbers are mapped to the following charts showing how single frequencies or groups of frequencies are selected. Each refers to a mode of operation that includes a S*ignal Channel* or *Administration Channel* and one or more possible *Operation Channels*. The following sections detail the purpose and specific use of each of these channel options.

Switch Position	Settings for up to 6 co-located units						
	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7
1	Operate						Signal
2		Operate					Signal
3			Operate				Signal
4				Operate			Signal
5					Operate		Signal
6						Operate	Signal

Switch Position	Settings for up to 3 units in close proximity						
	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7
7	Operate	Signal		Operate			
8		Signal			Operate		Operate
9		Signal	Operate			Operate	

Switch Position	Settings for up to 2 units in close proximity						
	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7
A	Operate		Signal		Operate		
B		Operate		Signal		Operate	
C		Signal		Operate		Operate	
D	Operate		Operate		Signal		Operate

Table 6: Switch Position Frequency Defaults

S = Signal Channel O = Operating Channel
Switch positions E & F are reserved for future use

Both the *SLAVE and MASTER* must be set to the same switch setting in order to communicate properly. In multiple user configurations the Operation Channels are distributed such that they are never shared by two transmitters.

Each configuration is comprised of one Signal Channel for setup/handshaking and two or more possible Operating Channels for use during the call. The time spent on the Signaling Channel is about 500ms. These configurations have been designed to provide minimum interference and maximum possibility of establishing a quality connection.

Note: Under normal operation the channel select switch is set to zero, allowing the Trailblazer to choose from a custom frequency group where it will search for a clear available channel. This option provides maximum performance and should be the normal choice. The optional settings detailed above are designed for quick start testing or to satisfy unique operational requirements such as co-location or persistent interference issues. For all changes to channel selection the devices must be reset before the new selection will be acknowledged.

2.5 Field Installation

2.5.1 Bench Testing

Before going into the field it is very important to set up the units on the bench and become familiar with their operation. Follow the above setup and using the internal antennas. Full operation should be confirmed before leaving for the field.

2.5.2 Mounting the Cabinet

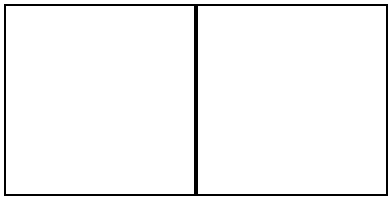


Figure 8: Mounting the Cabinet Outside

2.5.3 Synchronization of Co-located units

When co-locating more than one device in a given location it is necessary to synchronize the transmitters at the **Master site** only such that they transmit and receive at the same instant. Without synchronization bit errors will result and may cause calls to be dropped or audio to become intermittent.

The synchronization cable is fabricated and installed to link the internal clock circuitry of all co-located units. Note that the pin configuration for the first unit is such that it becomes the master clock for the subsequent connected units.

The cable consists of a DB-9 female connector and a *tightly twisted pair* CAT 5 rated cable (due to the high speed nature of the signal this type of cabling ***must*** be used).

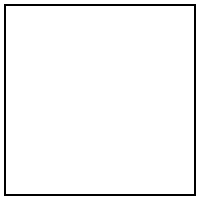


Figure 9: Sync and Bus Port

Sync and Bus Port

- Pin 2 of the first connector runs to pin 3 of the second.
- Pin 8 of the first connector runs to pin 7 of the second.
-

This pattern is repeated for additional units as follows:

- Pin 2 of the second connector runs to pin 3 of the third.
- Pin 8 of the second connector runs to pin 7 of the third.
- etc.

When using the rack mount card cage the backplane automatically handles the synchronization needs

3 Operation

3.1 Configuration with the Graphic User Interface

3.1.1 Overview

The FT-512 GUI Optimizer software allows you to configure, test and monitor Trailblazer products easily through familiar setup screens.

There are several screens that serve as input/output graphical representations of a more complicated Command Line script language. Operating parameters of the FT-512 boards are stored in Flash EEPROM onboard, simplifying manufacturing and field configuration.

3.1.2 Installation of FT-512 GUI CD in a computer

The GUI software is provided on a CD-ROM disc. It may be installed on any Microsoft Windows 9x/ME/NT/2000/XP equipped PC with an available RS-232 serial communications (COM) port. The screen resolution must be at least 800 x 600 (SVGA). The following describes the installation:

- Insert the CD-ROM disk. If the installation doesn't begin immediately you will have to double click the [CD drive letter]:\setup.exe file through the Start→ Run → Browse to CD drive and then double click on **setup.exe**.
- Accept all of the *default* choices presented to you by the installation software.
- See our web site to insure you have the latest software release.
- Don't execute the installed software until connecting the cable link as described below.

3.1.3 Communications with the FT-512 and a computer

You will need a standard PC running Windows 9x, ME, NT4, 2000 or XP with a spare asynchronous serial Communications (COM) port numbered 1 through 4.

A Serial Communications (SC) Cable is supplied with your system. This cable is a transmit/receive and CTS/RTS cross pair, DB9 female to a DB9 male. If this cable is lost or should need to be replaced for any reason, see the Appendix for configuration port pin-outs to describe its makeup.

3.1.4 Running the FT-512 GUI CD in a computer

Please have the COM cable connected before starting the GUI program. After a brief CWT splash screen with the GUI version number you will get a Select Port choice window.

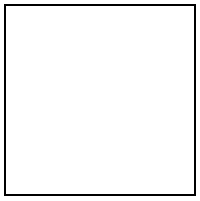


Figure 10: COM Port Selection

Use this to select which COM port you have the SC cable connected to. Typically this is COM1 or COM2. Ignore the statement that "the configured serial port is not valid". This window will no longer appear once you (see below) have selected a default COM port on the password tab.

3.1.5 Password Entry and Privileges

You will need to enter your password and then hit the *TAB* key. The factory set password for this is "*superuser"*.
This screen allows for 3 levels of privileges including changing your password.

