

## CARLSON WIRELESS TECHNOLOGIES, Inc.

### CARLSON WIRELESS USA

USA Headquarters:  
1180-B Evergreen Road  
P.O. Box 2400  
Redway, CA 95560 USA

Tel: +1 707 923 3000

Fax: +1 707 923 1913

Email [sales@wireless-telephone.com](mailto:sales@wireless-telephone.com)

URL <http://www.wireless-telephone.com>

### About Carlson Wireless Technologies Inc.

Carlson Wireless Technologies, Inc. was formed in March 1999 as a privately held corporation based in Redway, California. Carlson Wireless Technologies (CWT) is dedicated to designing, manufacturing and marketing state-of-the-art digital WLL (wireless local loop) telephone systems that provide high-quality voice and data for rural and remote telephone users worldwide. CWT was founded by James Carlson following a 15-month product development by a team of engineers at Carlson Engineering Services (CES). In 1999 CWT purchased the rights to the digital wireless telephone system designed by CES. CWT will market and manufacture the product, which has been named "The i-WLL Internet-Ready, All-Digital Wireless Remote Telephone Link."

CWT is marketing the i-WLL product through established telecom and wireless equipment distributors. Please contact our sales department +1 707 923 3000, or [sales@wireless-telephone.com](mailto:sales@wireless-telephone.com) for more information.

DISTRIBUTED BY:



Trailblazer with Integral Antenna

### INSTALLATION and USERS MANUAL for Model i-WLL-T Trailblazer 2 Line

**Caution!** - Please read the sections on Unpacking, Planning, and Installation before installing this equipment

## TABLE OF CONTENTS

SCOPE OF MANUAL	3
R.F. SAFETY HAZARD WARNING	3
UNPACKING	3
PRODUCT OVERVIEW	4
SYSTEM PLANNING	5
INSTALLATION	8
TROUBLESHOOTING	11
SPECIFICATIONS	12
COMPLIANCE INFORMATION	14
WARRANTY	15

i-WLL, the i-WLL logo , Trailblazer, the Trailblazer logo, Carlson Wireless USA, and the Carlson Wireless logo are registered trademarks of Carlson Wireless Telephone Inc. Any trademarks, trade names, service marks, or service names owned or registered by any other company and used in this manual are the property of their respective companies. Copyright 1999, 2000, Carlson Wireless Technologies Inc. All rights reserved.

## Carlson Wireless USA Limited Warranty

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 4736, 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.

## Compliance and US Regulatory Information

### **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 you may connect to your telephone line and still have all of those devices ring when you telephone number is called. In most, but not all, areas, the sum of the REN's of all devices connected to one line should not exceed five (5.0). To be certain of the number of devices you may connect to your telephone line, as determined by the REN, you should call your local telephone company to determine the maximum REN for your calling area.

### **Incidence of Harm**

If your telephone equipment cause 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 complaint 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. 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.

### **Radio interference**

#### **Carlson Wireless USA Model: i-WLL-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 or modification not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

## SCOPE OF MANUAL

This manual is designed to support the installation, operation and maintenance of the **i-WLL-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 unpacking and installation sections before

### **R.F. SAFETY HAZARD WARNING**

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment when installed as directed. This equipment should be installed and operated with fix-mounted antennas that are installed with a minimum of 2 meters of separation between the antenna and all persons body during normal operation.

## UNPACKING

The i-WLL-Trailblazer system 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.

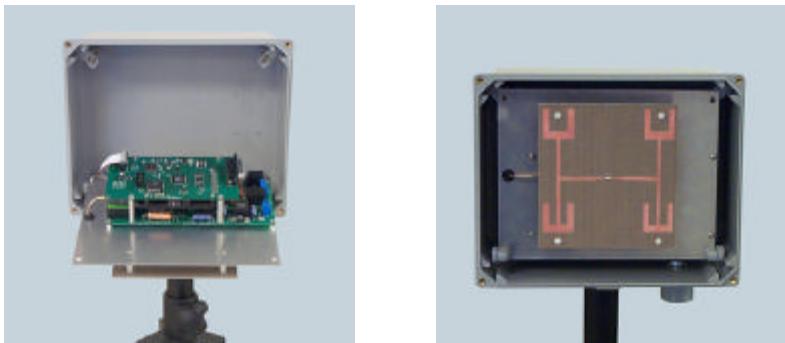
Caution! Observe static precautions when wiring or handling circuit boards. We provide secondary lightning protection only. Unless your feed cable is very short (less than 50 ft total) you will need a primary gas discharge type lightning protector also. At the office side of connection your telephone provider should have installed a primary protector.

