

i-WLL internet-ready
ALL-DIGITAL
REMOTE PHONE LINK

MODEL NO. i-WLL-15



INSTALLATION & OPERATING MANUAL

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

The employees and shareholders of Carlson Wireless Telephone Inc. wish to thank you for your purchase of the i-WLL product. For more information about the company, see our web site at <http://www.wireless-telephone.com>

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SCOPE OF MANUAL

This manual is designed to support the installation, operation and maintenance of the **i-WLL-15** 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 proceeding.

UNPACKING

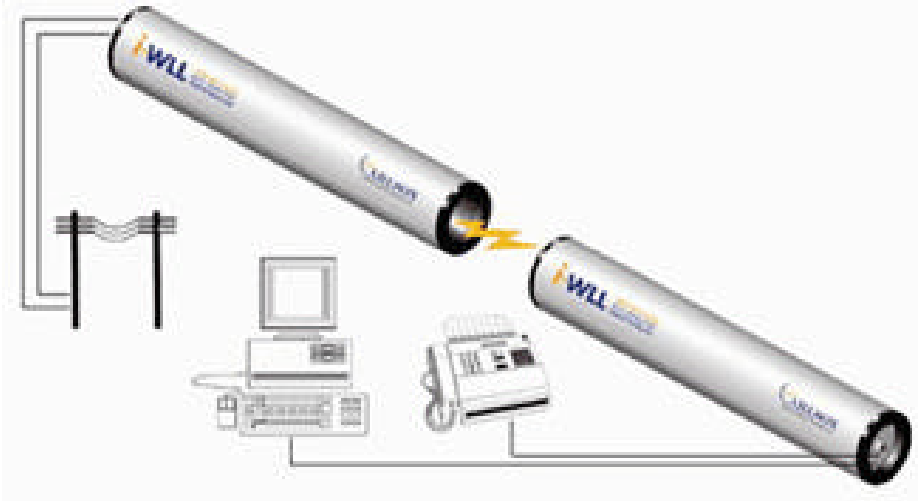
The i-WLL-15 system will arrive in one box approximately 32 x 16x 9 inches (80 x 40 x 23 cm). Small amounts of feed cable and power supplies may also be included in this box if ordered.

Caution!

1. There are 2 large U-bolts holding the outer housing to the mounting plate of each system. The fasteners on these are self locking nuts. **DO NOT TURN OR ROTATE THESE NUTS.** They are set to a specific torque and if over-torqued the housing will distort potentially damaging the electronic modules inside.
2. **DO NOT REMOVE THE FRONT END CAP.** The seal is not lubricated for removal and reinstallation. All of the electronics and antenna assembly are serviced though the rear (mount-side) end cap.

PRODUCT OVERVIEW

The i-WLL 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 the Internet to 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 - i-WLL uses the globally license-free 2.4 GHz ISM frequency band.
- Flexible voltage – low power usage - just 3 to 6 Watts at any DC voltage between 12 and 55V.
- Small, lightweight, self-contained units make i-WLL easy to install - no special expertise needed. i-WLL FXO (central office) and FXS (subscriber) units - which include all electronics, antenna and RF cabling - are housed in a weatherproof enclosure 4.5" in diameter by 30" long (11.5 x 76.2 cm) .

SYSTEM PLANNING

Certain requirements are necessary for the i-WLL-15 system to function.

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

We have a chart showing various antenna and distance combinations.

Distance in Miles	Distance in km	Model	Path Loss in dB	ERP in dBm	Link Margin
1.5	2.4	I-WLL-15	108	27	27
2.0	3.2	I-WLL-15	110	27	25
5.0	8.0	I-WLL-15	118	27	17
7.0	11.3	I-WLL-15	121	27	14
8.0	12.9	I-WLL-15	122	27	13
8.0	12.9	I-WLL-25	122	29	17
10.0	16.1	I-WLL-15	124	27	11
10.0	16.1	I-WLL-25	124	29	15
12.0	19.3	I-WLL-25	126	29	13
15.0	24.1	I-WLL-25	128	29	11
20.0	32.2	I-WLL-35	130	36	24
25.0	40.2	I-WLL-35	132	36	22
50.0	80.5	I-WLL-35	138	36	16