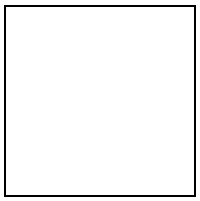


Figure 11: Password Screen

The Super User can change any assignments including the unit's SFD number, and the default COM port setting.

Set COM Port here

change any assignments except the unit's SFD number, and the default COM port settings.

The Restricted user cannot change any assignments. He/She can only view the current settings and perform tests.

3.1.6 Configuring the Basic Parameters

The next screen presented is the Configure screen. This is where the setup of the radio is done.

The rotary switch position onboard the FT-512 is also shown here.

Note at the bottom of the screen is a progress bar.

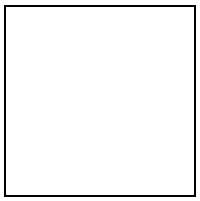


Figure 12 GUI – Configure Screen w/ Progress Bar at Bottom

For trouble free operation, allow the progress bar to *complete its task* before selecting other functions.

Serial Number. This is *set at the factory* and is used by the factory for part and revision identification.

Setting the Special Field Delimiter number. The Special Field Delimiter (SFD) number is set by the super user. This is what gives the part it's uniqueness and *security over the airwaves*. You must have the *same SFD number in two units* that you want to communicate together. The number must be between 1 and 65534.

Switch Position. This window will read out what the setting of the rotary switch on the FT-512 is. *Only switch position 0 allows the user to configure the operating frequencies*. Non zero switch settings select the pre-programmed frequencies that can be seen in the right hand window.

Master/Slave. Of any pair, one is set as Master and the other is Slave*. If more than one pair are collocated, they must be all be Masters at that end.*

Data Speed. Selection of the desired synchronous data rate is accomplished with this pushbutton. Choices of 512, 256, 128 and 64 kb/s exist.

DTR Line Active. DTR stands for Data Terminal Ready. It is part of the data port flow control logic which qualifies data as acceptable or unacceptable. Considering that the Trailblazer, by default, will emulate the DCE side of a V.35 port, a typical handshaking session would go as such:

> If the setting is "yes" , then the unit will operate without a user supplied DTR signal. If "no", then the unit must see a high signal on DTR before a connection can be established. When the Terminal equipment has booted, DTR will go high, When the Trailblazer's COM link is up, is ready to accept and send data, and sees the opposing DTR high, it will raise DCD (Data

Carrier Detect) & CTS (Clear To Send), CTS will only go high if RTS is high. If the Trailblazer's elastic buffer fills up, it will lower CTS.

Link Always Up. This is set to "Yes" if the system is designed for "always up" data use. If the system is used for POTS telephone service and should be off air when idle, then the switched position of "No" would apply.

CDMA Code. We allow 4 non orthogonal codes to be used. This can be beneficial for reusing frequencies within a given area. The paths need to be isolated by 30dB and the units synchronized when collocated.

3.1.7 Choosing Channel Configurations

The channel center frequencies are mapped to a number in the following charts. They can be configured and downloaded using the FT-512 GUI application running on a PC, or by using the manual selector switch as described in the following section.

The first group of non-overlapping channels		
Channel 1	2412	MHz
Channel 2	2424	MHz
Channel 3	2436	MHz
Channel 4	2448	MHz
Channel 5	2460	MHz
Channel 6	2472	MHz

The next group of offset channels		
Channel 7	2418	MHz
Channel 8	2430	MHz
Channel 9	2442	MHz
Channel 10	2454	MHz
Channel 11	2466	MHz

NOTE: Channels 6 and 11 not used in USA

Table 7: Channel Selection Table

3.1.8 Frequency Selection

This system uses a common channel for administrative setup and tear down of the link. Start by choosing the administrative or signaling frequency. There is a drop down menu that appears when selecting the signaling frequency box. For selecting frequencies for the operating pool simply highlight and then hit the → right arrow key. To remove a frequency from the pool, highlight then hit the ← left arrow key.

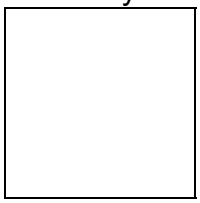


Figure 13: Selecting the Signaling Channel

Once the signaling frequency is selected, the operating frequencies are selected by highlighting the number desired and then clicking on the single -> right arrow. There can be as many as 5 operating frequencies in the pool. If transmission is impaired the system will choose the next frequency in line.

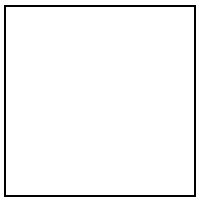


Figure 14: Selecting the Operating Channel

As a default we have selected 2.424, 2.448 and 2.460 GHz.

3.1.9 POTS Lines and Onboard V.35 Port Setup

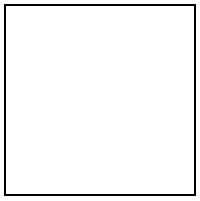


Figure 15: GUI - POTS lines and onboard V.35 port

This screen allows one to implement a mixture of POTS and V.35 synchronous serial data services. At the bottom of the screen calculations show original, used and remaining bandwidth capacity. You can select a mix of services until the unused is zero. Always hit the apply button and wait until the progress bar has completed before exiting the screen.

3.1.10 QUAD V.35 Port Add-on Card Setup Information

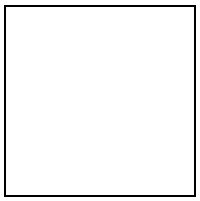


Figure 16: GUI - Quad V.35 Port Setup

This screen allows one to implement up to four V.35 synchronous serial data ports operating at different clocking rates. At the bottom of the screen calculations show original, used and remaining bandwidth capacity. You can select from individual ports until the remaining Kb/s is zero. Always hit the apply button and wait until the progress bar has completed before exiting the screen.

4 Test & Maintenance

4.1 Diagnostics

4.1.1 Description of Diagnostic Functions

The configuration GUI can be very useful at setup time. The disadvantage is that it requires a PC (laptop).

4.1.2 GUI Signal Strength and Packet Error Testing

This screen is used for testing the radio path performance in the field. It shows in large letters the Current frequency, Signal strength and Packet errors.