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.



## PRODUCT OVERVIEW

The i-WLL-T All-Digital, Internet-Ready, Remote Phone Link is a dual line, point-to-point, spread spectrum telephone system that delivers v.34 data rates, providing email and Internet web surfing from your remote PC - as well as high-quality voice! And both lines are fully independent and will transmit either voice or data.



The i-WLL breakthrough offers many advantages not found in the market today:

- Never needs tuning because i-WLL is a 100% digital, self-configuring, eight channel system. This simplifies installation and greatly reduces the need for maintenance and service over time.
- Complete privacy is assured by the fully encrypted, spread-spectrum modulation scheme.
- Highly efficient spectrum use from a unique combination of FDMA and CDMA.
- Seamless integration with the global telephone network assured by i-WLL's worldwide ISDN system architecture with full 144 kbps bandwidth.
- No individual license needed for operation - the i-WLL Trailblazer uses the globally license-exempt 2.4 GHz ISM frequency band.
- Flexible voltage – low power usage - just 2 to 4 Watts at any DC voltage between 12 and 48V.
- Small, lightweight, self-contained units make the Trailblazer easy to install. FXO (central office) and FXS (subscriber) units - include all electronics, antenna and RF cabling and are housed in a weather-proof enclosure just 8h x 10w x 5d inches (22h x 27w x 13d cm) .

## RF PERFORMANCE

Frequency Range	2400 to 2483.5 MHz
RF Channels	6 operational + 1 administrative
Spreading Method	Direct Sequence
Modulation	BPSK
Spreading Codes	4
Processing Gain	12 dB
ERP (Effective Radiated Power)	$16 + 14 = 30 \text{ dBm}$
Receive Sensitivity	-95 dBm @10-6 BER
System Range	14 miles (22 km) w/ 13 dB fade

## PHYSICAL & ENVIRONMENTAL SPECIFICATIONS

Enclosure Material	GE Valox w/ neoprene gasket
Dimensions ( inches)	8 1/2 w x 10 1/2 lg x 5 dp
Dimensions (cm)	22 w x 27 lg x 13 dp
Shipping Wt (system complete)	18 lbs (8 kg)
Shipping Size (inches)	19 x 15 x 13
Shipping Size (cm)	47 x 37 x 32
Operating Temp	-30 to +60 degrees C
Humidity	10 to 95% non-condensing
Shock and Vibration	Mil standard 810 D
Exposure to the Elements	Nema 4X, all except submerged

## WARRANTY

2 years parts and labor

## CERTIFICATIONS AND REGULATORY

FCC Reg No., Part 68	BMD8 USA – 27773-PT-E
FCC Reg No., Part 15	OPA-I-WLL
Industry Canada CS-03	3448-10241A
Industry Canada RSS-210/139	3448-391166A

Specification subject to change without notice

## SPECIFICATIONS

### BASEBAND PERFORMANCE

Voice Coding	Uncompressed 64 kb/s PCM
Signaling	DTMF is passed through
Modem Support	up to V.34-1996, (33.6 kb/s)
Fax Support	up to G4, unrestricted
Digital Interface	Asynchronous, RS-232, DCE
Idle Channel Noise	-68 dBm max (20 dBnCo)
End-to-End System Latency	5 ms typical

### NETWORK INTERFACE SPECIFICATIONS - FXO or Central Office

Line Impedance	900 Ohm +2.16 uF, loop start
Maximum Loop Length	1500 Ohms
Ring Equivalent Number	0.3B
Ring Detect	40-110 Vrms, 17-34 Hz
2 Wire Return Loss (ERL)	Greater than 20 dB