Fade Margin Chart

What's an acceptable "Link Margin"? An 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 vertical or horizontal 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). Multi-path occurs when a reflector such as earth's terrain or man made structures cause additional delayed signals to be received. If a 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 6 to 10 dB of margin. If you don't have line of sight, multi-path could easily cause 20 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. Fortunately most of the users are located in urban areas, leaving sharing concerns down to consumer microwave ovens and other spread spectrum rural telephone users. The I-WLL-15 system has divided the ISM band into 8 sub-bands or channels. One channel is used for system administration with the system then randomly selecting 1 of the 7 remaining channels for operation. **The functionality of the i-WLL-15 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.

(3) Availability of telephone service and power.

The I-WLL-15 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 55 Volts DC with the current being inversely proportional to the voltage, the power use being approximately 3 Watts for the FXO side, in any state, and 3 to 6 Watts for the FXS side depending on usage state. We recommend over-sizing 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 any voltage drop situation we recommend 24 volt, 500 mA power supplies. **Using non-twisted IW or Quad phone wiring will result in cross-talk between lines.**

(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 pipe, commonly known in North America as 1 to 2 inch pipe (2.5 to 5 cm), with an actual outside diameter of 1.3 to 2.5 inches (3 to 6 cm). This mast must not move significantly in any anticipated wind and must be connected with a short copper #8 AWG wire to a copper clad ground rod driven at least 6 feet (2m) into moist earth.

INSTALLATION

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

(1) Connecting the feed cable to the outside unit. On the mounting end of the tube there is an end cap with a weather sealing clamp. This allows the feed cable to penetrate the housing and remain sealed to outside weather. Begin with the removal of the rear end cap by using a coin as a wedge and working your way around the tube until the end cap pops off. Inside the end is the electronics assembly consisting of the printed circuit boards and integrated antenna. There are two screw down terminal blocks on the exposed end. 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. Make sure to hand tighten only the weather sealing cord grip.

Note: Make sure that the antenna elements are vertical or perpen-

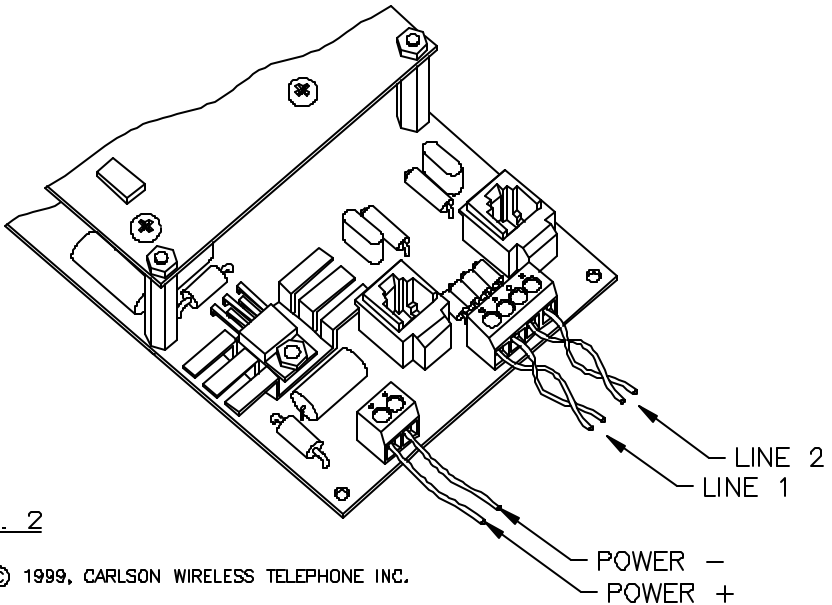


Fig. 2

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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.