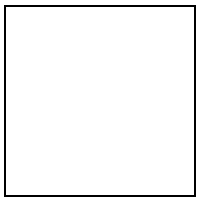


Figure 17: GUI - Signal Strength and Channel Testing

Along the bottom there are buttons for interference testing of any frequencies you have listed in the pool. *Always transfer out of this screen and back to configure before exiting the program!*

4.1.3 System Information

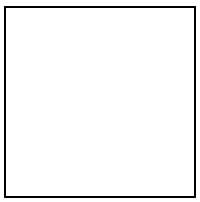


Figure 18: GUI - System Information

This screen shows the software and firmware revisions, history of resets, what type of Add-on card is connected if any, number of devices the Add-on card may have, and relative time and date. The time and date are not maintained if power is lost or the system is reset so it should be the last thing set.

Reset causes are broken down as such:
Power – number of times the supply voltage failed.
External – number of times the manual pushbutton has been depressed.
Brownout – number of times the supply voltage went below the minimum of 10 volts but did not fail completely.
Watchdog – number of times the watchdog initiated a reset.

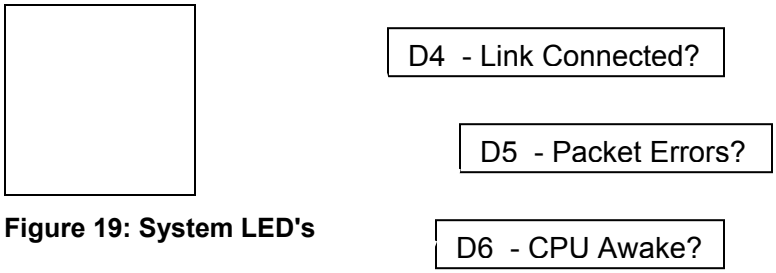


Figure 19: System LED's

4.1.4 LED Function

The LED's labeled D4, D5 and D6 represent the following functions;

D4 – (SYSTEM ACTIVE) This led is lit if the Microprocessor is trying to connect or connected.

D5 – (PACKT ERR) This will flash for a fraction of a second when the units are establishing a link and then after the link has been established it should go dark. It then will light for ½ of a second if it detects any packets with data errors. This would occur with interference or insufficient path margin.

D6 – (CPU WAKE) This led will flash rapidly once the hardware has completed the "power on self test" (post) procedure successfully.

4.1.5 In Factory Tests

The following compliance tests are competed in the factory before the product is shipped:

FT-512 Quality Assurance Testing

Engineer _____ Date _____ Serial Number _____

	Slave	Master
Hardware		
1. PC Board Revision #	Rev.	Rev.
2. Visual Inspection		
a. S2 soldered to ground		
b. Switch position - (Default 0)		
Voltage / Current		
3. Test bench voltage (20.0 VDC)	VDC	VDC
4. Current draw	mA	mA
5. 5 volt regulator (Measure @ JP18)		
6. 3.3 volt regulator (Measure @ JP19)		
7. 2.5 volt regulator (Measure @ JP20)		
Software		
8. Fuse bit programming		
9. AtMega program load	Version 1.	Version 1.
10. FPGA passed LED test	Version 1.	Version 1.
Configuration port test		
11. CDMA Code (1, 2, 3, 4)		
12. Set Master / Slave (M, S)		
13. Set speed (512, 256, 128, 64)		
14. Set serial number		
Clocking and Sync		
15. Sync. port in/out test		
16. Clock speed @ (512, 256, 128, 64)		
17. External clock Auto-Sync		
18. Co-location sync test		
24 Hr Burn-In Assurance Test		
Radio Test		
19. Radio serial number		
20. Freq. with radio on line (32.768 MHz)		
21. Freq. Admin and operate		
a. V.35 data port bit error test		
b. RS_232, DSR, CTS DCD test		
22. Radio power @ mid-band	dB	dB
23. RSSI test with 100dB att.	dB	dB
Shipping and Assembly		
24. Internal antenna gain test		
25. External antenna test		

Shipped with serial cable _____ GUI CD Version 2.___

4.2 Maintenance

4.2.1 Installation of Software Upgrades

(Yet to be completed)

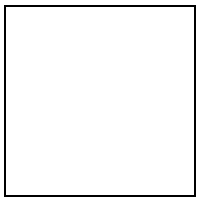
4.2.2 Installation of Firmware Upgrades

(Yet to be completed)

4.3 Troubleshooting

4.3.1 Units are on the Bench

The following flowchart should help focus in on the fault.
Assuming you have a pair of boards on the bench with adequate power connected.



Heartbeat LED - D1

Figure 20: LED - D1

Is the Microprocessor heartbeat LED -D1, flashing?

D4 should be on steady- otherwise the unit is resetting
D5 should not be lit – other wise it getting packet errors
D6 should be flashing rapidly – showing the micro processor is awake.

If you connect the GUI with a console cable, are you able to communicate.
Once communication is established:

Do the SFD numbers match?
Are both Administrative channels the same?
Is there an Operating channel set in the “Master”?
Is one unit a “Slave” and the other a “Master”?
Are both rotary switches set on 0?
Are the CDMA codes the same on each pair? (1 through 4)
Are both Data Rates set the same?

5 Product Accessories / Options

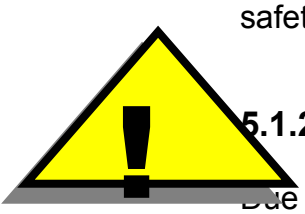
5.1 External Antenna - Professional Installers Only

Detached antennas, whether installed indoors or out, should be installed ONLY 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 CWT 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. In the United States, this product must not be co-located or operating in conjunction with any other antenna or transmitter ."

5.1.1 Scope

This section is designed to support the installation, operation and maintenance of the 24 dBi high gain parabolic grid antenna used in conjunction with the FT-512 Trailblazer All-Digital Remote Wireless Telephone Link. To avoid harm to persons or damage to the product please ensure that you have read through the safety, unpacking and installation sections before proceeding.