### NETWORK INTERFACE SPECIFICATIONS - FXS or Subscriber

Line Impedance	600 Ohm, loop start
Loop Current	27 mA fixed
Maximum Loop Length	600 Ohms including instrument
Ringing Voltage	86 Vrms Modified Sq Wave
Ringing Frequency	20 Hz standard., 16, 25 Hz opt
Ringing Load	5 REN-B max (5 Watts)
2 Wire Return Loss (ERL)	Greater than 20 dB

### POWER REQUIREMENTS & CONSUMPTION

Filtered DC	12 to 48 volts
Absolute Minimum / Maximum	10 to 55 volts
FXS End, On-Hook	2 Watts max
FXS End, 2 Lines Off-Hook	4 Watts typ
FXO End - On or Off-Hook	2 Watts max

## SYSTEM PLANNING

Certain requirements are necessary for the i-WLL-Trailblazer system to function.

### (1) A radio path with losses fitting within the capacity of the system.

Distance in miles	Distance in km	Antenna Gain in dBi	Frequency in GHz	Path Loss in dB	ERP in dBm	Link Margin in dB
1.5	2.4	14.0	2.45	108	30	32
2.0	3.2	14.0	2.45	110	30	30
5.0	8.0	14.0	2.45	118	30	22
7.0	11.3	14.0	2.45	121	30	19
8.0	12.9	14.0	2.45	122	30	17
10.0	16.1	14.0	2.45	124	30	16
12.0	19.3	14.0	2.45	126	30	14
14.0	22.5	14.0	2.45	127	30	13
20.0	32.2	14.0	2.45	130	30	10
20.0	32.2	20.0	2.45	130	36	22
30.0	48.3	23.0	2.45	134	39	24
50.0	80.5	27.0	2.45	138	43	28

\* Note: external antennas used for 20, 30 and 50 mile paths

### Fade Margin Chart

The above chart shows various antenna and distance combinations. The external antenna option is only available through professionally trained dealers.

What's an acceptable "Link Margin"? One accepted theory is that 10 dB of fade margin will deliver a 90% reliability and 20 dB will deliver a 99% reliability etc.. There are other factors that affect this including multipath and polarization. At 2.4 GHz there is only a small ground wave component involved in the radio propagation. This means that the above numbers are presuming clear LOS (line of sight) and first Fresnel zone. Multipath occurs when a reflector such as earth's terrain or man made structures cause additional delayed signals to be received. If a reflected signal was delayed 180 degrees out of phase with the line of sight signal, and the magnitudes are the same, they will cancel out completely! In the real world, if you do have line of sight path, multi-path degradation is the reason why you need a minimum of 16 to 20 dB of margin. If you don't have line of sight, multi-path could easily cause 16 dB of degradation.

## **(2) Other users of the 2.400 to 2.483 GHz ISM band.**

The ISM or Industrial, Scientific, and Medical band, is shared with many other type of services. Some examples follow:

### *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.

### *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*

We have measured typical consumer microwave oven outputs at levels up to +20dBm ERP. This consists of narrow less than 1 MHz wide spikes, sweeping wildly in frequency due to the circulators built into the ovens. The higher power spikes were mostly concentrated in the upper half of the band between 2450 and 2485 MHz. Fortunately few of the users are located in rural areas, leaving sharing concerns down to consumer microwave ovens, LAN's and other rural telephone users. **The functionality of the i-WLL 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. This means that any user has to accept all other users in this band, interfering or not.

### ***How this impacts the CDMA/FDMA technology used in the I-WLL.***

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.

## **TROUBLESHOOTING**

The outcome of the installation is dependent on the weakest link.

Five things are paramount to his system working well:

- (1) An acceptable radio path
- (2) Other users of the 2.4 GHz ISM band.
- (3) Customer's wiring of power and telephone circuits
- (4) Antenna alignment within +/- 10 degrees for i-WLL-Trailblazer
- (5) Quality of the telephone lines from the telephone company
- (6) Quality of the power supplies.

If the system appears dead, with no tones audible on the subscriber phone, look for a wiring fault. You can test for loop voltage at the FXS end by measuring the voltage on each line. Each should be 30 VDC. Next would be checking the DC current used by each unit. For example the FXS unit with 16 Volts provided should draw (2W / 16V) ~125 mA. at idle and ~300 mA with both lines off hook. This test is very useful to prove out the wiring.