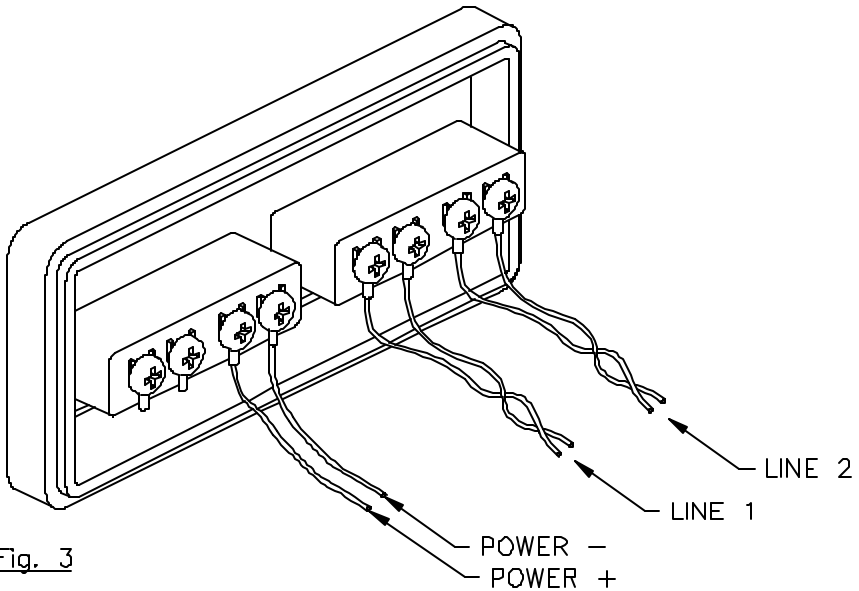


Fig. 3

© 1999, CARLSON WIRELESS TELEPHONE INC.

(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 it's manufacturer.

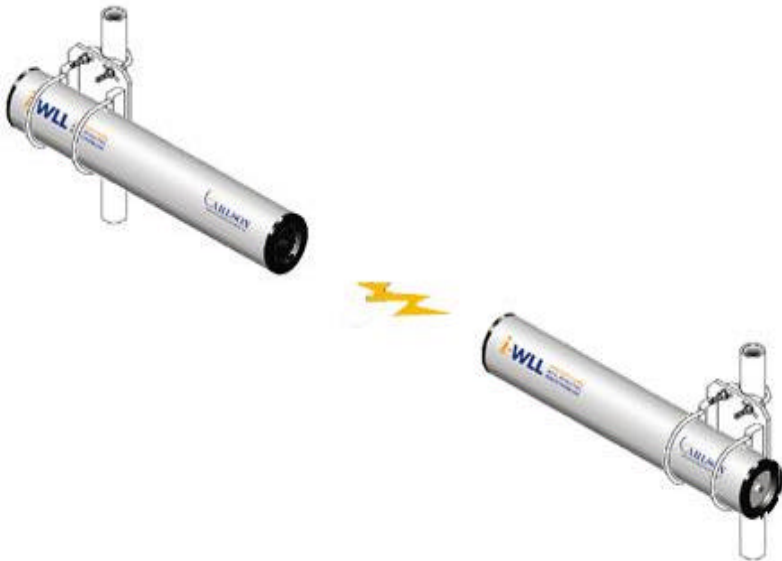
(4) Rough alignment. This is usually easier than it would seem. Since it is a prerequisite that you have line of sight between the two points, here are several ideas that have worked for installers:

- (1) If you can see the other unit, simply aim the tubes towards each other.
- (2) During midday, use a large mirror to create a bright 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 13.5 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.

Remember to leave the antenna elements vertical, or perpendicular to the ground for best performance



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-15
- (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 line 1 and line 2. Each should be 30 VDC. Next would be checking the DC current used by each unit. For example the sub unit with 16 Volts provided should draw $(3W / 16V) \sim 200$ mA. at idle and ~ 400 mA with both lines off hook. This test is very useful to prove out the wiring.

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 that the antenna elements are vertical to earth, and 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.