5.1.2 RF Safety Hazard Warning

Due to the substantial energy radiated from the antenna, this product must never be mounted such that the cabinet containing the antenna can be closer than 2 Meters (6.7 Feet) to any persons.

5.1.3 Unpacking

Please note any damage to the box and report to shipper before opening. The 24 dBi 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.

Upon opening the box one will find an N-female to N-male 36 inch long cable taped to the grid reflectors which are face down with corners padded. After removing the reflectors there will be a remaining box taped to the bottom. Inside this box will be the mounting bracket, clamp and hardware, extension tube, and dipole.

5.1.4 Product Overview

The 24 dBi Parabolic Grid Antenna is welded galvanized steel with gray epoxy powder coat paint. Because of the design and color, it blends well with any background. This antenna has a history thousands of successful field installations over the years. Antennas are complete with Reflector, Patented Dipole and Heavy Duty brackets for 1 to 2.5 inch diameter poles. These antenna systems are designed to survive high wind environments.

Refer to the “Product Specification” Section for specification and characteristics.

Features

- 50 Ohm Passive Feed Dipole
- Horizontal or Vertical Mounting
- Type N Female Connector
- Rugged, Lightweight and Waterproof
- Adjustable Tilt Bracket

Cross-Wind Handling Capabilities of Reflector Antennas

Simple wind load calculations are based on the worst case condition of a cross wind on a 24dBi reflector type antenna. The wind loading and resulting wind induced torque, of the dipole and the reflector were taken separately to simplify the torque calculations.

The wind side surface area of the dipole is 19 sq. in. at a center point 9.5 inches from the pole (pivot axis). The reflector wires are estimated to have a side sectional surface area of 78 sq. in. at a center point 5.5 inches from the pole.
At 100 MPH (146.7 fps or 0.1444 Mach) the equivalent wind pressure is .221 PSI. The dipole load is Fdp = 19 x .221 = 4.2 lbs., and the reflector load is Fref = 78 x .221 = 17.2 lbs.

The total torque at the pole is the sum of the dipole and reflector torque: Ttotal = Tdp +Tref = Fdp x 9.5" + Fref x 5.5" = 39.9 + 94.6 = 134.5 in-lbs or 11.2 ft-lbs at the pole.

Measurements show the bracket holding torque to be 26 ft-lbs with the bracket nut tightened to 30 in-lbs (hand tight on a wing nut), 50 ft-lbs with a nut torque of 55 in-lbs and 70 ft-lbs with a nut torque of 75 in-lbs.

Follow up verification was performed by mounting a video camera to a mast pole while the reflector and dipole were subjected to 80 MPH winds. Throughout the test, no rotation or vibrations were observed, in either a head wind or a cross wind.

5.1.5 Installation

The use of an external antenna with Model FT-512 Trailblazer Pro 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.

Calculating the EIRP of an External antenna

The output of the FT-512 Trailblazer radio is calibrated at the factory to +16 dBm +/- 2dB. It is not adjustable in the field. The 36 inch LMR 400 “N” to “N” short cable allows the Trailblazer system to be located just behind the antenna with losses totaling approximately 2 dB. The external antenna sold by CWT has a gain throughout the 2.4 ISM band of 24dBi.

Using this as an example one can calculate the following:
Given a radio maximum output power of 18 dBm - interconnecting cable losses of 2 dB = total power arriving to antenna of 16 dBm. Now adding the 24 dB Antenna gain of 24 dB = A total Effective Rated Power of 40 dBm.

The “3 for 1” FCC rule states that for every 3 dB above 6 dB of antenna gain you must lower the maximum RF power available to the antenna from +30 dBm by 1 dB. In this example the antenna gain is (24 – 6) 18 dB above 6 or (18 / 3) or 6 times 3 dB above 6 dB. Checking to see if the transmit power meets the rule is done by subtracting 6 from +30 dB equaling +24 dBm. The transmitter output RF power is +18 dBm max.

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

Note that this manual is designed for Professional Installers Only.

Detached antennas, whether installed indoors or out, should be installed ONLY 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 CWT 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 Model I WLL Trailblazer System require topographic analysis, site survey, and link budget calculation; therefore CWT trained professionals are required to perform the installation.

Marketing and sales channels

CWT DOES NOT sell the Trailblazer PRO direct to end users. i WLL Trailblazer PRO System will be sold only to CWT's Authorized Resellers. Those authorized resellers are technically trained by CWT's Engineers periodically and must follow the rules set by CWT. 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 be done ONLY by professional installers that are familiar with the FCC regulations. CWT does not sell the Trailblazer PRO in the consumer business at all. We have 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 in technical trade shows and magazines.

5.1.6 Mounting

Rough alignment. This is usually easier then it would seem. Since it is a prerequisite that you have line of sight between the two points, here are several ideas that have worked for installers:
(1) If you can see the other unit, simply aim the units towards each other. (2) During midday, use a mirror or compact disk to create a reflection approximately towards the other site while someone watches for the flash.
(3) Plot out the path on a topographical map and set the antennas using a compass.

How close in alignment do they need to be? +/- 10 degrees will be adequate for most paths using the 14 dB gain antenna. Certain paths that have a low fade margin may require a more accurate setting.

Alignment indicators: Due to the nature of digital modulation and the associated circuitry, there is not analog test point where signal strength may be monitored. Rather, the bit error rate may be monitored on the digital board. With an ideal link errors will not be encountered and the LED will not illuminate. If there are obstructions or interference in the link this LED will begin to blink. The rate of flash is an indication of a degraded link with a higher flash rate indicating more errors and hence a poor link.

Final alignment is performed by connecting a standard telephone directly to the subscriber (FXS) wide and listening to the dial tone. As the antenna (device housing) is moved to the left the signal will degrade, the bit error LED will flash, and eventually the link will be lost. Noting where the antenna is aimed when the link is lost the antenna is then rotated to the right until the same dropout is experienced. The antenna is then located in a final position which is midway between these points. Due to the 33 degree beam width of the antenna this method of alignment is more than sufficient to ensure proper alignment.