Next, check to see that the radio located under the daughter card is all the way inserted into it's socket by ejecting it and reinserting at the same time seating the antenna connector into the radio.

Next, it will be important to confirm that a local test at the FXO base site was done. If not, you will need to bring the FXS unit back to the base site and temporarily connect the FXS unit up and confirm proper local operation.

If the system cuts in and out, or fails to draw dial tone, look for an alignment problem or path obstruction. Also you should check to see if not in a rural area you may have a congested frequency band.

If you are having cross-talk between lines, examine the phone cabling making sure it is individually twisted pairs, preferably with a Category 5 rating.

If after checking the above, you are still having problems please contact our sales dept. for technical assistance by phone or email.

*A note about the power supplies: The FXO unit will draw 2W off hook or idle. The FXS will draw 2W idle and 4W with both lines off hook. We suggest over-sizing the supplies by at least 3 times. For example a 15 volt filtered DC switching type supply @ 1.00 Amp. It is much more likely to survive power fluctuations and environmental temperatures and the extra voltage above 12 allows for losses in the feed wire.*

**(4) 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 topo 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.

**Final alignment.** This is usually done by connecting a standard cordless phone to the FXS or FXO end, and then give a best guess to the direction, establish a connection and rotating the antennas both right and left noting the points where the signal disappears, (assuming that it does) and then centering them between those cutoff points.



Photo showing assembly of mount and adjustment screws

We minimize the interference from these devices through intelligent channel selection and external directional antennas.

#### *Intelligent Channel Selection*

Our system needs about 10 MHz of clear bandwidth to operate properly. If the system experiences undesirable interference levels the next call will be chosen on a different channel. If the system experiences minimal interference levels then that channel will remain as a favorite. This is similar to what we have seen in some of the more sophisticated cordless telephones.

#### *A very directional antenna*

For professionally trained dealers we have we have a much tighter beam-width antenna utilizing a parabolic grid design. This antenna provides very high side and rear signal rejection and only adds a small percentage of cost of the system.

#### **(3) Availability of telephone service and power.**

The I-WLL-Trailblazer system consists of two units. One is designed to connect to the standard phone lines provided by a local telephone company office (FXO side) and the other connects to the telephone instruments such as; DTMF (touch tone) telephones, fax machines, and computer modems (FXS side) via individually twisted pair phone/data cable. The system is very flexible about voltage requirements. 12 to 48 Volts DC with the current being inversely proportional to the voltage, the power use being approximately 2 Watts for the FXO side, in any state, and 2 to 4 Watts for the FXS side depending on usage state. We recommend oversizing the supply by 1.5 to 2 times. Depending on the length, most installations can use 4 twisted pair, #22 AWG feed cable. This will drop about 1 volt per 100 feet of length. To allow for most voltage drop situations we recommend a 15 volt, 1 A power supplies.

#### **(4) Mounting structure.**

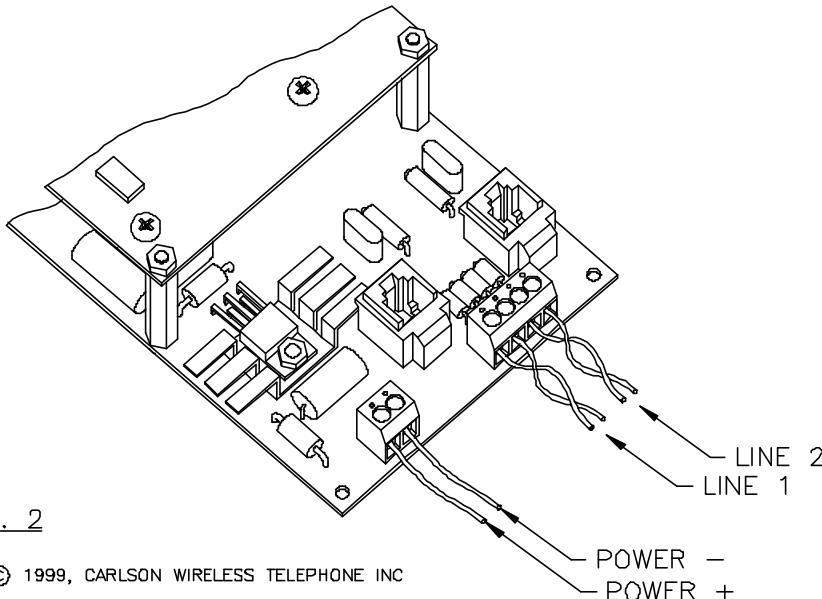
**Warning! Use extreme caution to avoid contact with any high voltage power lines when constructing antenna structures!**