Software Updates: Inappropriate operations (bugs) reported by users will be evaluated by the engineering department. Fixes will be available from our web site with instructions

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 2-3W off hook or idle. The sub will draw 3W idle and 6W with both lines off hook. We suggest over-sizing the supplies by 2 times. For example a 12 volt filtered DC wall transformer supply @ 1.00 Amp (12W) or even better a 24 volt filtered DC @ 500 mA. (12W). They are much more likely to survive power fluctuations and high tempera-*

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	0.5B
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
Ringing Voltage	86 Vrms Modified Square 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 Maximum / Minimum	10 to 55 volts
Sub End, On-Hook	3 Watts max
Sub End, 2 Lines Off-Hook	6 Watts max
Base End - On or Off-Hook	3 Watts max

RF PERFORMANCE

Frequency Range	2400 to 2483.5 MHz
RF Channels	7+1 (admin)
Spreading Method	Direct Sequence
Modulation	BPSK
PN Bit Length	16
Processing Gain	12.04 dB
ERP (Effective Radiated Power)	+28.5 dBm
Receive Sensitivity	-93 dBm @10-6 BER
System Range	10 miles (16.1 km)

PHYSICAL & ENVIRONMENTAL SPECIFICATIONS

Enclosure Material	ABS weather sealed plastic
Dimensions (inches)	4 1/2 diameter x 30 in length
Dimensions (cm)	11 diameter x 76 in length
Shipping Weight (system complete)	24 lbs (11 kg)
Operating Temp	-30 to +65 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 - see detail

CERTIFICATIONS AND REGULATORY

FCC Reg No., Part 68	BMD USA – 27773-PT-E
FCC Reg No., Part 15	OPA-I-WLL, Pending Final
Industry Canada CS-03	3448-10241A
Industry Canada RSS-210	Pending Final