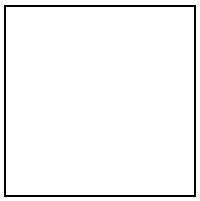


Figure 21: Mounting of Parabolic Grid 24 dBi Gain Antenna (Horizontally Polarized)

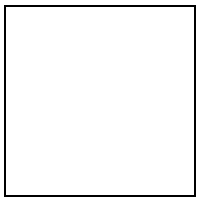


Figure 22: 24 dBi External Antenna Diagram

6 Appendix

6.1 About Carlson Wireless

6.1.1 Mission

Carlson Wireless Technologies (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 for rural and remote telephone users worldwide.

6.1.2 History

CWT was founded in 1999 by James Carlson. This followed year long product development by a team of engineers working for Carlson Engineering Services (CES). In 1999 Carlson Wireless Technologies Inc. (CWT) was formed to purchase the rights to the digital wireless telephone system designed from CES. In April 2002 CWT purchased the assets of Adicom Wireless Inc. formerly of Pleasanton, CA. Adicom Wireless had spent 4 years and over $40 million in development of a CDMA multipoint system. The designs and patents are being utilized in this newer FT-512 point to point and point to multipoint product line.

Carlson Wireless Technologies, Inc. is a privately held California “C” corporation headquartered in Redway, California.

6.1.3 Summary

CWT is marketing the Trailblazer product through established telecom and wireless equipment distributors. Please contact our pre-sales department +1 707 923 3000, or sales@carlsonwireless.com for more information.

6.2 Technical Specifications N x 64 Serial Radio

Trailblazer FT-512 – Fractional E1/T1 N x 64 Serial Radio *(Sep 2002)*

SYSTEM SPECIFICATIONS	
Product Description	Digital Microwave Radio with a Programmable V.35 Synchronous Data Port
Air Interface	Proprietary Time Division Duplexing with Direct Sequence Spread Spectrum
Overall Data Throughput Rate	512 , 256, 128, 64 kbps, selectable from configuration GUI
End-to-End System Latency	Less than 5 ms
System Range: (256kbps) w/ Std. Internal 14 dBi Antenna	14 miles (22 km) Nom w/ 12 dB Fade Margin and Interference Free Spectrum
w/ Opt. External 24 dBi Antenna	30 miles (48 km) Nom w/ 16 dB Fade margin and Interference Free Spectrum
DATA CHANNEL SPECIFICATIONS	
Synchronous Data Port Interface	V.11 (V.35 w/ RS422 and RS232)
Synchronous Data Rate	512 kbps, 256kbps, 128kbps, 64kbps
Clocking	Transmit data and receive data clocks generated internally. Will sync to an external clock on the master side for a "tail circuit" operation.
Data Interface Connector	25 pin "D" type female
Configuration Connector	9 pin "D" type female
POWER REQUIREMENTS & CONSUMPTION	
Filtered DC nominal	12 to 48 volts, Earth Ground Required
Absolute Minimum – Maximum	10 to 56 volts
Operating Current	2 Watts (i.e. 20v @ 100ma) Typical
AC Adapter	Supplied Separately (100 to 260 VAC, 50-60 Hz)
RF PERFORMANCE	
Frequency Range: Standard Model	2400 to 2483.5 MHz
RF Channels	13 Operational reserving 1 for Administrative
Spreading Method	Direct Sequence with 16 PN Code Length
Modulation	Direct Sequence BPSK or QPSK
Processing Gain	12.04 dB
RF Output Power	+15 min with 17 dBm Typical
Max System ERP	31 dBi (17 dBm + 14 dBi Antenna)
Receive Sensitivity	-93 dBm/256 kbps @10-6 BER –90 dBm/512 kbps @ 10-6 BER
Transmit/Receive Burst Packet Synchronization	RS-422 Balanced Pair, Output and Input
Antenna	Integrated Internally
w/ Opt. External 24 dBi Antenna	30 miles (64 km) Nominal w/ 16 dB Fade Margin
External Antenna Port	"N" Type Female
ENVIRONMENTAL & PHYSICAL SPECIFICATIONS	
Operating Temp	-30 to +60 Degrees C (Ambient with Solar Shielding)
Humidity	0 to 95% - Non-Condensing
Shock and Vibration	Mil Standard 810 D
Mounting	25 – 50 mm (1 to 2") pipe or rack mount for co-located option
Exposure to the Elements (in outside enclosure)	NEMA 4X, Rain, Wind, and Ice Protected
Enclosure Material	GE Valox99® Polycarbonate w/ Neoprene Gasket
Unit Weight (field station complete)	8 lbs; 3kg
Unit Dimensions	8 1/2 x 10 1/2 x 5 inches; 22 x 27 x 13 cm

Shipping Weight (pair of FT-512 units complete)	20 lbs; 8 kg
Shipping Container Size	19 x 15 x 13 inches; 47 x 37 x 32 cm
INTEGRATED ANTENNA SPECIFICATIONS	
Frequency Range	2350 to 2500 MHz
Impedance	50 Ohm
Connector	SMA Male Reverse
Forward Gain on “E” Plane	13.8dBi
VSWR	1:1.5 or 14 dB RL
Front to Back Ratio	25 dB
3 dB Beamwidth	Horizontal - +/- 14 Degrees, Vertical - +/- 18 Degrees
Polarization	Normal Configuration Vertical
WARRANTY	1 Year Parts and Labor
Specifications Subject to Change without Notice.	