The enclosure is designed to mount on a steel vertical mast, with an actual outside diameter of 1.3 to 2.5 inches ( 3 to 6 cm ). This mast must locate the radiating element at least 6.6 feet (2 m) from any persons, not move significantly in any anticipated wind and must be connected with a bare copper #8 AWG wire to a copper clad ground rod driven at least 6.6 feet (2 m) into moist earth.

## INSTALLATION

Note that the installation of the FXO and FSO units are quite similar

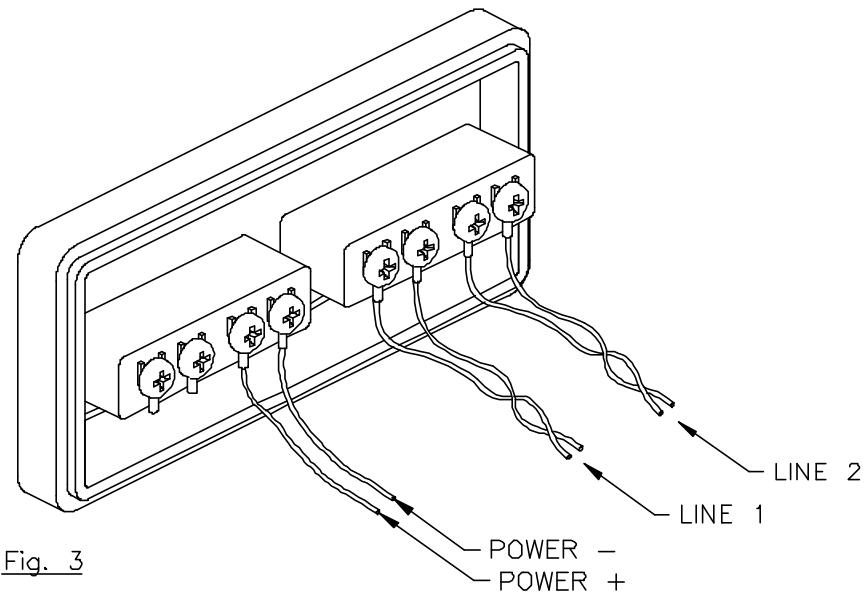
**(1) Connecting the feed cable to the outside unit.** Begin by removing the 4 front cover screws. Now remove 2 upper screws holding the hinged backplate. The backplate will now hinge down exposing the electronics section. Notice there are 2 circuit boards stacked together. The top board contains the digital radio and interface with the lower board containing the power supply and analog interface. There are two screw down terminal blocks on the left side. One block has 2 connections and it is where the DC power supply connects. The other block has 4 connections, for telephone lines 1 and 2. The following diagram shows how to wire the connectors.



**TIMESAVER TIP!** By installing the FXO unit first, you can test the system locally by temporarily connecting the FXS unit up at the FXO site and proving your connections. This can greatly simplify any trouble shooting you may have later.

### **(2) Connecting the feed cable to the inside equipment.**

Inside the building the feed cable is brought out to a terminal block consisting of 4 pairs of screw down connections. The following diagram shows how to wire the connectors. Frequently the pair used for power may be paralleled with the 4th spare pair to allow less voltage loss in the feed cable especially if the run is longer than 100 feet.



**(3) Lightning protection.** Grounding of the drain wire: For feed cable runs of less than 35 feet (10m) and not located in a highly active lightning area, connecting the bare drain wire to a copper clad ground rod driven at least 6 feet (2m) into moist earth with a short copper #8 AWG wire at the point of the terminal block may suffice. The antenna mast must also be grounded in the same fashion by a separate grounding rod. However if the run is longer than 35 feet or the location is in a highly active lightning area then a standard 3 way gas tube protector must be added. Connecting information on this device is provided by its manufacturer.