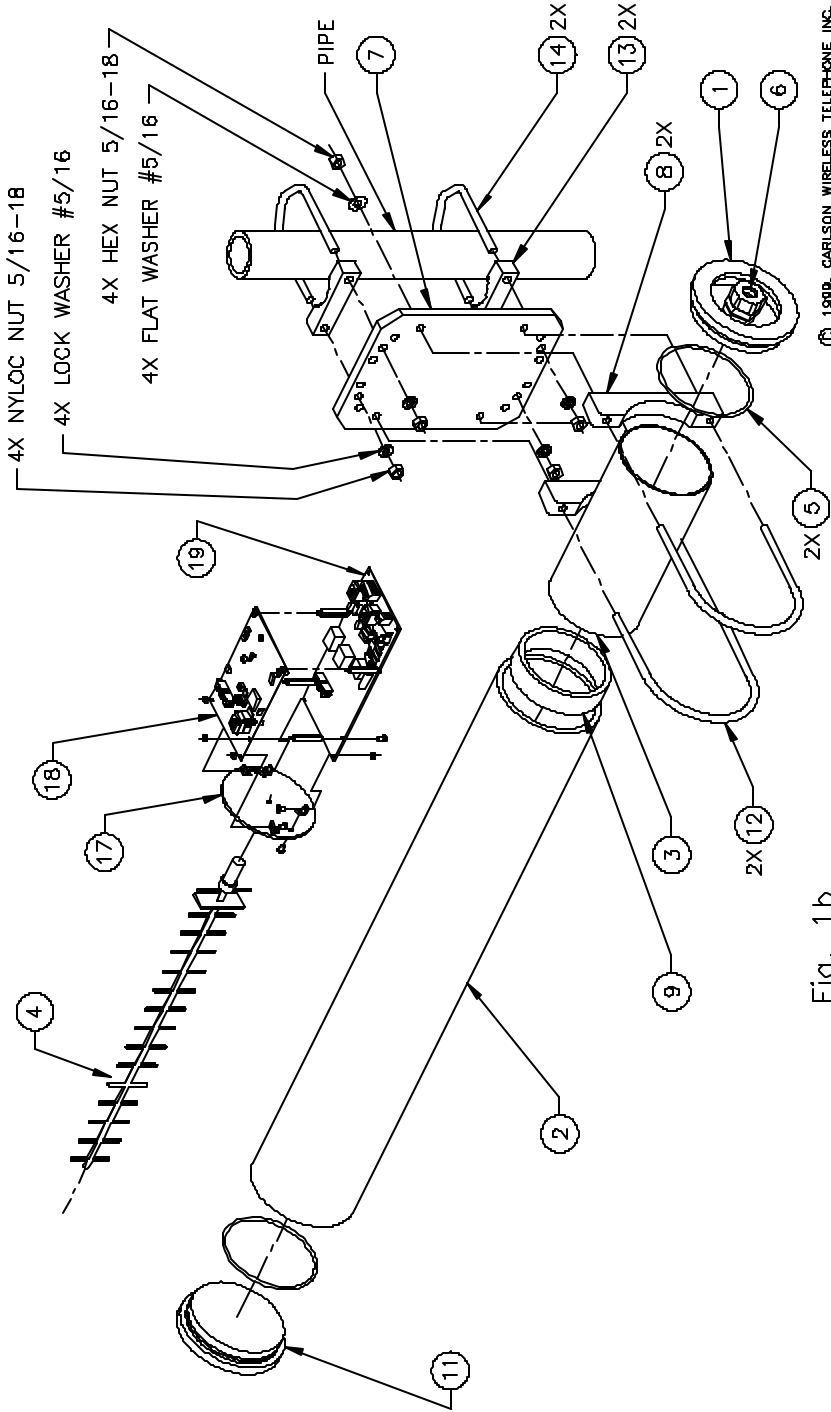


Fig. 1 b

PARTS LIST i-WLL-15

PART-REV #	DESCRIPTION
19 – L	PCB, LINE INTERFACE & POWER REGULATOR
18 – S	PCB, DIGITAL TOP
17 – B	MOUNT, FRONT ANTENNA
16 –	(RESERVED)
15 –	(RESERVED)
14 – G	U-BOLT, 2-3/4 INCH
13 – E	CLAMP BASE, 2 3/4 INCH
12 – B	U-BOLT, 4-1/2 INCH
11 – C	END CAP, FRONT
10 –	(RESERVED)
09 – A	RING, RETAINING
08 – G	BRACKET, SADDLE
07 – G	PLATE, MOUNTING
06 – B	GRIP, CABLE & SEALING GLAND
05 – C	O-RING 1/8 x 3.50 x 3.75
04 – B	ANTENNA, 16 ELEMENT 13.5 dB GAIN
03 – D	SHIELD, INNER SS
02 – D	HOUSING, OUTER
01 – E	END CAP, REAR

Consumer and US Regulatory Information

Connection to the telephone network

1. The Federal Communications Commission (FCC) has established rules which permits this device to be directly connected to the telephone network.

2. If this device is malfunctioning, it may also be causing harm to the telephone network; this device should be disconnected until the source of the problem can be determined and until repair has been made. If this is not done, the telephone company may temporarily disconnect service.

3. The telephone company may make changes in its technical operations and procedures; if such changes affect the compatibility or use of this device, the telephone company is required to give adequate notice of the changes.

4. If the telephone company requests information on what equipment is connected to their lines, inform them of:

- (a) The telephone number that the unit is connected to
- (b) The ringer equivalence number
- (c) The USOC jack required
- (d) The FCC Registration number

Item (b) and (c) are indicated on the label.

5. In the event of equipment malfunction, all repairs should be performed by our company or an authorized agent. It is the responsibility of users requiring services to report the need for service to our company or to one of our authorized agents.

Service can be obtained at: Carlson Wireless Telephone Inc.,
1150 Evergreen Road
P.O. Box 2400,
Redway, CA 95560 USA,
Tel: +1 707 923 9593

FCC Reg No., Part 68

BMD USA – 27773-PT-E

Notification to the telephone company

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.

Notification to the telephone company cont'd

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 your 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.

Jack Types Needed

Connection to the telephone network should be made by using standard modular telephone jack types (USOC) RJ11C or RJ11W.

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 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-15

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.

Carlson Wireless USA Limited Warranty

Carlson Wireless Telephone (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 9593, 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.

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About Carlson Wireless Telephone Inc.

Carlson Wireless Telephone, Inc. was formed in March 1999 as a privately held corporation based in Redway, California. Carlson Wireless Telephone (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), a private engineering design firm. 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 9593, or sales@wireless-telephone.com for more information.

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