6.3 Technical Specifications 8 Line FXS plug in card

FEATURES:

Worldwide dial-up telephone network compatibility

Enhanced V.90 modem performance

All CLASS services fully supported including Caller ID and CWID

Pay Phone compatible with soft loop reversal and optional 12/16 kHz Signal Pulse Metering (TTX)

Will extend a line build out up to 1200 ohms (17km with 19ga. wire)

Complies with the requirements of LSSGR, TR57, ITU Q.552, and G.712

GENERAL SPECIFICATIONS	
Product Description	Foreign Exchange Subscriber Card
DS-0 lines	2, 4 or 8 depending on order
Regulatory	LSSGR, TR57, ITU Q.552, and G.712
Line and Balance Impedance	Both resistive and reactive can be set per country requirements
2 WIRE LINE SPECIFICATIONS	
Open Loop Voltage	24 to 48 volts, selectable
Loop Current	24 ma max
Maximum Loop Length	1200 ohms
Ringing Voltage	42 standard, optional 42 to 80 VAC
Ringing Load	3 REN
Ringing Waveform	Balanced sinusoidal
Idle channel noise – 2w port	u-Law, -16 dBrnC, A-Law, -74 dBmp
Idle channel noise – PCM side	u-Law, -18 dBrnC, A-Law, -69 dBmp
Longitudinal Balance	L-T -53dB, T-L - 46dB, 4-L -46dB
TTX Generation	12 or 16 kHz, typ set to 200 mv rms.
Gain Tracking	Ref 1014 Hz, -10dBm0, +/- 0.25 dB from -40 to 0dBm0
Nominal Transmit Level	0.0 dBm0, factory programmable
Nominal Receive Level	-2.0 dBm0, factory programmable
2 wire port return loss	26 dB min.
POWER REQUIREMENTS & CONSUMPTION	
Filtered DC nominal	12 to 48 volts, Earth Ground Required
Absolute Minimum – Maximum	10 to 56 volts
Operating Current: no load, full load	1 Watts (i.e. 20v @ 50ma) , 4 watts with all lines active
ENVIRONMENTAL & PHYSICAL SPECIFICATIONS	
Operating Temp	-30 to +60 Degrees C (Ambient with Solar Shielding)
Humidity	0 to 95% - Non-Condensing
Shock and Vibration	Mil Standard 810 D
Shipping Weight	4 lbs; 2 kg
WARRANTY	1 Year Parts and Labor
Specifications Subject to Change without Notice.	

6.4 Technical Specifications 8 Line FXS plug in card

FEATURES:

Worldwide dial-up telephone network compatibility

Transient protection to 5 kilovolts

Superior voice solution with low noise and excellent line impedance matching

Designed for maximum performance with modems up to V.92

All CLASS services fully supported including Caller ID and CWID

Pay phone loop reversal detect and optional 12/16 kHz Signal Pulse Metering (TTX) detection

Complies with the requirements of TIA/EIA/IS-968 (FCC), UL 1950, UL 60950, EN 60950, IEC60950, EN55022B, CISPR22B, EN55024, and TRB-21

GENERAL SPECIFICATIONS	
Product Description	Foreign Exchange Office Card
DS-0 lines	2, 4 or 8 depending on order
Regulatory	TIA/EIA/IS-968 (FCC), UL 1950, UL 60950, EN 60950, IEC60950, EN55022B, CISPR22B, EN55024, and TRB-21
Line and Balance Impedance	Both resistive and reactive can be set per country requirements
2 WIRE LINE SPECIFICATIONS	
Maximum Loop Length	1500 ohms or 18 ma.
Ring Equivalent Number	0.3B per line
Ring Detect Threshold	24-110 Vrms, 17-34 Hz
Ring	Balanced sinusoidal
Idle channel noise – 2w port	u-Law, -16 dBrnC, A-Law, -74 dBmp
Idle channel noise – PCM side	u-Law, -18 dBrnC, A-Law, -69 dBmp
Longitudinal Balance	L-T -53dB, T-L - 46dB, 4-L -46dB
Gain Tracking	Ref 1014 Hz, -10dBm0, +/- 0.25 dB from -40 to 0dBm0
Nominal Transmit Level	0.0 dBm0, factory programmable
Nominal Receive Level	-2.0 dBm0, factory programmable
2 wire port return loss	26 dB min.
POWER REQUIREMENTS & CONSUMPTION	
Power provided by FT-512 card	
Operating Current: no load, full load	Less than 100 mw with all lines active
ENVIRONMENTAL & PHYSICAL SPECIFICATIONS	
Operating Temp	-30 to +60 Degrees C (Ambient with Solar Shielding)
Humidity	0 to 95% - Non-Condensing
Shock and Vibration	Mil Standard 810 D
Shipping Weight	4 lbs; 2 kg
WARRANTY	1 Year Parts and Labor
Specifications Subject to Change without Notice.	

6.5 Cable Pin outs

6.5.1 Configuration Port Pin out

A DB9 pin Female to be fit in the PC is wired with:

DCD on pin 1, (not used)

TX Data on pin 2,

RX Data on pin 3,

DTR on pin 4, (not used)

SG (signal ground) on pin 5

DSR on pin 6,

RTS on pin 7,

CTS on pin 8,

RI on pin 9, (not used)

A DB9 pin Male to be fit in the FT-512 is wired with:

Rx Data to pin 2,

Tx Data to pin 3,

DSR to pin 4,

SG (signal ground) to pin 5

CTS to pin 7,

RTS to pin 8,

6.5.2 Synchronization Port Pin out

A DB9 pin Male to be fit in the signal source master, is wired with:

SYNC_OUT+ on pin 2,

SYNC_OUT- on pin 8,

A DB9 pin Male to be fit in the signal receiving master is wired with:

SYNC_IN+ on pin 3,

SYNC_IN- on pin 7,

6.5.3 V.35 Port - Wiring the DB 25 to a Typical 34 pin Winchester

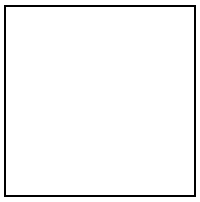


Figure 23: V.35 Wiring Pin out

6.6 Warranty

Limited Warranty, USA

Carlson Wireless Technologies (CWT) 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 two (2) years 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 +1-707-923 3000, for a RMA (Return Materials Authorization) number and mail your product adequately packed, postage paid and insured to the address provided. This warranty is extended only to the original purchaser. A purchase receipt or other proof of date of original purchase will be required before warranty performance is rendered. This warranty only covers failures due to defects in materials or workmanship which occur during normal use. It does not cover damage which occurs in shipment or failures which are caused by products not supplied by Carlson or failures which result from accident, misuse, abuse, neglect, mishandling, misapplication, alteration. modification, lightning, line power surge, introduction of sand, dust, humidity and liquids or commercial use of the product, 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. If the problem is not handled to your satisfaction, fax, phone, or write the company at the address indicated in the service section of this manual.

6.7 Antenna Patterns

6.7.1 Internal Antenna Patterns

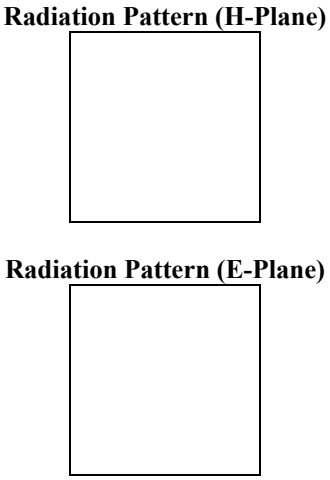


Figure 24: Internal Antenna Patterns

External Antenna Pattern

Specifications:

Input Return Loss	-12 dB
VSWR	1.5:1
Impedance	50 Ohms
Pole Diameter	1 to 2.5 in., 2.5 to 6 cm
Operating Temperature	-45 to +70 C
Gain	24 dB
3 dB Beam Angle	8 Deg
Cross Pole	26 dB
Front to Back	> 24 dB
Side Lobe	-20 dB
Wind Loading (100mph)	40 lbs
Weight	8.2 lbs
Dimensions	34 x 28 in., 86 x 71 cm

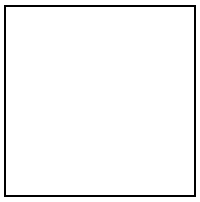


Figure 25 : High Gain External Antenna Radiation Characteristics

6.8 Acronyms/Abbreviations

ACK..... acknowledgment
ALM..... alarm
ANSI ..... American National Standards Institute
AR..... access rate
ARP ..... address resolution protocol
async ..... asynchronous
BOP ..... bit oriented protocol
CCITT..... Consultive Committee for International Telephony and Telegraphy
CD ..... carrier detect
CO ..... central office
CPE..... customer premise equipment
CR, C/R..... command response
CRC..... cyclic redundancy check
CS ..... clear to send
CSU ..... channel service unit
CTS..... clear to send
dB..... decibel
DCD..... data carrier detect
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
FEP..... front end processor
FIFO..... first in first out
FR..... frame relay
FRAD ..... frame relay access device
FSU..... frame relay service unit
GUI..... graphical user interface
HDLC..... high-speed data link control
IA..... inactive
IP..... internet protocol
ISDN..... integrated services digital network
ITU..... International Telecommunications Union
KA..... keep alive
kbps..... kilobits per second
LAN..... local area network
LED..... light emitting diode
LLC..... logical link control
LMI..... local management interface
LRC ..... lateral redundancy check
MIB ..... management information base

ms ..... millisecond
OCU ..... office channel unit
OOS..... out of service
PPP ..... point-to-point protocol
PU..... physical unit
PVC ..... permanent virtual circuit
RD ..... receive data
RDL..... remote digital loopback
RFC..... request for comments
RIP..... routing information protocol
RMA..... return material authorization
RNR..... receiver not ready
RR..... receiver ready
RS ..... request to send; also recommended standard
RTS..... request to send
Rx..... receive
SAP..... service access point
SDLC..... synchronous data link control
SLIP..... serial line internet protocol
SNA..... systems network architecture
SNMP ..... simple network management protocol
SPID..... service profile identifier
SR ..... data set ready
SW56 ..... switched 56
sync..... synchronous
TD..... transmit data
TR ..... data terminal ready
TX ..... transmit
UA..... unavailable
UNI..... user-to-network interface
WAN..... wide area network

6.9 Glossary

American National Standards Institute (ANSI)
Devices and proposes recommendations for international communications standards.

asynchronous
A method of data transmission which allows characters to be sent at irregular intervals by preceding each character with a start bit, followed by a stop bit.

bandwidth
The bandwidth determines the rate at which information can be sent through a channel (the greater the bandwidth, the more information that can be sent in a given amount of time).

bridge
A device that supports LAN-to-LAN communications. Bridges may be equipped to provide frame relay support to the LAN devices they serve. A frame relay capable bridge encapsulates LAN frames in frame relay frames and feeds them to a frame relay switch for transmission across the network. A frame relay capable bridge also receives frame relay frames from the network, strips the frame relay frame off each LAN frame, and passes the LAN frame on to the end device. Bridges are generally used to connect LAN segments to other LAN segments or to a WAN. They route traffic on the Level 2 LAN protocol (e.g. the Media Access Control address), which occupies the lower sub-layer of the LAN OSI data link layer. See also router.

CD
carrier detect. A signal generated by a modem or DSU/CSU. CD indicates the presence of a carrier signal on a communications link.

channel service unit
CSU. A device used to connect a digital phone line (T1 or Switched 56 line) coming in from the phone company to either a multiplexer, channel bank, or directly to another device producing a digital signal; for example, a digital PBX, a PC, or data communications device. A CSU performs certain line-conditioning and equalization functions, and responds to loopback commands sent from the central office. A CSU regenerates digital signals. It monitors them for problems, and provides a way of testing the digital circuit.

clocking
An oscillator-generated signal that provides a timing reference for a transmission link. A clock provides signals used in a transmission system to control the timing of certain functions. The clock has two functions, (1) to generate periodic signals for synchronization and (2) to provide a time base.

CPE
customer premise equipment. All telecommunications terminal equipment located on the customer premises, including telephone sets, private branch exchanges (PBXs), data terminals, and customer-owned coin-operated telephones.

C/R bit
In the Q.921 protocols, a bit that identifies a data-link-layer frame as either a

command or a response.

CRC

cyclic redundancy check. A computational means to ensure the accuracy of frames transmitted between devices in a frame relay network. The mathematical function is computed, before the frame is transmitted, at the originating device. Its numerical value is computed based on the content of the frame. This value is compared with a recomputed value of the function at the destination device.

CS

See CTS.

CSU

See channel service unit.

CTS

clear to send. A signal on the DTE interface indicating that the DCE is clear to send data.

DBU

dial backup. Providing a secondary, switched dial service to route data upon primary link failure.

data service unit

DSU. A device designed to transmit and receive digital data on digital transmission facilities.

dB

decibel. A unit of measure of signal strength, usually the relation between a transmitted signal and a standard signal source.

data communications equipment (DCE)

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.

DDS

digital data service. A private line digital service, for transmitting data end-to-end at speeds of 2.4, 4.8, 9.6, and 56 kbps and in some cases 19.2, 38.4, or 64 kbps. The systems can use central hub offices for obtaining test access, bridging legs of multipoint circuits, and cross connecting equipment. DDS is offered on an inter-LATA basis by AT&T and on an inter-LATA basis by the Bell operating companies.

data link connection identifier (DLCI)

A unique number assigned to a PVC end point in a frame relay network. Identifies a particular PVC endpoint within a user's access channel in a frame relay network and has local significance only to that channel.

discard eligibility (DE)

A user-set bit indicating that a frame may be discarded in preference to other frames if congestion occurs, to maintain the committed quality of service within the network. Frames with the DE bit set are considered Be excess data.

DSR

data set ready. A signal on the EIA-232 interface that indicates if the communications is connected and ready to start handshaking control signals so communications can begin.

DSU

See data service unit.

DSU loopback

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

data terminal equipment. The end-user terminal or computer that plugs into the termination point (DCE) of a communications circuit. The main difference between the DCE and the DTE is that pins two and three are reversed.

end device

The ultimate source or destination of data flowing through a frame relay net-work sometimes referred to as DTE. As a source device, it sends data to an inter-face device for encapsulation in a frame relay frame. As a destination device, it receives de-encapsulated data (i.e., the frame relay frame is stripped off, leaving only the user's data) from the interface device.

encapsulation

A process by which an interface device places an end device's protocol-specific frames inside a frame rely frame. The network accepts only frames formatted specifically for frame relay; therefore interface devices acting as interfaces to a frame relay network must perform encapsulation. See also interface device and frame-relay-capable interface device.

file server

In the context of frame relay network supporting LAN-to-LAN communications, a device connecting a series of workstations within a given LAN. The device per-forms error recover and flow control functions as well as end-to-end acknowledgment of data during data transfer, thereby significantly reducing overhead within the frame relay network.

gateway

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

high level data link control (HDLC)

A generic link-level communications protocol developed by the International Organization for Standardization (ISO). HDLC manages synchronous code-transparent, serial information transfer over a link connection. See also synchronous data link control (SDLC).

host computer

The primary or controlling computer in a multiple computer operation.

in-band

Signaling (dialing, diagnostics, management, configuration, etc.) over the same channel used for data.

ingress

Frame relay frames leaving from an access device in a direction toward the frame relay network.

interface device

Provides the interface between the end device(s) and a frame relay network by encapsulating the user's native protocol in frame relay frames and sending the

frames across the frame relay backbone. See also encapsulation and frame-relay-capable interface device.

IP

internet protocol. A protocol which provides for transmitting blocks of data between hosts identified by fixed-length addresses.

ISDN

integrated services digital network. A network architecture that enables end-to-end digital connections. The network supports diverse services through integrated access arrangements and defines a limited set of standard, multipurpose interfaces for equipment vendors, network providers, and customers. Inter-working with a public switched telephone network is retained.

local area network (LAN)

A privately owned network that offers high-speed communications channels to connect information processing equipment in a limited geographic area.

MIB

management information base. A database of network management information used by SNMP.

multi-point

A configuration or topology designed to transmit data between a central site and a number of remote terminals on the same circuit. Individual terminals will generally be able to transmit to the central site but not to each other.

out-of-band

Signaling that is separated from the channel carrying information (voice, data, video, etc.). Typically the separation is accomplished by a filter. The signaling includes dialing and other supervisory signals.

packet

A message containing both control information and data. The control information is used for routing the packet through a network to its final destination. Contrast with frame relay frame.

packet-switching network

A telecommunications network based on packet-switching technology, wherein a transmission channel is occupied only for the duration of the transmission of the packet. Contrast with frame relay network.

parameter

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

ping

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

point-to-point

Type of communications link that connects a single device to another single device, such as a remote terminal to a host computer.

remote configuration

A feature that allows the slave to be configured from the master or VT-100 compatible terminal.

router

A device that supports LAN-to-LAN communications. Routers may be equipped to provide frame relay support to the LAN devices they serve. A frame-relay-capable router encapsulates LAN frames in a frame relay frames and feeds those frame relay frames to a frame relay switch for transmission across the network. A frame-relay-capable router also receives frame relay frames from the network, strips the frame relay frame off each frame to produce the original LAN frame, and passes the LAN frame on to the end device. Routers connect multiple LAN segments to each other or to a WAN. Routers route traffic on the Level 3 LAN protocol (e.g., the internet protocol address). See also bridge.

sealing current

A designation for a powering situation that consists of a wet loop without span power.

service

The provision of telecommunications to customers by a common carrier, administration, or private operating agency, using voice, data, and/or video technologies.

SNMP

simple network management protocol. A control and reporting scheme widely used to manage devices from different vendors. SNMP operates on top of the Internet protocol.

switched network

The network of dial-up telephone lines using circuit switching to provide communications services to network users.

synchronous

Communications in which the timing is achieved by sharing a single clock. Each end of the transmission synchronizes itself with the use of clocks and information sent along with the transmitted data.

synchronous data link control (SDLC)

A link-level communications protocol used in an international business machines (IBM) systems Network Architecture (SNA) network that manages synchronous, code-transparent, serial information transfer over a link connection. SDLC is a subset of the HDLC protocol developed by ISO.

TELNET

The standard TCP/IP remote login protocol

VT-100

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